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Entry Test Series

A Solution to

NMDCAT

Self Study

First Edition
According to New Syllabus 2021

BIOLOGY

By Professor Imran Khan

FULL LENGTH PRACTICE EXAMS NO.1

1. Which one of the following constitutes the best reason for distinguishing the living from the non-living?

(a) Irritability

(b) reproduction and locomotion

(c) respiration and excretion

(d) growth and locomotion

2. Rate of growth of stem is measured by:

(a) hydrometer

(b) photometer

(c) osmometer

(d) auxanometer

3. Characteristic features of the living being are:

(a) irritability

(b) metabolic activity

(c) respiration and reproduction

(d) all of these

4. Botanists believe that the first plants, which originated on the earth, were:

(a) algae and fungi

(b) mosses

(c) pine and cycads

(d) mosses and their relatives

5. Ultimate source of energy in an ecosystem is:

(a) food

(b) ATP

(c) sunlight

(d) glucose

6. There is interdependence amongst living beings, because:

(a) they were created to live in this fashion

(b) it is a biological miracle

(c) it has no significance from the viewpoint of evolution

(d) it is a result of adjustments in the long history of biological evolution

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7. Animals are like plants in that:

(a) they respire during night only

(b) they respire when required

(c) they respire during day and night

(d) they respire during day only

8. Animals differ from plants mainly in:

(a) structure (b) vital activity

(c) nutrition (d) reproduction

9. The fundamental substance of all living beings is:

(a) cell (b) nucleus

(c) tissue (d) protoplasm

10. What is the most important property of water for which it is needed in the body?

(a) it is in a liquid form

(b) it is tasteless, colourless and odourless solvent

(c it is a universal solvent

(d) it is made of H_2 and O_2 and this O_2 can be used in cellular metabolism

11. A plant cell differs from an animal cell in the absence of:

(a) endoplasmic reticulum (b) mitochondria

(c) centrioles (d) ribosomes

12. Mitochondria will be found in abundance in cells of the tissue having:

(a) wound-healing activity (b) average activity

(c) minimum activity (d) maximum activity

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13. To determine the ultra- structure of a cell organelle the most likely method successful observations would be:

(a) autoradiography (b) light microscopy

(c) electron microscopy (d) phase contrast microscopy

14. Activities of all living cells are controlled by:

(a) chloroplast (b) tonoplast

(c) nucleus (d) DNA and RNA

15. Golgi body is found in:

(a) RBE of man (b) all of the cells

(c) bacteria (d) all cells except RBC and bacterial cell

16. A cell increases in volume when placed in a solution which is:

(a) isotonic (b) slightly hypertonic

(c) extremely hypertonic (d) hypotonic

17. Animal cell is limited by:

(a) plasma membrane (b) cell wall

(c) cell membrane (d) basement membrane

18. The main difference between animal and plant cells is that:

(a) plant cells lack rigid cell wall (b) animal cells lack rigid cell wall

(c) plant cells possess small vacuoles (d) animal cells possess large vacuoles

19. Continuity of cytoplasm from cell to cell is maintained through:

(a) middle lamella (b) endoplasmic reticulum

(c) cell membrane system (d) plasmodesmata

20. Cell organelles are embedded in:

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(a) mitochondria (b) protoplasm

(d) nucleolus (d) cytoplasmic membrane

21. When green tomato turns red, then:

(a) chromoplasts are changed into chloroplasts

(b) chloroplasts are disintegrated and get converted into chromoplasts

(c) new chromoplasts are made

(d) leucoplasts are developed

22. Which of the following types of plastids are commonly found in the cells not exposed to light?

(a) chloroplast (b) chromoplast

(c) leucoplast (d) all kinds of plastid

23. Nucleoli are rich in:

(a) DNA and RNA (b) DNA, RNA and proteins

(c) DNA (d) RNA

24. Artificial synthesis of DNA was done by:

(a) Nirenberg (b) Kornberg

(c) Wastson and Crick (d) Khorana

25. Two strands of DNA are attached by:

(a) peptide bond (b) phosphate bond

(c) hydrogen bond (d) ester linkage

26. The largest cell in the human body is:

(a) muscle cell (b) kidney cell

(c) liver cell (d) nerve cell

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27. Vacuole of plant cell contains:

(a) cell sap (b) cytoplasm

(c) protoplasm (d) nucleus

28. The important cell inclusions are:

(a) nucleus and mitochondria (b) protoplasm and Golgi body

(c) ribosome and plastid (d) all of these

29. Which of the following does not have definite membrane bound nucleus?

(a) mycoplasma (b) bacteria

(c) blue green algae (d) all of these

30. Chromatin is important component of:

(a) nucleus (b) nucleolus

(c) cell sap (d) semen

31. Plasma membrane is:

(a) impermeable (b) formed of cellulose

(c) nonselective barrier (d) selective barrier

32. Middle lamella is found in:

(a) cell membrane (b) nucleoplasm

(c) cytoplasm (d) cell wall

33. The chemical substance most abundantly present in the middle lamella:

(a)pectin (b) lignin

(c) cutin (d) suberin

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34. Cilia and flagella develop from:

(a) cilium (b) cristae

(c) chromosome (d) basal body

35. The cellular structure which always disappears during mitosis is:

(a) mitochondria (b) plastid

(c) nuclear membrane (d) plasma membrane

36. Meiosis is significant because:

(a) it produces identical cells

(b) it restores original number of chromosomes

(c) there is doubling of DNA content in the cell

(d) it occurs only in somatic cells

37. How many times mitotic divisions must occur in a cell of the root tip to from 256 cell?

(a) 64 (b) 8

(c) 32 (d) 128

38. Amitosis:

(a) cleavage of the nucleus without recognizable chromosomes

(b) a division of chromosomes

(c) an indefinite division of chromosomes

(d) chromosomes are present at the bridge

39. Daughter cell formed as result-of meiosis are not similar to that of parent cell because:

(a) crossing over occurs and number of chromosome becomes half

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(b) prophase is large

(c) there are two divisions

(d) synapsis occurs

40. Meiosis involves:

(a) one division of nucleus and one division of chromosome

(b) one division of nucleus and two division of chromosome

(c) two division of nucleus and two division of chromosomes

(d) two division of nucleus and one division of chromosomes

41. The structure of chromosomes can be best seen at:

(a) prophase (b) metaphase

(c) anaphase (d) telophase

42. In mitosis centromere divides at:

(a) prophase (b) metaphase

(c) anaphase (d) telophase

43. Meiosis and mitosis are unlike because in meiosis:

(a) homologous chromosomes pair and exchange part

(b) chromosomes number is halved

(c) the four nuclei formed are not identical

(d) all of the above three are correct

44. In the meiotic division four daughter cells are produced by two successive divisionsin which:

(a) first division is educational and second is reductional

(b) first division is reduction and second is educational

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(c) both divisions are educational

(d) both divisions are reductional

45. Which is the longest phase of cell cycle?

(a) G_0phase

(b) s phase

(c) G_1 phase

(d) G_2 phase

46. In which of the following would you observe high mitochondrial activity?

(a) germinating seeds

(b) falling leaves

(c) meristematic tissue

(d) both in germinating seeds and meristematic tissue

47. Tissues are:

(a) a group of cells which are similar in origin and function

(b) organs which are similar in origin and function

(c) group of cells which are not similar in function

(d) group of cells, which are not similar in origin

48. Tracheae, tracheids, wood fibres and parenchymatous tissue are found in:

(a) phloem

(b) cortex

(c) xylem

(d) medullary rays

49. Phloem sclerenchyma, sieve tubes, parenchyma and companion cells are found in:

(a) xylem

(b) phloem

(c) cambium

(d) medullary rays

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50. The hydathodes are:

(a) honey glands (b) water secreting glands

(c) oil secreting glands (d) mucilge secretingglands

51. The lateral meristem is responsible for:

(a) growth in length (b) growth in parenchyma

(c) growth in cortex (d) growth in thickness

52. Increase in length of a stem is caused by:

(a) apical meristem (b) cork cambium

(c) vascular cambium (d) mitotic division in pith and cortex

53. Companion cells are usually associated with:

(a) fibres (b) tracheids

(c) sieve tubes (d) vessels

54. The best method to determine the age of a tree is to:

(a) count the number ofleaves on a tree (b) find out the number of branches

(c) count the number of annual rings (d) any of the above

55. The lateral roots, generally originate in:

(a) cortex (b) endoderms

(c) pericycle (d) hypoderms

56. Food is transported to different plant parts through:

(a) xylem (b) phloem

(c) cambium (d) root hair

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57. The chief function of the vessels in the plant:

(a) is to give mechanical strength to stem

(b) to translocate food manufactured in the leaves to other parts of the plant

(c) is conduction of water and mineral salts

(d) to remove excess of water through root at night when there is no transpiration

58. Active cell division can be seen in:

(a) cortex (b) cambium

(c) pith (d) pericycle

59. External protective tissues of dicot plants are:

(a) epidermis and cork (b) cork and pericycle

(c) cortex and epidermis (d) pericycle and cortex

60. Cross section of the trunk of a tree showed 50 annual rings the age of the tree is:

(a) 25 years (b) 50 years

(c) 50 days (d) 100 years

61. A simple mechanical tissue with unlignified cell wall is:

(a) parenchyma (b) sclerenchyma

(c) collenchymas (d) chlorenchyma

62. The chief function of sieve tubes is:

(a) to translocate the organic materials manufactured in the leaves

(b) to conduct minerals

(c) to transport water from root to leaves

(d) to help the plant in forming wood

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63. Thickening of cell wall, lignification and specialization for mechanical functions are characteristics of:

(a) parenchyma
(b) collenchymas
(c) sclerenchyma
(d) chlorenchyma

64. Tendon is a structure, which connects:

(a) a bone with another bone
(b) muscle with a bone
(c) a muscle with a muscle
(d) a nerve with a muscle or bone

65. Fibrous tissue, which connects bones is:

(a) tendon
(b) adipose tissue
(c) ligament
(d) connective tissue

66. Tendons and ligaments are tissues of the category of:

(a) connective
(b) epithelium
(c) muscles
(d) nerve

67. Axons serve to:

(a) bring impulses to cell body
(b) bring blood into heart
(c) take away impulses from cell body
(d) take impulses to cell body and then away from cell body

68. Blood platelet are necessary for:

(a) metabolism
(b) digestion
(c) excretion
(d) blood clotting

69. Mast cells secrete:

(a) histamine
(b) serotonin

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(c) heparin

(d) all of these

70. Myelin sheath is a layer covering:

(a) a vertebrate nerve fibre

(b) a vertebrate muscle fibre

(c) an insect nerve fibre

(d) all of these

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ANSWER FULL LENGTH PRACTICE EXAM NO. 1

1.	C	11.	C	21.	B	31.	D	41.	C	51.	D	61.	C
2.	D	12.	D	22.	C	32.	D	42.	C	52.	A	62.	A
3.	D	13.	C	23.	B	33.	A	43.	D	53.	C	63.	C
4.	A	14.	D	24.	B	34.	D	44.	B	54.	C	64.	B
5.	C	15.	D	25.	C	35.	C	45.	B	55.	C	65.	C
6.	D	16.	D	26.	D	36.	B	46.	D	56.	B	66.	A
7.	C	17.	A	27.	A	37.	B	47.	A	57.	A	67.	C
8.	C	18.	B	28.	D	38.	A	48.	C	58.	B	68.	D
9.	D	19.	D	29.	D	39.	A	49.	B	59.	A	69.	A
10.	C	20.	B	30.	A	40.	D	50.	B	60.	B	70.	A

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FULL LENGTH PRACTICE EXAMS NO.2

1. The "blood bank" of our body is:

(a) spleen (b) lungs

(c) heart (d) liver

2. Which of these is a kind of tissue?

(a) liver (b) blood

(c) gut (d) pancreas

3. Function of nervous tissue is:

(a) sensitivity (b) irritability

(c) responsiveness (d) contractility

4. Branch of biology dealing with microscopic anatomy of tissues is:

(a) cyctology (b) morphology

(c) histology (d) taxonomy

5. RBCS of man are:

(a) round, biconcave, non-nucleated (b) round, biconcave, nucleated

(c) round, biconvex. non-nucleated (d) oval, non-nucleated

6. Which of the following embryonic layers originate from the mesoderm of mammals?

(a) skeleton (b) muscle

(c) brain (d) both (a) and (b)

7. What is meant by binomial nomenclature?

(a) indication of the name, by its species and variety

(b) indication of the name by its genus and species

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(c) indication of the name by its family and genus

(d) indication of the name by its order and family

8. Strongest muscles in human body are found in:

(a) jaws (b) thighs

(c) hands (d) neck

9. According to botanist first plants, which originated on the earth were like:

(a) mosses and relatives (b) virus and bacteria

(c) algae and fungi (d) ferns and lycopods

10. In which of the following groups would you place a plant which produces seeds but lacks flowers?

(a) gymnosperms (b) bryophytes

(c) pteridophytes (d) fungi

11. Algae and fungi are grouped in which of the following:

(a) thallophyta (b) gymnosperms

(c) angiosperm (d) bryophytes

12. Which of the following plants have maximum power of adaptability?

(a) pteridophytes (b) angiosperms

(c) bryophytes (d) algae

13. Thallophytes having chloroplast are:

(a) algae (b) fungi

(c) bacteria (d) moss

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14. Liverworts and mosses are kept under:

(a) angiosperms (b) gymnosperms

(c) bryophyte (d) pteridophyta

15. Which of the following group of plant produces spores has vascular tissue and lacks seeds?

(a) gymnosperms (b) pteridophytes

(c) bryophytes (d) fungi

16. The most primitive vascular plants are:

(a) cyeas (b) ferns

(c) red algae (d) brown algae

17. Embryophyta includes:

(a) angiosperms only (b) all the plants

(c) algae and fungi (d) bryophyta and pteridophyta

18. Which of the following are kept in tracheophyta?

(a) algae and fungi

(b) gymnosperms and pteridophyta

(c) pteridophyta and angiosperms

(d) pteridophyta, gymnosperms and angiosperms

19. Which of the following is not a pteridophyte?

(a) selaginella (b) fern

(c) equisetum (d) sphagnum

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20. Blue-green mold" name is given to:

(a) aspergillus (b) penicillium

(c) alternaria (d) agaricus

21. Which one is not a bryophyte?

(a) polytrichum (b) dawsonia

(c) pellia (d) fern

22. Gymnosperm differs from angiosperm in having:

(a) tracheids only (b) naked ovules

(c) no ovary (d) all of these

23. Which phylum of animals is exclusively marine's?

(a) porifera (b) coelenterate

(c) mollusca (d) echinodermata

24. Which of the following is most un-matching group?

(a) cockroach, king-crab, spider, silverfish (b) whale, bat, lizard, sea horse

(c) starfish, sea urchin, sea cucumber (d) crayfish, cuttlefish, sawfish, hagfish

25. Body is segmented in:

(a) mollusca (b) porifera

(c) coelenterate (d) annelida

26. Phylum arthropoda is characterized by:

(a) hairs, external segmentation, 3 pairs of legs

(b) exoskeletal system, 1 pair of chelicerae

(c) external segmentation, a pair of chelicerae, a pair of pedipalp

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(d) chitinous exoskeleton, external segmentation, paired jointed appendages

27. Radial symmetry is seen in:

(a) sponges (b) fishes

(c) starfish (d) mollusca

28. Integument of arthropoda is covered with:

(a) chitinous cuticle (b) smooth muscle

(c) strong calcareous shell (d) none of these

29. Air bladder is:

(a) excretory organs of mammals (b) reparatory organ of birds

(c) hydrostatic organ of bony fishes (d) organ of hydrophytes

30. Peculiarity of fish heart is that it has:

(a) all arterial blood (b) all venous and partly arterial

(c) partly venous and partly arterial (d) no blood at all

31. Coelentrates differ from the other animals in having:

(a) nematocysts (b) skeleton

(c) bilateral symmetry (d) polymorphism

32. Cephalopoda is a class of animals in which:

(a) notochord extends up to head (b) foot is located upon head

(c) head is fused with thorax (d) head is located upon foot

33. Group amniota includes:

(a) birds and reptiles (b) birds and mammals

(c) reptiles, birds and mammals (d) reptiles and mammals

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34. Which of the protozoans is considered as connecting link between animal and plants?

(a) paramecium (b) monocystis

(c) englena (d) entamoeba

35. Which of the following phylais not having vascular, respiratory and excretoryorgans?

(a) arthropoda (b) annelid

(c) porifera (d) Platyhelminthes

36. Water vascular system is typically found in:

(a) sponge (b) hydra

(c) starfish (d) leech

37. Chordates are distinguished from non-chordates by the presence of:

(a) ventral nerve cord (b) dorsal nerve cord

(c) brain (d) dorsal tubular nerve cord

38. Eumetazoa includes:

(a) protista (b) coelenterate

(c) sporozoa (d) protozoa

39. An endoskeleton is found in:

(a) earthworm (b) scorpion

(c) snake (d) cockroach

40. The main function of the contractile vacuole in amoeba and other aquatic protozoans is:

(a) nutrition (b) osmoregulation

(c) circulation of food (d) excretion of nitrogenous wastes

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41. Phylum coelenterata has remained at:

(a) cellular level of organization
(b) tissure level of organization
(c) tis sure level of organization
(d) organ level of organization

42. Heretima is:

(a) sterile
(b) unisexual
(c) radially symmetrical
(d) hermaphrodite

43. Lung book are the respiratory organs of:

(a) scorpion
(b) hydra
(c) cockroach
(d) prawn

44. Acoelomates:

(a) have cavity lined with mucus cells
(b) have cavity not linked with epithelial cells
(c) have coelom
(d) lack coelom

45. Paramoecium has:

(a) two contractile vacuoles
(b) one contractile vacuoles
(c) four contractile vacuoles
(d) many contractile vacuoles

46. Which one of the following is a genetically transmitted disease?

(a) haemophilia
(b) blood cancer
(c) typhoid
(d) bone cancer

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47. Which of the following pair is correctly matched?

(a) scabies: entamoeba

(b) malaria : plasmodium

(c) tetanus: haemophilus

(d) pneumonia: sarcoptes

48. Which of the following statements is not characteristic of echinoderms?

(a) all are marine

(b) the body is segmentrical

(c) adults are radially symmetrical

(d) water vascular system is present

49. Which of the following disease is caused by bacteria?

(a) cholera

(b) malaria

(c) elephantiasis

(d) measles

50. Which one of the following is communicable disease?

(a) cancer

(b) diphtheria

(c) rheumatism

(d) diabetes

51. Human beings belong to:

(a) the order primates under the class chordate

(b) the class primates under the phylum chordate

(c) the class primates under the phylum chordate

(d) the class mammalia under the phylum chordate

52. A person suffering from tetany is treated by the administration of:

(a) thvroxin

(b) calcitonin

(c) aldosterone

(d) parathonnone

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53. Which one of the following is not mosquito borne disease?

(a) dengue fever (b) filariasis

(c) sleeping sickness (d) malaria

54. Wine turns sour because of:

(a) aerobic bacteria (b) anaerobic bacteria

(c) exposure to light (d) heat

55. Which of the following disease is caused by bacteria?

(a) arthritis (b) diphtheria

(c) beri-beri (d) small pox

56. The bacterium haemophilous influenzae causes:

(a) pneumonia (b) meningitis

(c) influenza (d) small pox

57. Bacterium responsible for fermentation of dairy milk and plant product is:

(a) lactobacter (b) haybacillus

(c) acetobacter (d) rhizobium

58. Bacterial cell division in every minute, it takes an hour to fill a cup, how much time it will take to fill half the cup?

(a) 59 minutes (b) 30 minutes

(c) 60 minutes (d) 29 minutes

59. Bacterial cell membrane is made up of:

(a) lipo-protein (b) cellulose

(c) chitin (d) fat

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60. Which are the smallest bacteria among the following?

(a) cocci (b) spirilli

(c) bacilli (d) vibrios

61. Tobacoo mosaic disease is caused by:

(a) virus (b) bacilli

(c) vibrios (d) fungi

62. Bacteria multiply:

(a) asexuallyby fission (b) fusion

(c) spore formation (d) zygospore formation

63. Spirogyra:

(a) is filamentous (b) has chloroplast

(c) belongs to chlorophyte (d) all of these

64. Which of the following statement is correct?

(a) all the blue-green algae can fix nitrogen

(b) most of the blue-green algae can fix atmospheric nitrogen

(c) none of the blue-green algae ean fix atmospheric nitrogen

(d) blue-green algae can fix nitrogen only when present in root nodules of legumes

65. Which of the following is the symbiotic N_2fixing prokaryote?

(a) anabaena (b) cladophora

(c) batrachospermurn (d) coleochaete

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66. Mycorrhiza, a relationship between fungi and roots of higher plants is:

(a) parasitic relationship
(b) saprophytic relationship
(c) symbiotic relationship
(d) epiphytic relationship

67. A mushroom is:

(a) agaricus
(b) algae
(c) fungi
(d) pinus

68. The amphibians of the plants kingdom are:

(a) Thallophytes
(b) pteridophytes
(c) angiosperms
(d) bryophytes

69. A moss differs from the fern in having:

(a) flagellated antherozoids
(b) archegonia
(c) haploid spores
(d) dependent sporophyte

70. In cockroach accessory glands are meant for:

(a) circulation
(b) respiration
(c) excretion
(d) reproduction

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ANSWER FULL LENGTH PRACTICE EXAM NO. 2

1.	A	11.	A	21.	D	31.	A	41.	C	51.	D	61.	A
2.	B	12.	B	22.	D	32.	D	42.	D	52.	D	62.	A
3.	C	13.	A	23.	D	33.	C	43.	A	53.	B & C	63.	D
4.	C	14.	C	24.	D	34.	C	44.	D	54.	A	64.	B
5.	A	15.	B	25.	D	35.	C	45.	A	55.	B	65.	A
6.	D	16.	B	26.	D	36.	C	46.	A	56.	C	66.	C
7.	B	17.	B	27.	C	37.	D	47.	B	57.	A	67.	C
8.	A	18.	D	28.	A	38.	B	48.	B	58.	A	68.	D
9.	A	19.	D	29.	C	39.	C	49.	A	59.	A	69.	D
10.	A	20.	B	30.	B	40.	B	50.	B	60.	A	70.	D

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FULL LENGTH PRACTICE EXAMS NO.3

1. Tracheae and trachioles are the:

(a) respiratory organs of cockroach (b) respiratory organs of earthworm

(c) respiratory organs of ascaris (d) respiratory organs of nerles

2. The mode of nutrition in amoeba is:

(a) heterotrophic (b) autotrophic

(c) saprophytic (d) parasitic

3. The toad is:

(a) herbivorous (b) a frog

(c) omnivorous (d) carnivorous

4. Parotid glands are found in:

(a) frogs and toads (b) toads only

(c) frogs only (d) fish

5. Chemically enzymes are:

(a) carbohydrates (b) proteins

(c) fats (d) amino acids

6. If food intake is greater than greater used, the surplus is deposited as:

(a) fat (b) proteins

(c) carbohydrates (d) enzymes

7. More energy is produced from 1 gram mol of:

(a) fats (b) sugars

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(c) proteins (d) vitamins

8. Scurvy is a disease caused by:

(a) presence of Rh antigen in blood (b) deficiency of vitamin E

(c) deficiency of vitamin C or ascorbic acid (d) deficiency of vitamin D

9. Vitamins are:

(a) organic substances and cannot be synthesized by animals

(b)inorganic substances and can be synthesized by animals

(c) organic substances which can mostly be synthesized by animals

(d) inorganic substances which one converted into organic by simple animals only

10. Deficiency of vitamin a causes:

(a) beri-beri (b) retarded growth and development

(c) rikets (d) night blindness

11. Function of vitamin k is in:

(a) regulation of phosphorus and calcium metabolism

(b) blood dotting

(c) carbohydrate metabolism

(d) respiration

12. The most common concentrated source of proteins in Pakistan is:

(a) potatoes (b) meat

(c) eggs (d) pulses

13. Starch is:

(a) carbohydrate (b) protein

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(c) enzyme (d) fat

14. Sucrose is found in:

(a) milk (b) honey

(c) sugarcane (d) orange

15. Which one of these carbohydrates is a monosaccharide?

(a) cellulose (b) sucrose

(c) starch (d) glucose

16. Vitamin D is also called:

(a) calciferol (b) ascorbic acid

(c) retinol (d) folic acid

17. Micro-nutrients:

(a) are less important in nutrition than macro-nutrients

(b) are as important in nutrition as macro-nutrients

(c) may be emitted from culture media without any detriment effect on the plants

(d) are called 'micro' because they play only a minor role in plant nutrition

18. Which of the following is not a macro-nutrient?

(a) Mg (b) Ca

(c) Fe (d) P

19. Mineral salts are absorbed by the roots from the soil, in the form of:

(a) very dilute solution (b) dilute solution

(c) concentrated solution (d) very concentrated solution

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20. Plants always take their food:

(a) in organic form (b) in inorganic form

(c) in solid form (d) in soluble form

21. The first step in photosynthesis is:

(a) photolysis of water

(b) formation of ATP

(c) excitement of an electron of chlorophyll by a photon of light

(d) formation of NADPH

22. In which of following process the light energy is converted into chemical energy:

(a) digestion (b) respiration

(c) fermentation (d) photosynthesis

23. In light phase of photosynthesis there is formation of:

(a) ATP and $NADPH_2$ (b) NADPTB

(c) ATP (d) carbohydrates

24. What is the source of oxygen liberated in photo-synthesis?

(a) CO_2 (b) H_2O

(c) carbohydrates (d) photosynthetic enzymes

25. During dark reaction of photosynthesis:

(a) water splits

(b) Co_2 is reduced to organic compounds

(c) chlorophyll is activated

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(d) 6 carbon sugar is broken down into 3 carbon sugar

26. Ptyalin of saliva acts in:

(a) slightly alkaline medium
(b) slightly acidic medium
(c) neutral medium
(d) all type of media

27. Bile juice assists in digestion of fats by:

(a) emulsifying the fats
(b) contributing a lipolytic enzyme
(c) stimulating secretion of lipase
(d) increasing the alkalinity of digestive medium

28. Liver cells secrete:

(a) amylopsin
(b) trypsin
(c) bile juice and no enzymes
(d) digestive enzymes

29. Protein digestion requires:

(a) proteases
(b) peptides
(c) proteolytic enzymes
(d) all of these

30. Some proteolytic enzymes are:

(a) trypsin, erepsin, pepsin
(b) amylase, lipase, zymase
(c) amylase, steapsin, ptyalin
(d) all of these

31. Whichof these is a group of end products of carbohydrate digestion?

(a) glucose, galactose, fructose
(b) sucrose, galactose, maltose
(c) galactose, glucose, maltose
(d) lactose, maltose, glucose

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32. Pancreatic juice takes part in digestion of:

(a) proteins carbohydrates
(b) proteins, fat, carbohydrates
(c) proteins only
(d) proteins and fats

33. Conversion of glucose into glycogen in liver is called:

(a) glycogenolysis
(b) glycogenesis
(c) glycolysis
(d) gluconeogenesis

34. Oxygen carrier or the respiratory pigment in blood of frog and other vertebrates is:

(a) haernocyanin
(b) haemoglobin
(c) cytochrome
(d) haernolyrnph

35. A frog must swallow air if the lungs are to be expanded, because frog:

(a) has no diaphragm
(b) normally breathes through its skin
(c) has no vagus nerve
(d) is relatively low form of life

36. Anaerobic respiration is likely to occur in:

(a) ants
(b) earthworms
(c) Echinoderms
(d) tapeworms

37. What is the end product of glcolysis?

(a) pyuvic acid
(b) acetyl Co-A
(c) citric acid
(d) lactic acid

38. Out of there, the end product of anaerobic respiration is:

(a) $Co_2 + H_2O$
(b) fumaric acid
(c) pyruvic acid
(d) lactic acid

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39. In glycolysis, ultimately:

(a) protein is converted to glucose
(b) glucose is converted to fructose
(c) glucose is converted to pyruvic acid
(d) starch is converted to glucose

40. A person with blood group O can receive blood transfusion from persons with blood group:

(a) O and AB
(b) O, A and B
(c) O only
(d) AB only

41. Universal recipient in blood transfusion belongs to the group:

(a) A
(b) O
(c) AB
(d) B

42. Haemophilia is a disease caused by deficiency of:

(a) water in plasma
(b) RBCS
(c) WBCS
(d) thromboplastin

43. Mangolism or Down's syndrome is the result of:

(a) 47 chromosomes instead of 46
(b) 45 chromosomes instead of 46
(c) 23rd pair of chromosomes in three doses
(d) 21 st pair of chromosomes having a single dose

44. Eugenics pertains to:

(a) improvement of mankind by improving his heredity
(b) prescribing human sperms for artificial insemination
(c) study of human genetics

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(d) controlling size of human family

45. Sickle-cell anaemia is due to:

(a) hormones (b) viruses

(c) genes (d) bacteria

46. Sex linked inheritance was discovered by:

(a) Mendel (b) Landsteiner

(c) Morgan (d) Mc Clung

47. Chromosomal pattern of Turner's syndrome:

(a) 22 A + XXV (b) 22 A + XXX

(c) 22 A + X (d) 22 A + Y

48. Chromosomes of Klkinefelter's syndromes usually have:

(a) one X (b) XXV

(c) 2 X only (d) no Y

49. Autotrophic component of ecosystem is:

(a) sunlight (b) green plants

(c) herbivorous (d) bacteria and fungi

50. Which of the following is the main factor of water pollution?

(a) smoke (b) ammonia

(c) getergents (d) industrial wastes

51. The main air pollutant is:

(a) Co (b) Co_2

(c) N_2 (d) sulphur

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52. Which of the following-is non-renewable source of energy?

(a) coal (b) forest

(c) H_2O (d) wild life

53. Loss of air exchange capacity by deterioration of alveoli in lung tissues called:

(a) emphysema (b) necrosis

(c) effluent (d) eutrophication

54. Majorfood crop of the world belongs to:

(a) leguminosae (b) solanaceae

(c) gramineae/poaceae (d) cruciferae

55. the most important foods are derived from:

(a) roots (b) fruits

(c) leaves (d) stem

56. A cell became turgid when placed in:

(a) isotonic solution (b) hypertonic solution

(c) hypertonic solution (d) any acrated water

57. When the contents of a cell are in the shrinkage state the process is called:

(a) hypotonic (b) plasmolysis

(c) endosmosis (d) osmosis

58. Which of the following statements is true?

(a) the plasma is the liquid part of blood (b) RBC is smaller than WBC

(c) haemoglobin is stored in RBC (d) all are true

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59. The blood coming from the heart is carried to liver by:

(a) aorta (b) renal artery

(c) renal vein (d) hepatic artery

60. Ammonia is the chief nitrogenous excretory material in:

(a) cartilaginous fishes (b) fowl

(c) freshwater fishes (d) mosquitoes

61. Urea is produced from 'ammonia in the body of rabbit or man in:

(a) liver (b) kidneys

(c) spleen (d) heart

62. Kidney of a mammal resembles contractile vacuole of amoeba in expelling out:

(a) salt (b) glucose

(c) excess water (d) urea and uric acid

63. Which of these will completely be reabsorbed under normal condition in the nephrons?

(a) glucose (b) urea

(c) salts (d) uric acid

64. Aquatic animal are mostly ammonotelic because:

(a) ammonia helps in checking inflow of water into body

(b) excretion of ammonia requires large amount of water which is available to these animals

(c) water contains less nitrogen

(d) they get less light

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65. Which part of mammalian brain controls the muscular co-ordination?

(a) cerebellum (b) cerebrum

(c) corpus callosum (d) medulla

66. The central nervous system consists of:

(a) brain and the spinal cord (b) spinal cord and spinal nerves

(c) brain, spinal nerves and cranial nerves (d) brain and the cranial nerves

67. Acetylcholine is responsible for transmission of nerve impulses through:

(a) soma (b) dendrites

(c) axons (d) synapses

68. Cerebellum of brain is concerned with:

(a) static balance

(b) regulation of body posture and equilibrium

(c) initiation of muscular contraction

(d) co-ordination of muscular movements

69. Which part of the brain is responsible for sensation, memory and emotions?

(a) thaiamus (b) medulla oblongata

(c) cerebrum (d) cerebellum

70. Which of the following statements is incorrect?

(a) a gynoecium is the female part of the flower

(b) the style receives pollens

(c) stamens collectively are named as androecium

(d) in marchantia, eggs develop inside archegonium

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ANSWER FULL LENGTH PRACTICE EXAM NO. 3

1.	A	11.	B	21.	C	31.	A	41.	C	51.	A	61.	A
2.	A	12.	D	22.	D	32.	B	42.	D	52.	A	62.	C
3.	C	13.	A	23.	A	33.	B	43.	A	53.	A	63.	A
4.	A	14.	C	24.	B	34.	B	44.	A	54.	C	64.	B
5.	B	15.	D	25.	B	35.	A	45.	C	55.	B	65.	A
6.	A	16.	A	26.	B	36.	D	46.	C	56.	C	66.	A
7.	A	17.	B	27.	A	37.	A	47.	C	57.	B	67.	D
8.	C	18.	C	28.	C	38.	D	48.	B	58.	D	68.	D
9.	A	19.	A	29.	C	39.	C	49.	B	59.	D	69.	C
10.	D	20.	D	30.	A	40.	C	50.	D	60.	C	70.	B

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FULL LENGTH PRACTICE EXAMS NO.4

1. During the process of fertilization, it is usually found that of the two male gametes. One fuses with the egg and the second with the secondary nucleus this is known as:

(a) simple fertilization
(b) double fertilization
(c) fusion
(d) zygospore formation

2. The nutritive status of slime mould is:

(a) producer
(b) consumer
(c) decomposer
(d) consumer/decomposer

3. Sexual reproduction is uncommon in:

(a) deuteromycota
(b) zygornycota
(c) ascomycota
(d) basidiomycota

4. Fertilization of ovum takes place in man and other placental mammals in:

(a) ovary
(b) uterus
(c) fallopian tubes
(d) vagina

5. Corpus luteum in mammals occurs in:

(a) brain and connects the two cerebral hemispheres
(b) ovaries and produces progesterone hormone
(c) heart and initiates atrial contraction
(d) skin and acts as a pain receptor

6. Bread moldis used to manufacture:

(a) lactic acid
(b) acetic acid
(c) fumaric acid
(d) all of these

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7. Which one of the following substances is released into the blood stream of a normal individual to increase the concentration of blood sugar?

(a) vitamins (b) insulin

(c) glucagon (d) enzyme

8. A plant cell has the potential to develop into an entire plant. This property of the plant cells is known as:

(a) totipotency (b) nucleopotency

(c) tissue culture (d) gene cloning

9. Outer covering of cartilage is known as:

(a) endostium (b) perichondrium

(c) periostium (d) serous coat

10. Germs cells in the vertebrate gonads form by:

(a) mitosis (b) meiosis

(c) both meiosis and mitosis (d) maturation without cell division

11. Which one is called the king of genetics due to the excessive use for genetic research?

(a) neurospora (b) penicillium

(c) saccharomyces (d) aspergillus

12. Smallest insect is:

(a) house fly (b) fairy fly

(c) cockroach (d) small beetle

13. After ovulation in female rabbit, the collapsed ovarian follicle shrinks and becomes filled with cells to from:

(a) corpus luteum (b) endothelium

(c) epittelium (d) follicle

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14. Medicines from fungi are used extensively:

(a) exogenously
(b) endogenously
(c) exogenously and endogenously
(d) on animals only

15. Polar bodies are formed during:

(a) oogenousis
(b) spermatogenousis
(c) gematogenousis
(d) sporogenousis

16. Natural parthenogenesis occurs in:

(a) earthworms
(b) all insects
(c) honey bee
(d) protozoans

17. Main function of corpus lutcum is to:

(a) facilitate fertilization
(b) facilitate ovulation
(c) secrete progesterone
(d) facilitate passage of ova a in oviducts

18. In a spontaneous reaction the free energy of a system:

(a) decreases
(b) increases
(c) becomes equal to zero
(d) remain unchanged

19. Placenta acts like a:

(a) semi permeable membrane
(b) fully" permeable
(c) impermeable membrane
(d) none of these

20. Which of the following structure are protective in function?

(a) amnion and yolk sac
(b) amnion and allantois
(c) amnion and chorion
(d) chorion and allantois

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21. Which types of division occurs in cleavage?

(a) amitotic (b) mitotic

(c) meiotic (d) mitotic and meiotic

22. What is site of the fertilization in human being?

(a) vazina (b) uterus

(c) fallopian tube (d) ovary

23. Which layer forms liver, pancreas thymus and thyroid?

(a) endodenn (b) mesoderm

(c) lctoderm (d) epiblast

24. Sedimentation coefficient is:

(a) svedberg unit (b) centrifugation

(c) ultracentrifugation (d) density gradient centrifugation

25. Which group exclusively consists of polysaccharides?

(a) starch, glycogen lactose (b) lactose, cellulose, starch

(c) glycogen, maltose, starch (d) glycogen, cellulose, starch

26. The most diverse molecules in a cell are:

(a) mineral salts (b) lipids

(c) proteins (d) carbohydrates

27. Which one is correctly matched?

(a) vitamin A-thiamine (b) vitamin B-calciferol

(c) vitamin E-riboflavin (d) vitamin E-tocopherol

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28. Which of the following is not function of liver?

(a) detoxification (b) glycogen storage

(c) production of insulin (d) production of bile

29. Vitamin k is required for:

(a) formation of prothrombin (b) conversion of prothrombins

(c) synthesis of prothrombin (d) formation of thromboplastin

30. Vitamin D is synthesized in skin by the action of sunlight on:

(a) 7-dehydrocholesterol (b) cephalocholes

(c) cholesterol (d) all of these

31. Which of the following trace element is significant for maintenance of teeth?

(a) manganese (b) copper

(c) line (d) fluoride

32. Feeding on dead and decaying organism represent what type of nutrition:

(a) autotrophic (b) parasitic

(c) saprotrophic (d) holozoic

33. We take food rich in lime juice then:

(a) action of ptyalin on starch stops (b) action of ptyalin on starch is unaffected

(c) action of ptyalin on starch is reduced (d) action of ptyalin on starch is enhanced

34. Which part of the body secretes the hormone secretin?

(a) oesophagus (b) stomach

(c) duodenum (d) ileum

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35. Enterokinase converts:

(a) starch → maltose

(b) proteins → dipeptides → amino acids

(c) trypsinogen → trypsin

(d) fats → glycerol

36. Which one of the following vitamins can be synthesized by bacteria inside the gut?

(a) K

(b) D

(c) B

(d) C

37. Which of the following are absorbed in the elementary canal as such?

(a) proteins

(b) fat soluble vitamins

(c) polysaccharides

(d) albumen of egg

38. Strongest part in the body is:

(a) muscle

(b) enamel

(c) bone

(d) cartilage

39. Gall bladder of a man is stimulated by:

(a) enterokinase

(b) cholecystokinin

(c) secretin

(d) enterogastrone

40. When gall bladder of a man is removed:

(a) effect of pancreatic juice upon food is impaired

(b) acidity continues in duodenum

(c) fat digestion is not possible

(d) all of these

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41. Taste buds of bitter taste are located in our tongue:

(a) on upper surface in posterior (b) on lower surface

(c) on lower sides (d) at tip

42. Maximum absorption takes places in:

(a) rectum (b) colon

(c) stomach (d) ileum

43. Which of the following is unpaired bone of face?

(a) maxilla (b) lacrimal

(c) palatine (d) vomer

44. Seed coat and nut shells only contain _____ type of sclerenchyma cells.

(a) fibers (b) sclereides

(c) tracheids (d) vessels

45. Rectal glands remove the excessive salt to outside by:

(a) diffusion (b) active transport

(c) facilitated (d) both (a) and (b)

46. In marine environment, internal salt concentration will be lower in the cast of:

(a) most cartilaginous fishes (b) hag fishes

(c) most marine invertebrates (d) all of these

47. The covalent bound between two amino acids is called as:

(a) amide (b) protein

(c) protoamide (d) peptide

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48. The two families of nitrogenous bases of nucleotides are:

(a) adinine and guanine

(b) thymine and cytosine

(c)purine and pyrimidine

(d) uracil and purine

49. Endoplasmic reticulum is not found in:

(a) mammalian WBC

(b) mammalian RBC

(c) adipose cells

(d) cardiac dells

50. The science of improving physical and mental qualities of humans, through control of the factors influencing heredity, is called:

(a) genetics

(b) genetic engineering

(c) gene therapy

(d) phycology

51. Study of the external character of organisms is called:

(a) history

(b) biogeography

(c) paleontology

(d) morphology

52. Hypothesis is:

(a) a reasoned explanation

(b) an educated guess

(c) idea given on the basis of previous Knowledge

(d) all of these

53. Nanometer (nm) is other name of:

(a) mill micron (mμ)

(b) micron (μ)

(c) micrometer (μm)

(d) angstrom (A^o)

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54. Which of the following cannot be grown on artificial culture medium?

(a) E.coil (b) T.M.V

(c) yeast (d) aspergillus

55. Secretion of the sweat glands of mammals are primarily meant for:

(a) regulation of body temperature (b) removal of excess salt

(c) removal of excess water (d) killing of bacteria on skin

56. According to fluid-mosaic model, plasma membrane is made of:

(a) cellulose and hemicellulose

(b) phospholipids and hemicellulose

(c) phospholipids and intrinsic proteins

(d) phospholipids, intrinsic proteins and extrinsic proteins

57. Osmosis through semipermeable membrane is a flow of:

(a) solutes from low concentration to higher concentration

(b) phospholipids and gemicellulose

(c) phospholipids and intrinsic proteins

(d) phospholipids, intrinsic proteins and extrinsic proteins

58. How many molecules of oxygen gas (O_2) are used during the glycolysis of one glycolysis of one glucose molecule?

(a) 0 (b) 1

(c) 16 (d) 38

59. Which of the following substances donot pass across membranes by simple diffusion?

(a) O_2 (b) CO_2

(c) H_2O (d) H^+

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60. In the conversion of pyruvic acid to acetyl coenzyme A, pyruvic acid is:

(a) oxidized (b) reduced

(c) isomerized (d) broken into one carbon fragments

61. Which of the following structure is not found in prokaryotic cell?

(a) plasma membrane (b) nuclear envelop

(c) ribosome (d) cell wall

62. Which of the following is a testcross?

(a) AABB × AABB (b) AABD × AABB

(c) AABB × AABB (d) AABB × AABB

63. Which of the following taxonomic categories contain organisms least similar to ea. h other?

(a) class (b) genus

(c) family (d) species

64. Maximum mitochondria in the cells of:

(a) human liver (b) bird's wing

(c) human kidney (d) air bladder of a fish

65. Which one is false nucleus?

(a) nucleoid (b) nucleolus

(c) chromosome (d) coenocytic condition

66. Identification + nomenclature + classification + interrelationship = ?

(a) systematics (b) organic evolution

(c) phonetics (d) taxonomy

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67. Which of the following molecules moves regularly from the nucleus to the cytoplasm?

(a) glycogen
(b) RNA
(c) DNA
(d) cholesterol

68. Of all the texa, the only one that exists in nature as a biologically cohesive unit is the:

(a) species
(b) genus
(c) phylum or division
(d) kingdom

69. Bacteria that get their energy by fermentation and for whom oxygen is lethal are called:

(a) obligate anaerobs
(b) obligate aerobs
(c) facultative aerobs
(d) facultative anaerobs

70. When the fluid outside a cell has a greater concentration of a given molecule than the fluid inside the cell, the external fluid is:

(a) isotonic
(b) hypertonic
(c) hypotonic
(d) ultratonic

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ANSWER FULL LENGTH PRACTICE EXAM NO. 4

1.	B	11.	C	21.	B	31.	D	41.	A	51.	D	61.	B
2.	D	12.	B	22.	C	32.	C	42.	D	52.	D	62.	D
3.	A	13.	A	23.	A	33.	C	43.	D	53.	A	63.	A
4.	C	14.	C	24.	A	34.	C	44.	B	54.	B	64.	B
5.	B	15.	A	25.	D	35.	C	45.	B	55.	A	65.	A
6.	B	16.	C	26.	C	36.	A	46.	A	56.	D	66.	A
7.	C	17.	C	27.	D	37.	B	47.	D	57.	B	67.	B
8.	A	18.	A	28.	C	38.	B	48.	C	58.	A	68.	A
9.	B	19.	A	29.	C	39.	B	49.	B	59.	D	69.	A
10.	B	20.	C	30.	A	40.	D	50.	C	60.	A	70.	B

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THE CELL

Major Contents

Content

→ Cell Structure
→ Structure and Function of Cellular Organelles
→ Cell Division
→ Additional / Related Readings

Learning Outcomes

i. Compare the structure of typical animal and plant cell.
ii. Compare and contrast the structure of prokaryotic cell with Eukaryotic cells.
iii. Fluid mosaic model of cell membrane and transportation (diffusion, facilitated diffusion, active and passive transport), endocytosis and exocytosis.
iv. Outline the structure and function of the following organelles.
    a. Nucleus
    b. endoplasmic reticulum,
    c. Golgi apparatus,
    d. mitochondria,
    e. centrioles
    f. ribosome
v. Explain mitosis, what us tits significance?
vi. What is meiosis, describe it in detail?
vii. Discuss the terms karyokinesis and cytokinesis.
viii. Discuss and explain:
    a. Uncontrolled cell division (cancer)
    b. Programmed cell death (appotosis)
    c. Necrosis

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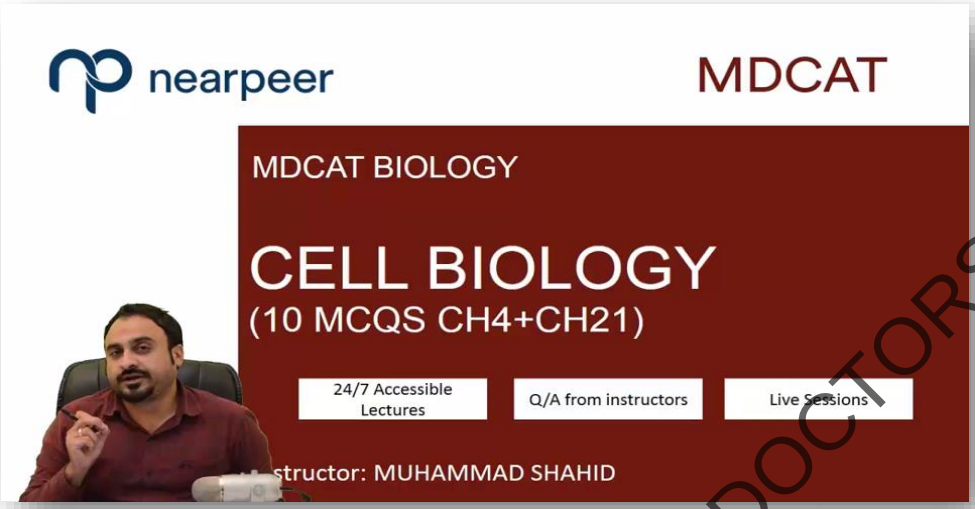

Did you know?

We have explained this entire Module (with practice questions) in just **14 video lectures** at www.nearpeer.org

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ANIMAL AND PLANT CELLS HAVE SOME COMMON FEATURES:

- In animals and plants each cell is surrounded by a very thin plasma (cell surface) membrane, which is too thin to be seen a light microscope.
- Cell has a nucleus which is a relatively large structure. The deeply staining material in the nucleus is called chromatin and is mass of loosely coiled threads. This material collects together to form visible separate chromosomes during nuclear division. It contains DNA which controls the activities of nucleus.
- The material between the nucleus and the plasma membrane is known as cytoplasm. Organelles themselves are often surrounded by membrane so that their activities can be separated from the surrounding cytoplasm. This is called compartmentalization. Since each type of organelles has its own function the cell is said to show division of labour.
- The most numerous organelles seen with the light microscope are usually mitochondria.

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DIFFERENCES BETWEEN ANIMAL AND PLANT CELLS:

- The only structure commonly found in animal cells which us absent from plant cells in the centriole. Under the light microscope it is a small structure close to the nucleus. It is involved in nuclear division.
- Individual plant cells are
- More easily seen with a light microscope than animal cells are because they are usually larger and surrounded by a relatively rigid cell wall outside the plasma membrane (singular plasmodesma) which pass through pore like structures in the walls of these neighbouring cells.
- Mature plant cells differ from animal cells in having a large central vacuole and chloroplast in case of photosynthetic cell.
- The vacuole is surrounded by a membrane, the tonoplast which controls exchange between the vacuole and the cytoplasm. The fluid in the vacuole is a solution of mineral salts, sugars, oxygen, carbon dioxide, pigments, enzymes and organic compounds including some waste products.
- Vacuoles also help to regulate the osmotic properties of cells.
- A large proportion of the inside of the cell is taken up with a fluid-filled compartment known as the vacuole. Together the wall and vacuole maintain the shape of the whole cell.
- Plant cells have specialized organelles, the chloroplasts, which enable them to make their own food by photosynthesis

ANIMAL CELL		PLANT CELL	
(i)	Usually smaller in size.	(i)	Comparatively larger in size.
(ii)	Enclosed by plasma membrane only.	(ii)	In addition to plasma membrane mostly surrounded by a thick cell wall.
(iii)	Plastids absent.	(iii)	Palstides (chloroplast and chromoplast) are very common.
(iv)	Cytoplasm consists largely of smaller vacuole.	(iv)	Cytoplasm peripheral, central space occupied by a large vacuole.
(v)	Prominent and highly complex Golgi bodies.	(v)	Contain several subunits of Golgi bodies called dictyosomes.
(vi)	Possess centrosome with one of two centrioles.	(vi)	No centrioles present, instead two small clear area called polar caps are present.

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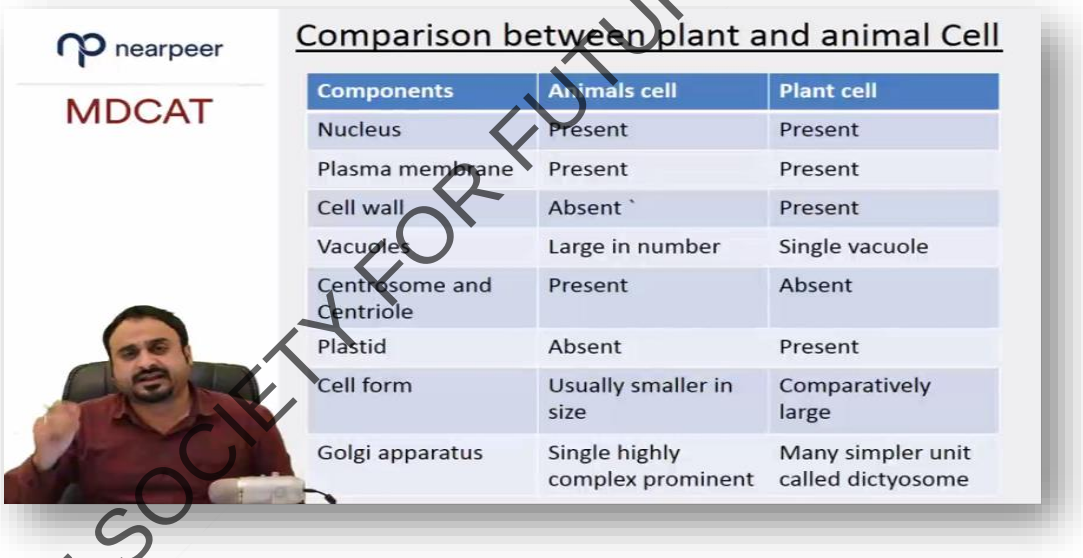
TABLE: COMPARING PLANT AND ANIMAL CELLS

FEATURE	ANIMAL CELL	PLANT CELL
Nucleus	√	√
Plasma membrane	√	√
Mitochondria	√	√
Rough ER	√	√
Golgi bodies	√	√
Lysosomes	√	√
Cell wall	×	√
Plastids, e.g. chloroplasts	×	√
Vacuoles	Small	Large
Centrioles	√	×



Did you know that you can watch this comparison in full detail in the video lecture **1.01 Intro to Cell Biology** at **www.nearpeer.org**

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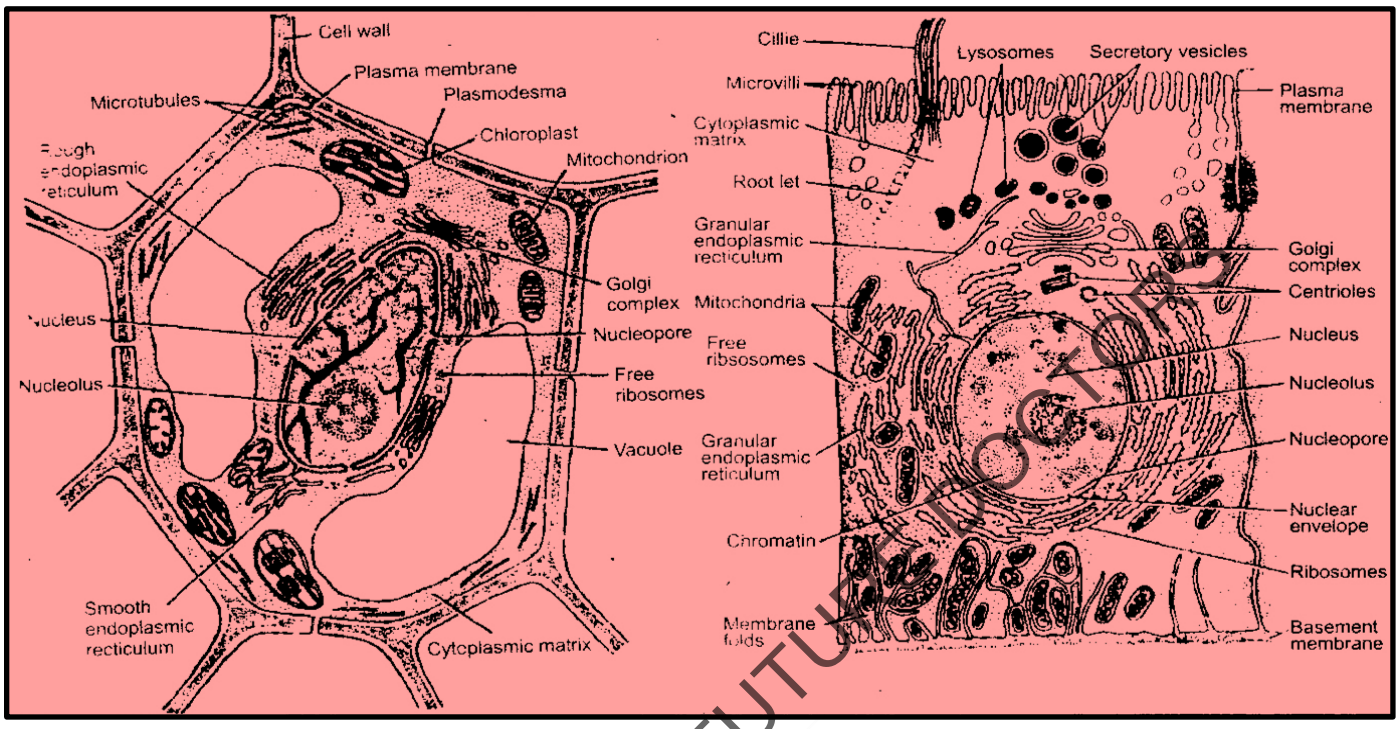

Fig. (a) Ultra structure of a typical cell of a higher plant
Fig. (b) Ultra structure of a typical animal cell

TABLE: MAJOR DIFFERENCES BETWEEN PROKARYOTES AND EUKARYOTES

PROPERTY	PROKARYOTIC CELLS	EUKARYOTIC CELLS
Nuclear membrane	Since there is no nuclear membrane therefore no distinct nucleus	Present
Chromatin material	The genetic material (DNA) is without any nuclear membrane and freely present in the cytoplasm.	A nucleus is present in which nuclear material (chromosomes) is enclosed in double nuclear membrane.
Chromosome	Chromosome is formed of DNA only	Chromosome is formed of DNA and protein.
Organelles	Few organelles None are surrounded by an envelope (two membranes) internal membrane	Many organelles envelop-bound organelles present e.g. nucleus, mitochondria, and chloroplasts. Great

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	scarce if present usually associated with respiration or photosynthesis.	diversity of organelles bounded by single membrane e.g. lysosomes, vacuoles, micro bodies, endoplasmic, reticulum etc.
Ribosomes	Ribosomes are 70 S smaller subunit is 30S while larger subunit is 50 S.	Ribosomes are 80 S smaller subunit is 40 S while larger subunit is 60 S.

Cell wall	Cell wall is composed of peptidoglycan or murein. When polysaccharide chains are bound covalently to shorter chains of amino acids. Peptidoglycan is formed. The entire cell wall is considered as a single complex molecule called sacculus.	The cell wall if present is formed of cellulose is most of the plant cells and is formed of chitin in fungi.
Cell division	In prokaryotes mitosis is missing and the cell divided by binary fission.	Cell division by mitosis.
Organelles	Organisms possessing prokaryotic cells are called prokaryotes.	Organism possessing eukaryotic cells is called eukaryotes.
Origin / Evaluation	Prokaryotes present primitive stage of evaluation.	Eukaryotes probably evolved from prokaryotes.
Flagella	Simple, lacking microtubules extracellular (not enclosed by cell surface membrane) 20 nm diameter.	Complex, with 9 + 2 arrangement of microtubules intracellular (surrounded by cell surface membrane) 200 nm diameter
Respiration	Mesosomes in bacteria except cytoplasmic membrane un blue green algae.	Mitochondria for aerobic respiration.
Photosynthesis	No chloroplasts no membrane stacking	Chloroplasts containing membranes which are usually stacked into lamellae or grana.
Nitrogen fixation	Mainly unicellular	Mainly have the ability
Form	Mainly unicellular	Mainly multi-cellular (except prototista, many of which are unicellular)
Cell size	Average diameter 0.5 – 20 µm	10-100 µm diameter common commonly 1000-10000 times volume of prokaryotic cells.
Examples	Prokaryotes include bacteria and blue green algae (cyanobacteria)	Eukaryotes include all other unicellular or multi-cellular organisms such as animals, plants fungi and Protista.

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CELL MEMBRANE

Plasma membrane or cell membrane is the outer most boundary of the cell. However, in most plant cells, it is covered by a cell wall.

Structure:

Under electron microscope it is a bilayered structure, this structure is delicate and elastic it has some ability to repair itself.

Models of Cell Membrane Structure:

There are two models of cell membrane structure:

i. **Unit Membrane Model:** According to this model the cell membrane is composed of lipid bilayer and sandwiched between two protein layers. This structure is present in all cell organelles (e.g. mitochondria, chloroplast etc.)

ii. **Fluid Mosaic Model:** According to the fluid mosaic model the cell membrane consists of a double layer of phospholipid molecules, known as a lipid bilyers. It has proteins and other molecules. The name fluid mosaic is used because the bilyer is a very fluid structure and it contains a mosaic of protein molecules.

Chemical Composition:

- Cell membrane contains phospholipids 20-40 % proteins 60-80 % cholesterol and polysaccharides.
- IT is about 7 nm thick
- The basic structure is a phospholipid bilayer.
- The hydrophilic phosphate heads of the phospholipids face outwards. The result is the aqueous environment inside and outside the cell.
- The hydrocarbon tails face inwards and create a hydrophobic interior.
- Most protein molecules float about in the phospholipid bilayer forming a fluid mosaic pattern.

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- The proteins stay in the membrane because they have regions of hydrophobic amino acids which interact with the fatty acid tails to exclude water.
- Some proteins and lipids have short branching carbohydrate chains like antennae forming glycoproteins and glycolipids respectively.
- Membrane also contains cholesterol. Like unsaturated fatty acids cholesterol disturbs the close packing of phospholipids and keeps them more fluid. This can be important for organisms living at low temperatures when membranes can solidify. Cholesterol also increases flexibility and stability of membranes,without it membrane break up.
- The two sides of a membrane differ in composition and function.

Functions of Membrane:

- The phospholipid bilayer provides the basic structure of membrane. It also restrict entry and exit of polar molecules and ions.
- Channel protein and carrier proteins are involved in the selective transport of polar molecules and ions across the membrane.
- Some proteins act as enzymes for example the epithelial cells on some parts of the gu contain digestive enzymes.
- Some proteins act as receptor molecules foe chemical signaling between cells.
- Some proteins act a antigens these act as cell identity markers.
- Glycolipids and glycoproteins help cells to recognize each other – allowing the immune system to tell the difference between body cells and invading bacteria.
- Energy transfer ion photosynthesis and respiration proteins take part in the energy transfer system.

TRANSPORT ACROSS THE CELL SURFACE MEMBRANE

Diffusion and Facilitated Diffusion:

Diffusion is the movement of molecules or ions from a region of their high concentration to a region of their low concentration. The process is passive (does not require energy and happens spontaneously).

Two factors affect the rate of diffusion.

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1. Difference in concentration between point A and point B,the steeper the gradient, the faster the rate of diffusion.
2. The greater the surface area of a membrane through which diffusion is taking place the greater the rate of diffusion.

Facilitated Diffusion:

- Some substances enter and leave cells much faster than you would expect it only diffusion occurred. We now know that some membrane proteins facilitate the diffusion of some substances across the cell membrane. Two types protein are responsible for facilitated diffusion.
- Specific carrier protein takes particular substance from the membrane to the other.
- Ion channels are proteins that open and close to control the passage of selected charged articles.
- Channel proteins have a fixed shape.

Osmosis:

Osmosis is a passage of water molecules from a region of their high concentration to a region of their low concentration through a partially permeable membrane. We can say that it is a form of diffusion in which only water molecules move.

Active Transport:

Active transport is the energy-consuming transport of molecules or ions across a membrane against a concentration gradient. Movement are usually in one direction only. Unlike diffusion which is reversible. The energy is supplied in the form of ATP made in respiration. Without respiration, active transport is therefore impossible.

Endocytosis and Endocytosis:

- Endocytosis and exocytosis are active processes involving the bulk transport of materials through membrane, either into cells (endocytosis) or out of cells (exocytosis).
- Endocytosis occurs by an enfolding or extension of the cell membrane to form a vesicle it is of two types.

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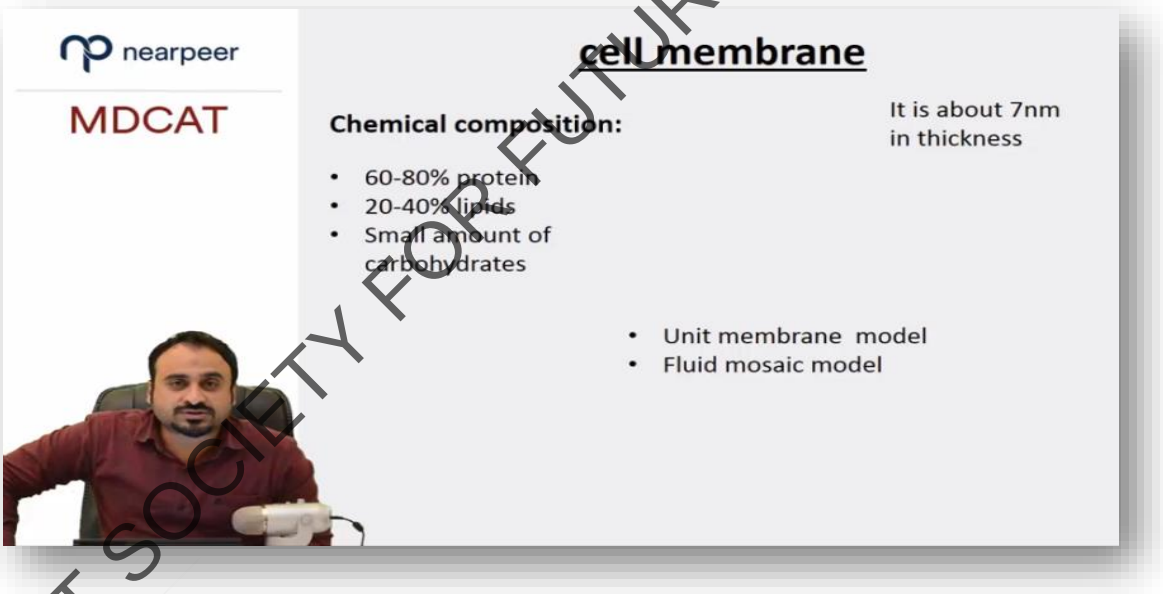
- Phagocytosis (cell eating) material taken up is in solid form. Cells specializing in the process are called phagocytes and are said to be phagocytic. For example, some white blood cells take up bacteria by phagocytosis. The sea formed during uptake is called a phagocytosis vacuole.

- Pinocytosis (cell drinking) material taken up is in liquid form. The vesicles formed are often extremely small, in which case the process is known as micropinocytosis and the vesicles as micropincytosis vesicles.

- Exocytosis is the reverse process of endocytosis. Waste materials may be removed from cells, such as solid, undigested remain from the pancreas is achieved in this way. Plant cells use exocytosis to export the material needed to form cell walls.



Understand entire **cell membrane** in less than 10 minutes and watch **practice questions** in video **1.02b Structure of Cell Membrane** at www.nearpeer.org

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The Nucleus

- The nucleus is the largest and most prominent organelles in the animal cell.
- Almost all eukaryote cells have a nucleus – red blood cells in mammals and phloem cells in plants are a exception.
- Every nucleus is surrounded by a nuclear envelope. This consists of two membranes that are separated by gap of 20 to 40 nm.
- Nucleus may be irregular in shape and about 10 µm in diameter. It contains the cell's DNA, which carries information that allows the cell to divide and carry out all its cellular processes.
- Nucleus controls the life and activities of the cell.
- In animal cells nucleus is generally present in the central part. In plant cells nucleus is pushed towards periphery due to a large central vacuole.
- DNA/RNA and proteins (including enzymes) forms the chemical composition of coleus.
- Nucleus consists of nuclear membrane, nucleoli, nucleoplasm and chromosomes.
- The number of nuclear pores is highly variable. For example the undifferentiated cells (e.g. eggs) have many pores (about 30000 per nucleus) while the differentiated cells (e.g. erythrocytes)have only 3 or 4 pores/nucleus. Each pore has a definite structure.
- Nucleus is a darkly stained structure within the nucleus. Nucleolus has no membrane. There are two regions of a nucleolus.

(i) **The Peripheral Granular Area:**

It contains the materials from which ribosomal subunits are formed.

(ii) **The Central FibrillarArea:**

It has large molecular weight RNA and rDNA.

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- The heredity material is in the form of chromosomes,which controls all the activities of the cell. Chromosome is formed of DNA and proteins.

- Nucleus is visible when the cell is in non-dividing stage. It contains chromatin network and soluble sap called nucleoplasm. Dark staining chromatin, consisting of tightly packed DNA, is known as Heterochromatin. The lighter, more loosely packed material is called Euchromatin contains the DNA that is being actively read to produce proteins. In heterochromatin, the DNA is packed together and is not being read. Nucleus is stained with basic dyes because of the chromatin material. During cell division chromatin material is converted into darkly stained thread like structures called chromosomes

- Chromosome is made of arms and centromeres.

- Centromere is the place on the chromosome where spindle fibres are attached during cell division.

  Each chromosome consists of two identical chromads at the beginning of cell division which are heldtogether at centromere.

- A chromatid is exact replica of the chromosome.

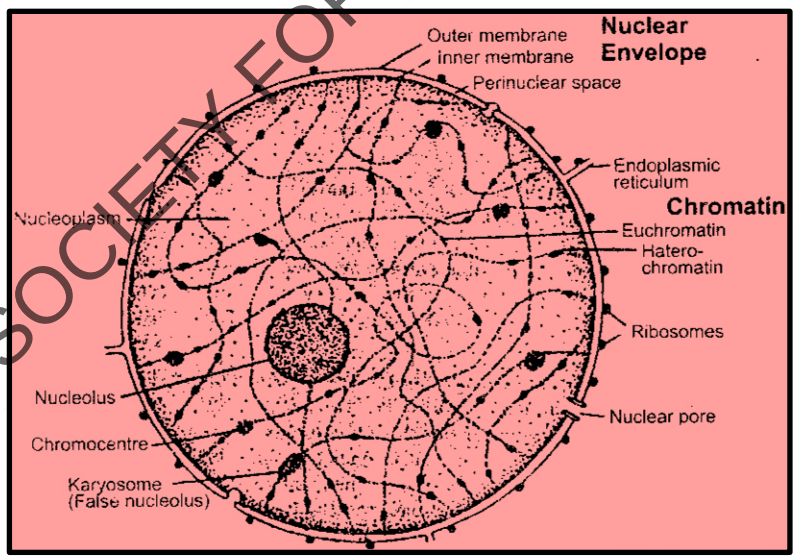

Fig. Ultra structure of interphase nucleus

- The information to control cell activities is present on the chromosomes in the form of genes.

- The chromosome number varies which may be 2n = 2 to 2n = 1200 (Pteridophytes).

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- The number of chromosomes in all individuals of the same species remains constant generation after generation.
- Some examples of chromosome No. are: Frog = 26, Chimpanzee = 48. Fruit fly (Drosophila melanogaster) = 8, Wheat = 42, Onion = 16, Potato. = 48. Garden pea = 14. **Penicillium**(a fungus) has two chromosomes (one pair), corn 20, wheat 42, sugarcane 80, some ferns have more than 500 pairs, mosquito 6, fruit fly 8, frog 26, honey bee 32, mouse 40 and human cells have 46 chromosomes (23 pairs).
- The number of chromosomes in normal body cells is diploid (2n) while the gem cells (sperms and eggs) have haploid chromosome number (11).

Examples: Human germ cells (eggs and sperms) = 23 chromosomes.

Drosophila germ cells = 4 chromosomes.

ENDOPLASMIC RETICULUM (ER)

- The nuclear envelope joins with the membrane of the endoplasmic reticulum (ER). It is a system of complex network spreaded throughout the cell.
- These are present in Eukaryotic cells & are of two types: RER & SER.
- On the outside surface of the RER are ribosomes.
- The main function of RER is to keep together and transport the proteins made on the ribosomes.
- Instead of simply diffusing away into the cytoplasm, newly made proteins enter into RER. Here they fold into three-dimensional shape.
- A mature cell that makes and secretes large amounts of protein – suchas one that makes digestive enzymes – has RER that occupies as much as 90 per cent of the total volume of the cytoplasm.
- PER is also a storage unit for enzymes and other proteins.

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- Small vesicles containing newly synthesized proteins pinch off from (he ends of the RER and either fuse with the Golgi complex or pass directly to the cell surface membrane.
- ER with no ribosomes attached is known as SER.
- Smooth ER is not involved in protein synthesis but is the site of steroid (lipid hormone) production. It also contains enzymes that detoxify, or make harmless, a wide variety of organic molecules, and it acts as a storage site for calcium in skeletal muscle cells.
- The channels having material present in them which is separated from the cytoplasmic materials by the spherical or tubular membranes is called cisternae.
- E.R provides mechanical support to the cell.
- In some cells SER transmit impulses. For example nerve and muscle cells.
- Both RER and SER are involved in the transportation of materials from one part of the cell to the other.

Difference between two type of ER:

Smooth (Agranular) and rough (granular)

Smooth Endoplasmic Reticulum (SER)		Rough Endoplasmic Reticulum (PER)	
(i)	It does not bear ribosomes over the surface of its membranes.	(i)	It possesses ribosomes attached to its membranes.
(ii)	It is mainly formed of, vesicles and tubules.	(ii)	It is mainly formed of cisternae and a few tubules.
(iii)	It is engaged in 'the synthesis of glycogen, lipids and steroids.	(iii)	It takes part in the synthesis of proteins and enzymes

RIBOSOMES

- Ribosomes were discovered by Palade in 1955.
- Ribosomes are small dense organelles, about 20 nm in diameter present in great numbers in the cell. Most are attached to the surface of RER but they can occur free in the cytoplasm.

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- Ribosomes are made from a combination of rRNA and protein. Eukaryotic ribosomes are compose-I of an equal quantity of RNA and protein. Therefore they are also called asribonucleo proteins.
- Ribosomes are involved in protein synthesis. They assemble amino acids in the rightorder to produce new proteins. The ribosome uses the code on' messenger RNA (mRNA) to put amino acid together in chains to form specific proteins.
- Generally proteins that are to be used inside the cell are made on free ribosome while those that are to be secreted out of the cell are made on ribosomes that are bound to ER membranes.
- New ribosomes are formed in the nucleolus.
- Eukaryotic ribosome is 80 S (60 S + 40 S). Mg^{++} controls this attachment.
- A group of ribosomes attached to the same mRNA are called polysomes.
- Nucleolus is a factory of ribosomes while ribosomes are the factory of protein synthesis.

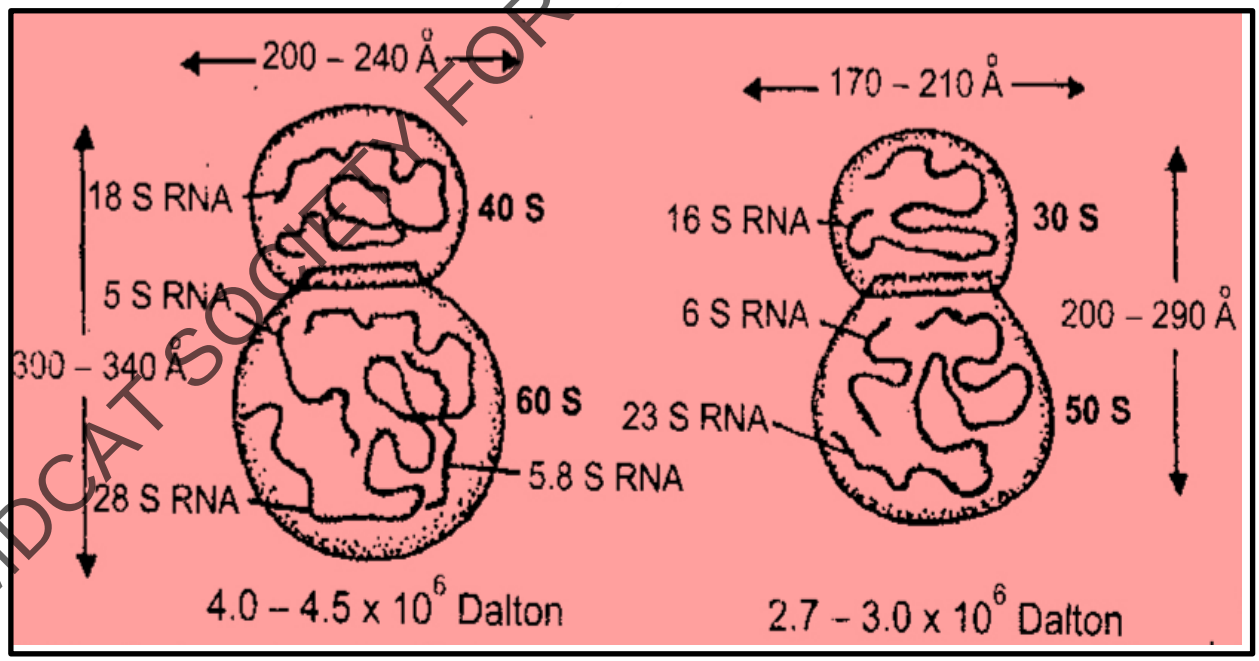

Fig. 80 S and 70 S Ribosome

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THE GOLGI COMPLEX

- The Golgi apparatus/Golgi complex was discovered by Comillo Golgi in 1898. It is found in eukaryotic cells.
- Golgi apparatus consists of stacks of flattened membrane bound sacs or flattened cavities or vesicles called Cisternae (5 – 8).
- The whole organelle is a shifting, flexible structure; vesicles are constantly being added at one side and lost from the other. Generally, vesicles fuse with the forming face (the one nearest to the nucleus) and leave from the maturing face (the one nearest to the cell surface membrane).
- Golgi complex has proteins, carbohydrates, glycoproteins and some enzymes. The (Golgi complex appears to be involved with the synthesis and modification of proteins. lipids and carbohydrates.
- Major functions of Golgi complex are formation of conjugated molecules and Secretions.
- Proteins made on the ribosomes attached to ER are packaged into the vesicles by the ER.Some of the vesicles join with the Golgi complex and the proteins they contain are modified before they are secreted out of the cell.
- Golgi apparatus + Golgi vesicles = Golgi complex
- Secretions are products formed in the cells on ribosomes and then pass to the outside through endoplasmic reticulum and Golgi apparatus.
- In plants Golgi apparatus is involved in the synthesis of cell wall.

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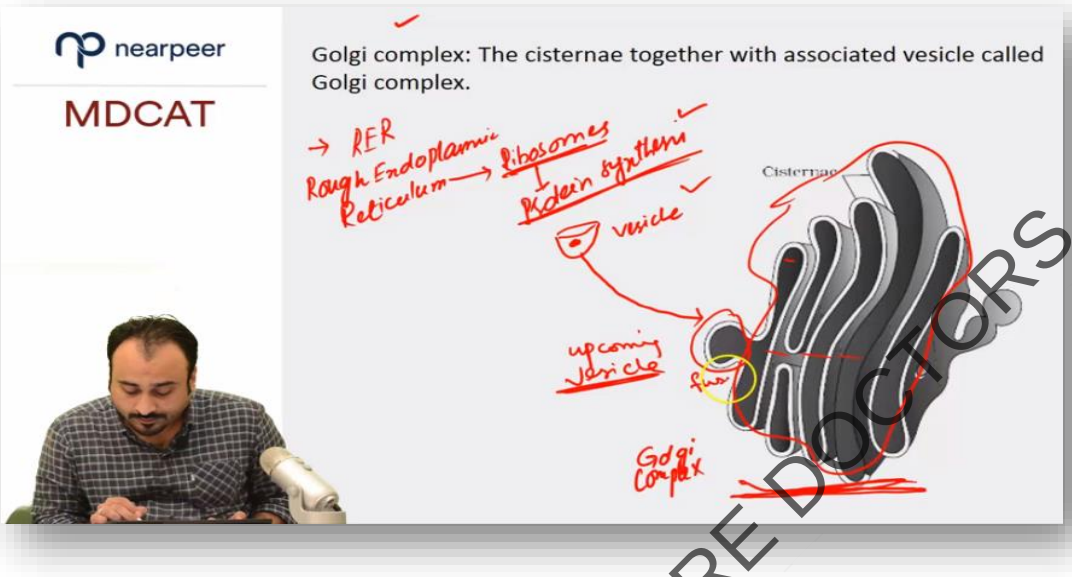

Watch **Video 1.05** of 2nd Module at **www.nearpeer.org** for the practice question of **Golgi Complex**

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MITOCHONDRIA

- Mitochondria are important organelles of eukaryotic cells. They manufacture and supply energy to the cell. Therefore they are also called powerhouse of the cell.
- Mitochondria are particularly abundant in metabolically active cells, tissues such (is muscle and tissues involved in active transport.
- The size (0.5 – 1.5 µn wide) and number of mitochondria varies and depend upon the physiological activity of the cell.

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- Under compound microscope mitochondria may be rod shaped, vesicles or filaments. In Electron Microscope, Mitochondria have two membranes, outer smooth and inner with aristae.
- The inner surface of aristae in the mitochondrial matrix has small knob like structures called F_1 particles. These are involved in ATP formation.
- Mitochondrial matrix contains enzymes, coenzymes and organic and inorganic salts. Mitochondria also contain DNA and ribosomes.
- Mitochondrial matrix helps in metabolic processes like Kerb's cycle, aerobic respiration and fatty acid metabolism etc. Their main function is to make ATP via the process of aerobic respiration. ATP diffuses into the cell and provides instant chemical energy.
- Mitochondria have a double membrane; the outer membrane is smooth while the inner one is folded. This arrangement gives as large internal surface area on which the complex reactions of aerobic respiration can take place.
- Mitochondrion is a self-replicating organelle.

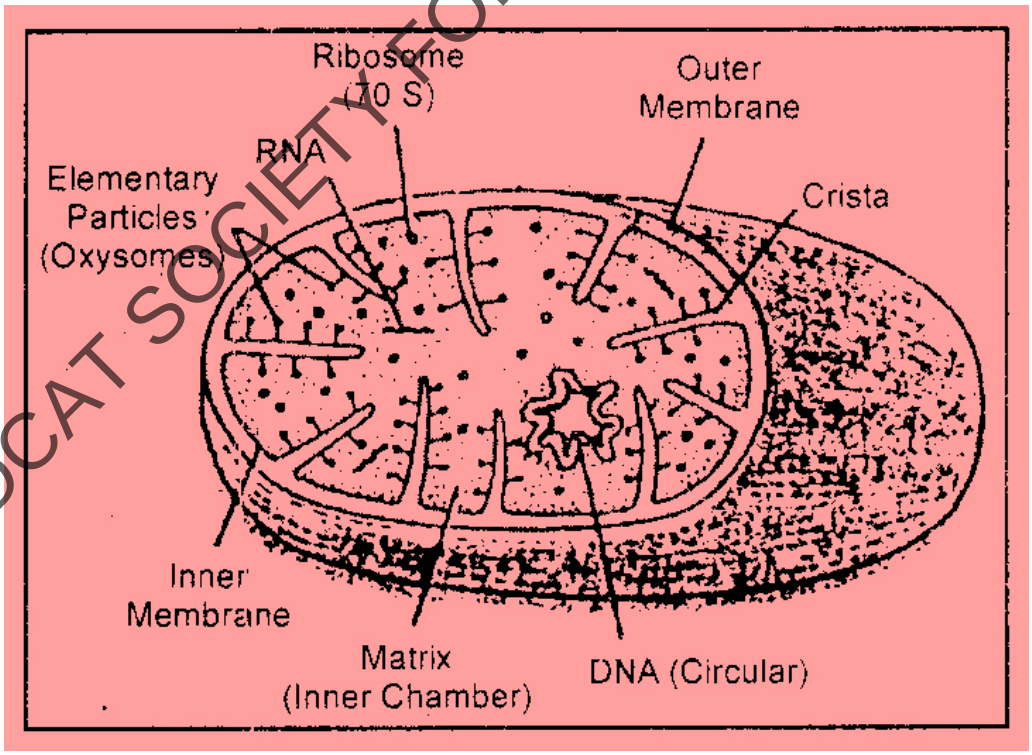

Fig. Structure of a Mitochondrion

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CENTRIOLES

- Centrioles are present in animal cells, some microorganisms and lower plants. They are absent in higher plants.
- Centrioles are short bundles of filaments, set at right angles to each other. They are found in a clear area of cytoplasm known as the centrosome.
- In a cross section, each centriole consists of a cylindrical array of 9 microtubules,each microtubule has 3 tubules. The tubules are composed of special protein caned tubulin. The chemical composition and structure is similar to that of cilia and flagella.
- Their function is the formation of spindle (that guides the chromosomes during cell division). In addition to spindle formation, the centrioles act as the centre of formation for the whole cytoskeleton and they are known as microtubule organizing centres.

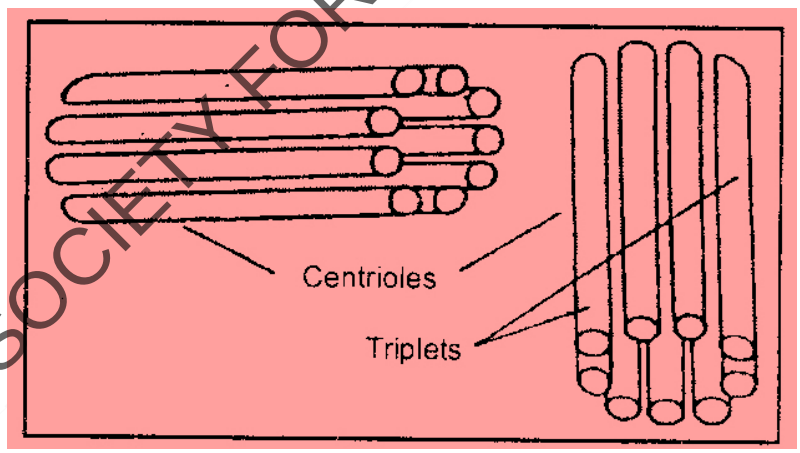

Fig. A pair of centrioles (Diplosome)

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ADDITIONAL / RELATED READINGS

1. A cell is the structural and functional unit of life.

2. Discovery of cell is linked with the invention of microscope because most of the cells are microscopic.

3. Robert Hooke discovered the cell in 1665 under his self-made compound microscope. According to Hooke, cell is an empty space surrounded by thick walls. He published his work in Micrographia in 1665.

4. Lorenz Oken in 1805 (a German scientist) said "all living beings originate from or consist of vesicles or cells".

5. Jean Baptist de-Lamarck (1809) said "nobody can have life if it is not formed by cellular tissue."

6. Robert Brown said that nucleus is present in the cell and the cell is not an empty space. He discovered the nucleus in the cells of orchids.

7. A German zoologist Theodor Schwann (1839) and a German botanist Schleiden (1838) worked independently on the cell. They found that a cell has 3 parts:

   (a) Nucleus

   (b) Cytoplasm (fluid surrounding the nucleus) and

   (c) Plasma membrane (outer thin membrane).

8. Cell theory is: "All living organisms are composed of cells and cell products".

9. The main features of Cell Theory in its present form are:

   (a) All organisms are composed of one or more cells.

   (b) All cells arise from pre-existing cells.

   (c) Cell is the basic structural and functional unit for all organisms.

10. A German physician Rudolph Virchow (1855) said "omniscellula e cellula" (new cells formed by the division of existing living cells). It was opposite to the idea of Abiogenesis

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11. Louis Pasteur (1862) said that bacteria are formed from existing bacteria.

12. August Weismann (1880) said that all living cells have a common origin because they have basic similarity in structure and composition.

13. The human naked eye can differentiate between two points, which are 1.0 mm apart. This is known as r e solution of the eye. This resolution can be increased by lenses.

14. In a compound microscope the resolution is 2.0 µm. It is 500 X that of naked eye.

15. A compound microscope has different magnification powers. The ocular lenses may he 5 X and 10 X while objective lenses may be 20 X, 40 X, 100 X etc.

16. The magnification power of microscope is determined by multiplying X values of ocular lens and X value of objective lens. For example: A microscope with 10 X ocular lens and 40 X objective lens will have 10 X 40 = 400 X magnifying power.

17. The source of illumination in compound microscopes is visible light. In electron microscope the source of illumination is a beam of electrons.

18. The resolution of electron microscope is 2 – 4 Angstrom. It is 500 X greater than that of the compound microscope and 250,000 X greater than that of the naked eye.

19. In multi-cellular organisms there is a division of labour. Examples from animals are:

    (a) Muscle cells contract and relax

    (b) Nerve cells transmit impulses

    (c) Gland cells secrete

    (d) Red blood cells carry oxygen

    (e) Some stomach cells secrete gastric juice

    (1) White blood cells (WBC) produce antibodies.

    (g) Eye cells detect and respond to light. Examples from animals are:

        (i) Xylem cells conduct water and mineral salts from soil to the aerial parts of the plant

        (ii) Phloem cells translocate food

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(iii) Sclerenchymatous cells give support to the plants

(iv) Chlorenchymatous cells carry out photosynthesis

(v) Parenchymatous. cells store surplus food and

(vi) Meristernatie cells produce new cells for growth and development of the plant

20. Due to different functions the cells have different shapes and sizes.

21. The function of an organism is due to activities and interactions of different cells and cell components.

22. To study cell parts, modern techniques are used. Most modern technique is cell fractionation.

23. The process of grinding to get a uniform composition/structure is called homogenization.

24. The tissues are taken and are homogenized by special instruments (like homogenizers).

25. The process of separation of different parts of the cell into different layers (on the basis of their size and weight and density of the medium) in the centrifuge tube using a centrifuge machine at medium speed is called density gradient centrifugation.

26. The process of separation of different parts of the cell into different layers (on the basis of their size and weight and density of the medium) in the centrifuge tube using a centrifuge machine at high speed is called density gradient ultracentrifugation.

27. Cell size is measured in micrometer (µm). One µm is 0.000,001 meter or 1×10^{-6} of a metre.

28. Ostrich's egg is the biggest egg

29. In most plant cells, cell membrane is surrounded by cell wall.

30. The electron microscope has shown that the cell wall is formed by three main layers:

(a) Middle lamella

(b) Primary cell wall

(c) Secondary cell wall

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31. First of all Middle Lamella is formed between the primary wall s of the neighboring cells. It is not the true wall and is composed of pectin or calcium pectate.

32. Primary wall is a true wall and develops in newly growing cells. It is mainly made up of cellulose with some deposition of pectin and hemicellulose.

33. In the primary cell wall the cellulose fibres are arranged in a criss-cross manner which give strength to the cell wall.

34. Secondary cell wall is formed on Inner surface of primary wall. It is thick and rigid than primary wall. Chemically it is composed of inorganic salts, silica, wax, cutin and lignin etc.

35. Cell wall protects the cell from osmoticlysis.

36. The polysaccharides in bacterial cell wall and cellulose in plant cell wall are carbohydrates.

37. The living content of the cell is called protoplasm.

38. The protoplasm of a eukaryotic cell is divided into nucleus and cytoplasm.

39. The material present in between the plasma membrane and the nuclear membrane is called cytoplasm.

40. Cytoplasm is formed by an aqueous ground substance which contains:

- Many cell organelles
- Insoluble wastes and storage products (called inclusions)
- Cytosol (the soluble part of cytoplasm is called cytosol)

41. Cytosol is 90 % water and 10 inorganic and organic molecules.

42. Cytosol has true solutions and colloidal solutions. The colloidal solution may be sol or gel. Sol is non-viscous and gel is viscous.

43. The peripheral part of the cell is like a gel.

44. The free floating cell organelles (e.g. Mitochondria) move in the cytoplasm due to cytoplasmic streaming movements and is called active mass movement of cytoplasm.

45. De Duve in 1949 isolated lysosomes. They are found in most eukaryotic cells

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46. Lysosomes are rich in acid phosphatases and several other hydrolytic enzymes.

47. Lysosomes are involved in:

- autophogy/self-eating (Autophagosomes)
- phagocytosis
- extra-cellular digestion and
- autolysis

48. The autophagosomes working on digestive vacuoles are also known as secondary lysosomes.

49. Autophagy helps in converting a tadpole larva into an adult amphibian.

50. If an enzyme that breaks glycogen to glucose is absent from Lysosomes, the result is a disease Glycogenosis type II.

51. TAY-SACH'S disease is due to the absence of an enzyme that is involved in the catabolism of lipids. Accumulation of lipids in brain cells leads to mental retardation and even death.

52. De-Duve and coworkers isolated peroxisomes in 1965 from liver cells and other tissues. These are single membrane organelles (0.5 µm in diameter).

53. Peroxisomes have oxidative enzymes such as peroxidase, castalase and glycolic acid oxidase etc.

54. Peroxisomes contain H_2O_2 producing oxidases and catalase.

55. In lipid-rich seeds (e.g. castor, bean and soybeans etc.), glyoxysomes are abundant during germination period. In lipid poor seeds (e.g. pea), they are absent.

56. Two important enzymes in glyoxysomes are glycolic acid oxidase and catalase.

57. In plant seedlings, Glyoxisomes convert stored fatty acids to carbohydrates and provide energy to grow a new plant. This process occurs through glyoxylate cycle. Enzymes of this cycle are present in the glyoxisomes.

58. In seeds rich in lipids (such are castor and beans) glyoxysomes break fatty acids to succinate.

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59. Central vacuole is formed by combining the smaller vacuoles during the growth and development of plant.

60. Vacuoles are bounded by a single membrane (tonoplast)

61. The cytosol contains cytoskeletal fabric formed of microtubules, microfilaments and intermediate filaments. This is Cytoskeleton.

62. The main protein in cytoskeleton are tubulin (iin microtubules) actin, mysosin, tropomysin and other which are alos found in the muscels.

63. Microtubules are long, unbranched and slender structures, they are composed of tubulin proteins.

64. The microtubules arejoined in a specific way to form some cell organelles. For examples cilia, flagella, basal bodies and centrioles etc.

65. Microfilaments are much more slenders. They are made up of contractile actin protein linked to the inner face of the plasma membrane.

66. Microfilaments are involved In internal cell motion also called cyclosis.

67. Amoeboid movements are because of micro filaments.

68. Intermediate filaments play a role in maintaining the cell shape and are also involved in the linkage of the cell parts.

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MICROTUBULES		MICROFILAMENT	
(i)	They are non-contractile.	(i)	They are contractile.
(ii)	A micro tubule contains 13 proto filaments.	(ii)	They do not possess longitudinal subunits.
(iii)	They are hollow tubules.	(iii)	They are solid structures.
(iv)	They are formed of α and β tubulin proteins.	(iv)	They are mainly made up of protein actin.
(v)	The diameter is 25 nm.	(v)	The diameter is 6 nm.
(vi)	They occur in centrioles, basal bodies, cilia. flagella, astral rays, spindle fibres etc.	(vi)	They occur below cell membrane and at the interphase of plasmagel-plasmasol.

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(i)	The number of cilia per cell is usually very large (300 – 1400)	(i)	The number of flagella per cell is usually 1 – 4
(ii)	They are smaller in size.	(ii)	They are larger (100-200 nm in length)
(iii)	Cilia are present all over the surface of the cell.	(iii)	Flagella are present only at end of the cell.
(iv)	They beat in a coordinated rhythm either simultaneously or one after the other.	(iv)	The Flagella beat independently.
(v)	They help in locomotion, aeration, feeding and circulation, etc.	(v)	They help in locomotion.

69. Plastids are membrane bounded, mostly pigment containing bodies present in the plant cells.

70. Chloroplasts are membrane bound structures (containing a green pigment) ill photosynthetic plant cells.

71. Chloroplasts vary in their shape and size with a diameter of about 4-6 μm.

72. The electron microscope shows that a chloroplast has three parts, the envelope, the stroma and the thylakoid.

73. Light reactions in thylakoids/Grana and Dark reactions in the Stroma.

74. About 50 or more thylakoids form one granum.

75. Chlorophyll molecules are arranged on the layers of thylakoids. Therefore the grana look green.

76. Chlorophyll molecule resembles the haem group of haemoglobin. The main difference between these two molecules is that chlorophyll has Mg^{++} while haem has Fe^{++} as the central atom.

77. Chromoplasts help in pollination and dispersal of seeds.

78. Leucoplasts are triangular, tubular or of some other shape. They are found in the underground parts of the plant and store the food.

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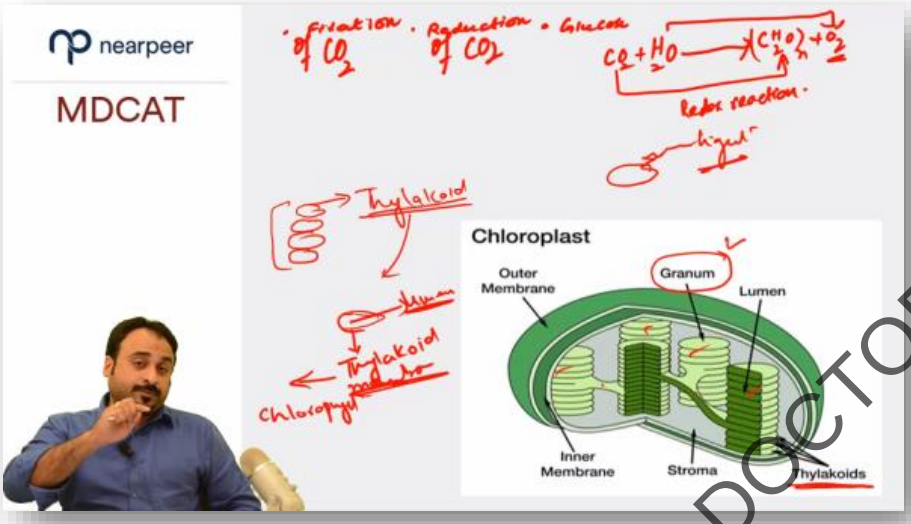

Watch **Module 2** of Bio and understand all of these topics in detail, along ith practice questions at **www.nearpeer.org**

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QUESTIONS FOR PRACTICE

1 Which of the following molecules move regularly from the nucleus to the cytoplasm?

(a) glycogen (b) RNA

(c) DNA (d) both RNA and DNA

2. Unless the cell is dividing, the DNA and Proteins are greatly elongated and appear a clump of stained material called:

(a) Nucleolus (b) chromosome

(c) chromatid (d) chromatin

3. Metabolism in the cell is safe due to:

(a) nucleus (b) DNA

(c) Compartmentalization (d) RNA and ATP

4. Which breaks complex macromolecules (e.g Polysaccharides and proteins etc.)?

(a) lysosome (b) Golgi complex

(c) RER (d) mitochondrion

5. The process involve in self-break down of a cell is called:

(a) autolysis (b) autophygy

(c) exocytosis (d) phagocytosis

6. The bacteria are:

(a) haploid (b) triploid

(c) diploid (d) polyploidy

7. Proteins are glycosilated in:

(a) RER (b) Golgi apparatus / Golgi complex

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(c) Ribosomes (d) SER

8. The stacked membranes in the chloroplast are called:

(a) thyllakoids (b) grana

(c) lamella (d) stroma

9. Proteins that are to be used outside the cell are synthesized:

(a) onRER (b) on SER

(c) in mitochondria (d) on free ribosomes

10. Golgi complex is concerned with cell:

(a) excretion (b) secretion

(c) digestion (d) division

11. Microbodies are:

(a)peroxisomes (b) mitochondria

(c) glyoxysomes (d) both peroxisomes and glyoxysomes

12. The detoxification is an important function of:

(a) RER (b) lysosomes

(c) SER (d) Golgi complex

13. Messenger RNA is formed in:

(a) mitochondria (b) nucleus

(c) lysosome (d) Golgi complex

14. Which of the following is a prokaryotic cell?

(a) virus (b) bacteria

(c) blue green algea (d) both bacteria and Blue green algae

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15. The chemical nature of plasma membrane is:

(a) proteinsonly (b) lipids only

(c) lipoprotein (d) cellulose

16. Cytoskeleton is present in:

(a) allcytoplasm of eukaryotes

(b) all cytoplasm of prokaryotes

(c) some cytoplasm of eukaryotes

(d) all cytoplasm and Nucleoplasm of eukaryotes

17. F_1particles are the site of:

(a) oxidation (b) oxidation and reduction

(c) reduction (d) phosphorylation

18. A small cell has:

(a) smallnucleus (b) large nucleus

(c) low metabolic rate (d) high metabolic rate

19. The nuclearmembrane is composed of:

(a) singleunit membrane (b) double unit membrane

(c) threelayers (d) four layers

20. The nucleolus is largely composed of:

(a) ribonucleoproteins (b) mononucleotides

(d) mononucleosides (d) lipoproteins

21. Microtubules and Microfilaments composed of:

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(a) actin (b) tubulin

(c) actin and tubulin (d) tubulin and actin

22. DNA stands for:

(a) polynucleotides (b) monocucleotides

(c) polynucleotides (d) mononecleotides

23. 9 + 0 arrangement of microtubules is found in:

(a) Cilia (b) flagella

(c) basal body (d) centriole

24. Centrioles are present in:

(a) animal cells (b) some microorganisms

(c) lower plant cells (d) all of these

25. One of the following structures is always in a pair:

(a) centrosomes (b) centrioles

(c) centromere (d) chromosome

26. The process by which a cell secretes macromolecules by fusing a transport vesicle to the plasma membrane is called:

(a) pinocytosis (b) phagocytosis

(c) exocytosis (d) endocytosis

27. Which is the correct pair?

(a) DNA replication – ribosome (c) anaerobic replication –cristae

(d) proteinsynthesis –SER (d) suicidal bags –lysosomes

28. All the biological membranes have fluid nature because of the continuous motion of:

(a) membraneproteins (b) glycoproteins

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(c) phospholipids (d) membrane proteins and phospholipids

29. Mitochondria not found in:

(a) rhizopus (b) ulthrix

(c) green algae (d) hyphomicrobium

30. Plastids not exposed to light are:

(a) chromoplast (b) amyloplast

(c) chloroplast (d) chromatophere

31. Out of these which one is the largest cell?

(a) chlamydomonas (b) yeast

(c) spirogyra (d) acetabularia

32. First person to see the cell in microscope:

(a) Schwann (b) R. Hooke

(c) Schleiden (d) R. Brown

33. Cilia are produced by:

(a) centrioles (b) peroxisomes

(c) dictyosomes (d) Golgi bodies

34. Oil oxidized into:

(a) resins (b) proteins

(c) lipids (d) carbohydrate

35. Translation is by:

(a) mRNA (b) ribosome

(c) tRNA (d) all of these

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36. Function of SER is the synthesis of:

(a) protein (b) lignin

(c) steroid (d) ATP

37. Which membrane is metabolically active?

(a) plant cell (b) animal cell

(c) bacterial (d) plant and animal cell

38. Which one is equal to mitochondrion?

(a) mesosome (b) glycolysis

(c) ETS (d) glycolysis and ETS

39. Chromatophores develop from:

(a) plasmamembrane (b) nuclear membrane

(c) plastids (d) thylakoids

40. 70 S Ribosomes present in:

(a) Prokaryotes t (b) chloroplast

(c) mitochondria (d) nucleolus

41. Which one is contractile?

(a) microtubule (b) all proteins

(c) mitochondria (d) both microtubules and micro filaments

42. Characteristic of living organisms to respond to stimuli is:

(a) responsiveness (b) taxis/reflex

(c) taxis (d) reflex

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43. Subunits of Golgi bodies are:

(a) dictyosomes (b) cisternae from SER

(b) differentkinds of membranes (d) Cisternae from RER

44. Autophagy is:

(a) celldeath

(b) selective digestion of cell part

(c) selfand continuous formation and degeneration

(d) cell division

45. We cannot study living cells in:

(a) electronmicroscope (b) dissecting microscope

(c) compound microscope (d) phase contrast microscope

46. The smallest cell is:

(a) PPLO (b) acetabularia

(c) nerve cell (d) egg of hen

47. Word cell is:

(a) Greek (b) English

(c) Latin (d) German

48. Process of isolation of cell components including cell organelles is:

(a) centrifugation (b) cell fractionation

(c) homogenization (d) centrifugation and Ultracentrifugation

49. Number of chromosomes in E. coli:

(a) 1 (b) 2

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(c) 3 (d) 4

50. Yeast cell wall contains:

(a) chitin (b) cellulose

(c) phospholiopid (d) peptidoglycan

51. Enzyme synthesis in a cell is controlled by:

(a) nucleargenes (b) ribosomes

(c) mRNA (d) tRNA

52. Dictyosomes present in:

(a) humanliver (b) human kidney

(c) bacteria (d) plant cell

53. Kitchen of the cell is:

(a) mitochondria (b) chloroplast

(c) RER and SER (d) nucleus

54. Protein factory is:

(a) ribosome (b) cytoplasm

(c) mRNA (d) RER and Golgi complex

55. ATP is produced during:

(a) photosynthesis (b) Kerb's cycle

(c) glycolysis (d) all of these

56. The three-dimensional web link structure that fills the cytoplasm of a cell, and within which Organellers are suspended:

(a) cytoskeleton (b) nucleoplasm

(c) endoplasmic reticulum (d) chromosome

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57. ATP is not produced during:

(a) photosynthesis (b) Kerb's cycle

(c) glycolysis (d) anabolism

58. A semi-fluid mix of ribosomes, DNA, and enzyme which surrounds the cristae inside mitochondria:

(a) matrix (b) nucleoplasm

(c) cytoplasm (d) protoplasm

59. What will happen if a chromosome loses its centromere?

(a) it will become a functionless degenerated chromosome

(b) it will become a functional chromosome

(c) it will become centriole

(d) it will become a centrosome

60. Culture from a single cell is called:

(a) cell line (b) germ line

(c) cell culture (d) tissue sulture

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UNIT NO. 1 (THE CELL)

1	**B**	**2**	**D**	**3**	**C**	**4**	**A**	**5**	**A**	**6**	**A**	7	**B**	**8**	**A**	**9**	**A**	**10**	**B**
11	D	**12.**	C	**13**	B	**14**	D	**15**	C	**16**	**A**	17	D	18	D	19	B	20	A
21	A	**22**	D	**23**	D	**24**	D	**25**	B	**26**	**C**	27	D	28	C	29	D	30	B
31	D	**32**	B	**33**	A	**34.**	D	**35**	D	**36**	**C**	37	C	38	C	39	C	40	A
41	D	**42**	A	**43**	B	**44**	B	**45**	A	**46**	**A**	47	B	48	B	49	A	50	A
51	A	**52**	D	**53**	A	**54**	A	**55**	D	**56.**	**A**	57	D	58	A	59	A	60	C

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CELL CYCLE

- The cell undergoes a sequence of changes, which involve period of growth, replication of DNA, followed by cell division. This sequence of changes is called cell cycle. It consists of two phases which are interphase and mitotic phase.
- The period of life cycle of cell (cell cycle) between two consecutive divisions is termed as the interphase or misleadingly called resting phase. It is the period of great biochemical activity and can further be divided into G_1-phase, S-phase and G_2-phase.
- G_2 (Gap 1) is the period of extensive metabolic activity, in which cell normally grows in size, specific enzymes are synthesized and DNA base units are accumulated for the DNA synthesis.
- G_0 Phase: Post-mitotic cell can exit the cell cycle during G_1 entering a phase called C_0 and remain for days, weeks, or in some cases (e.g. nerve cells and cells of the eye lens) even for the life time of the organism without proliferating further.
- In the case of human cell, average cell cycle is about 24 hours. Mitosis takes 30 minutes, G_1 9 hours, the S-phase 10 hours and G_2 4.5 hours.
- Cell cycle in yeast cells is only 90 minutes.

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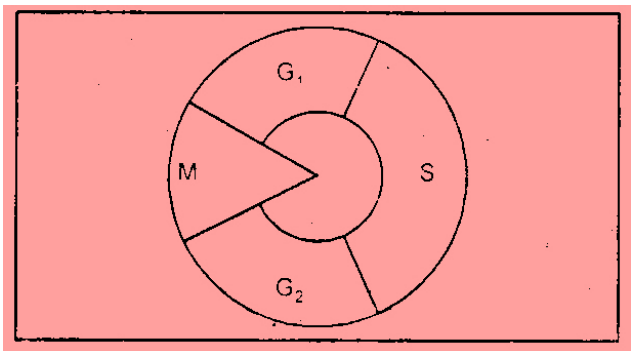

Fig. The Eukaryotic cell cycle

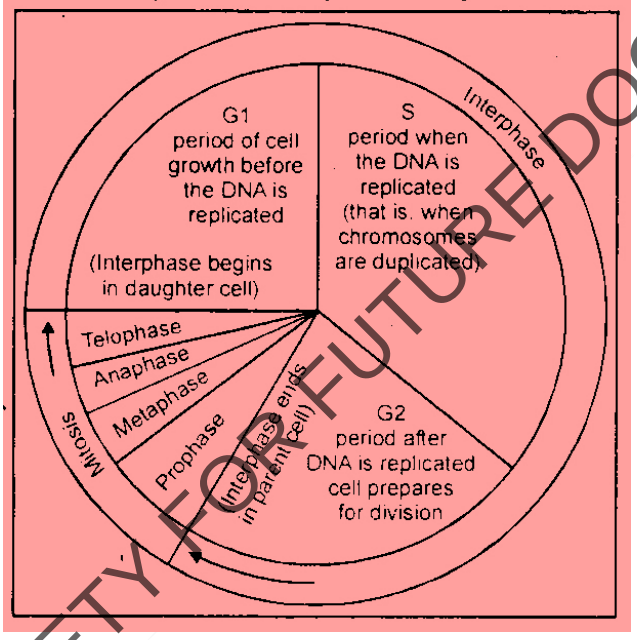

Fig. The Eukaryotic cell in detail

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MITOSIS

- It is the type of cell division, which ensures the same number of chromosomes in the daughter cells as that in the parent cells.
- Mitosis is a continuous process, but conventionally it may be divided into two phases which are Karyokinesis and Cytokinesis. Karyokinesis is the division of nucleus while the Cytokinesis is the division of the whole cell.

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KARYOKINESIS:

- At the beginning of the process in an animal cell, the partition of the centriole takes place.
- Three sets of microtubules (fibers) originate from each pair of centrioles.

  (i) One set the astral microtubules, radiate outward and form aster. Asters are the fibers that extend from the centrioles to the edges of the cell.

  (ii) The other two sets of microtubules form the spindle.

  - The kinetochore microtubules attach to chromosomes at kinetochores. Kinetochore is the Disc-shaped protein structure within the centromere to which the spindle fibres attach during mitosis or meiosis.
  - Polar microtubules do not interact the chromosomes but inter digitate with polar microtubules from the opposite pole. These microtubules are composed of a protein tubulin and traces of RNA.

- (Aster + spindle = mitotic apparatus).
- Function of Mitotic apparatus: capture and attach chromosomes, align them and finally separating them for equal distribution.
- Karyokinesis is divided into prophase, metaphase, anaphase and telophase.
- In PROPHASE the chromosomes become visible having two sister chromatids, attached at centromere. Towards the end of the prophase the nuclear envelope disappears, the nuclear material is released in the cytoplasm the neucleoli disappear. Mitotic apparatus is organized and the Cytoplasm becomes more viscous.
- In METAPHASE the chromosomes align at the equator of the spindle forming equatorial plate or metaphase plate. The array of chromosomes at the equator of spindle is called equatorial plate.
- In ANAPHASE the kinetochore fibers of spindle contract towards their respective poles. As a result there is equal distribution of chromatids.
- TELOPHASE is reverse of prophase. Mitotic apparatus is disorganized while the nuclear membrane and nucleoli are reorganized. As a result two nuclei are formed at two poles of the cell.
- Cytokinesis in animal cells is by cleavage furrow.

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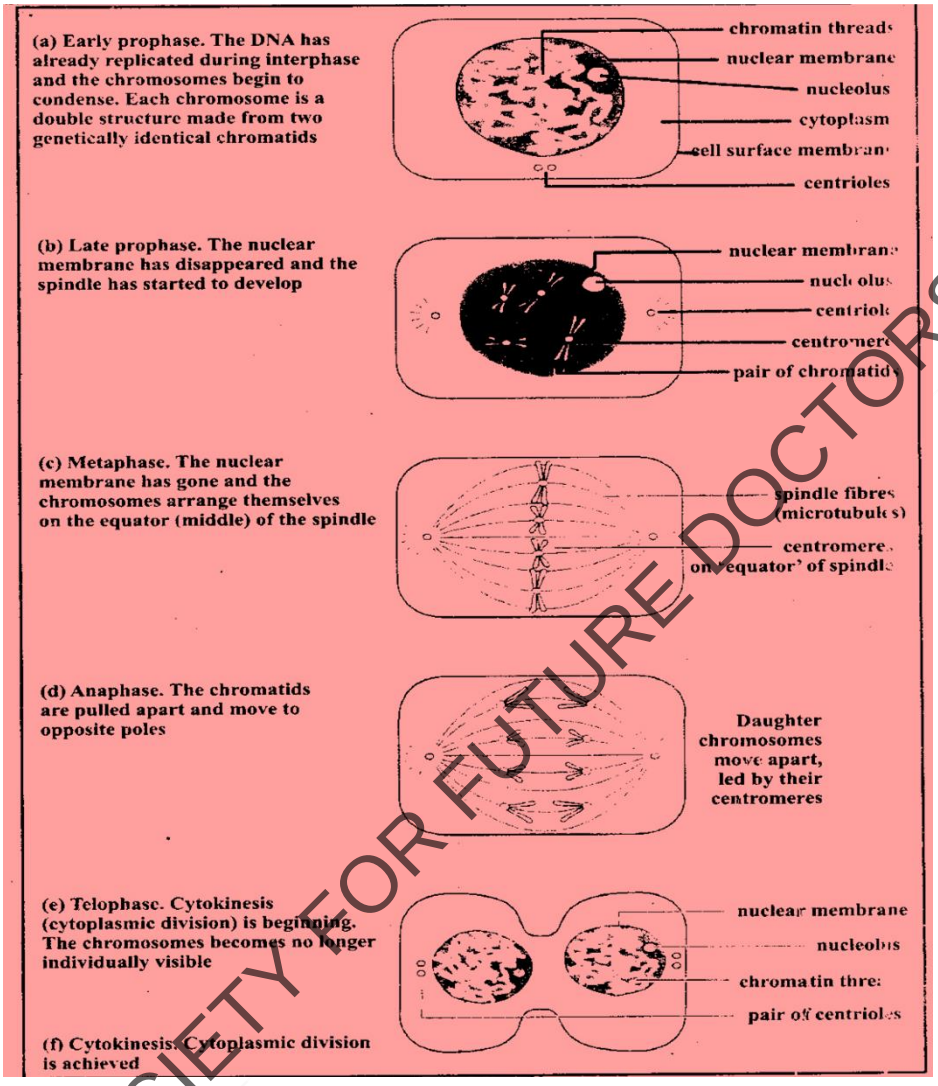

Fig. Mitosis

IMPORTANCE OF MITOSIS

- **No change in the hereditary material:** In mitosis the heredity material is equally distributed in the daughter cells.
- **Asexual Reproduction:** Some organisms both plants and animals undergo asexual reproduction (by mitosis).
- Regeneration: Regeneration is also due mitosis.
- Healing of wounds healing of wounds and replacement of older cells etc. are by mitosis.

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- Development and Growth: Development and growth of multi-cellular organisms depends upon orderly controlled mitosis.
- Tissue Culture and Cloning: Tissue culture and cloning is carried out through mitosis.

TABLE: Differences between Mitosis in Plant and Animal Cells

PLANT		ANIMAL	
(i)	No centrol present	(i)	Centrol present
(ii)	NO asters form	(ii)	Asters are formed
(iii)	Cell division involves formation of a cell plate.	(iii)	Cell division involves furrowing and cleavage of cytoplasm
(iv)	Occurs mainly at meristems	(iv)	Occurs in tissues throughout body

MEIOSIS

- Meiosis is the special type of cell division in which the numbers of chromosomes in daughter cells are reduced to half, as compared to the parent cell.
- Meiosis takes place in diploid cells only:
  - i) I in animals at the time of gamete formation
  - ii) In plants at the time of spore formation
- Each diploid cell after meiosis produces four haploid cells, because it involves two consecutive divisions after single replication of DNA. Two divisions are meiosis I and meiosis II. No G_2 in interphase of Meiosis.

MEIOSIS 1:

- **Prophase I:** It is a long phase. It has following sub-stages.
- **Leptotene:** The chromosomes become visible, shorten and thick. Homologous chromosomes start getting closer to each other.

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- **Zygotene:** Pairing of homologous chromosomes called synapsis starts. Each paired structure is called as bivalent or tetrad.
- **Pachytene:** Non-sister chromatids of homologous chromosomes exchange their segmentsdue to chiasmata formation, during the process called crossing over.
- **Diplotene:** The paired chromosomes repel each other.
- **Diakinesis:** Separation of the homologous chromosomes is completed. Nucleoli disappear.
- **Metaphase I:** Nuclear membrane disorganize Spindle fibers originate and the Homologous chromosomes/Tetrads/Bivalents are arranged at the equator of the spindle.
- **Anaphase I:** Tetads / bivalents are separated into two groups. Sister chromatids are not separated. This is actually reduction phase because each pole receives half of the total number of chromosomes.
- **Telophase I:** Two nuclei each with half number of chromosomes are formed. The cytoplasm also divides and the first meiotic division is completed.
- **Meiosis II:** After telophase I there is small interphase. There is no replication of chromosomes. It is like mitosis. Finally four haploid cells, with half of the number of chromosomes are formed.

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IMPORTANCE OF MEIOSIS

- Crossing Over: During crossing over parental chromosomes exchange segments with each other which results in large number of re-combinations.
- Random Assortment: During anaphase the separation of homologous chromosomes is random, which gives very wide range of variety of gametes.
- Both these phenomenon cause variations and modifications in the genome. Variation is the raw material of evolution. Every individual becomes specific. Even the progeny of same parent, i.e., brothers and sisters are not identical to each other.

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- Meiosis usually takes place at the time of gamete (sexual cells) formation in animals and spore formation in plants. In this way chromosome number is halved (n number). However the 2n number is restored after fertilization. In this way the constant chromosome number is maintained generation after generation.

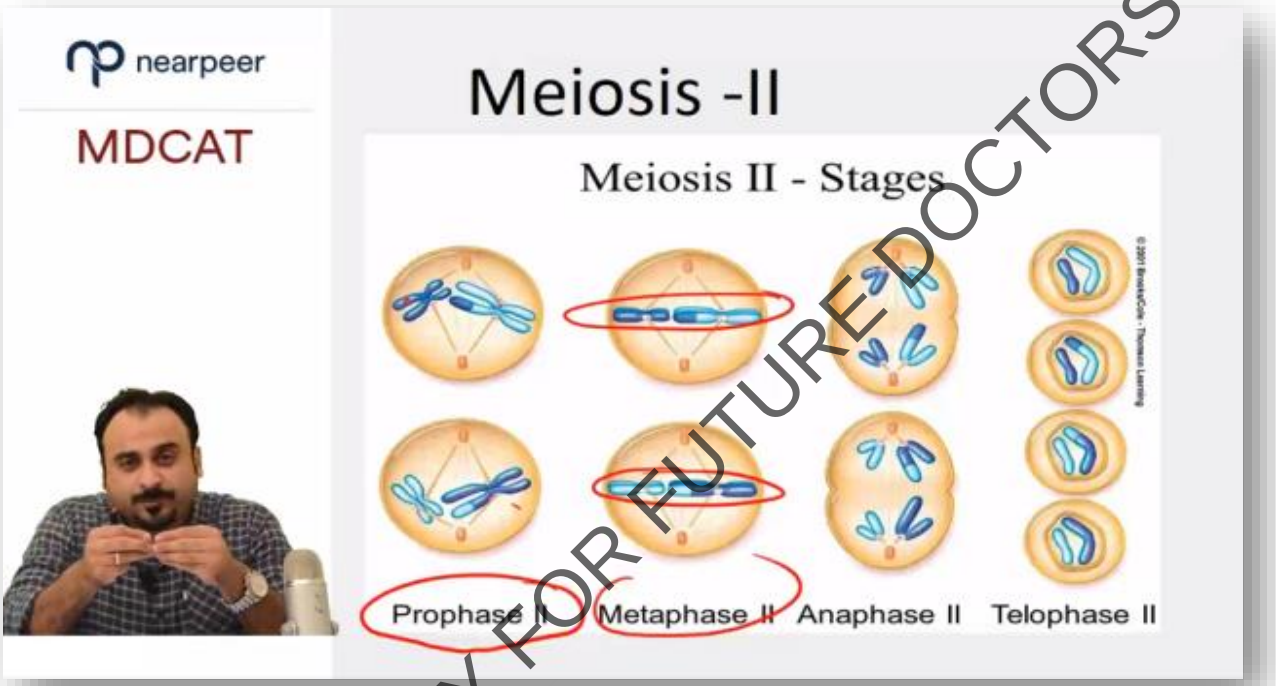

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TABLE: Comparison of Mitosis and Meiosis I

	MITOSIS	MEOSIS I
Prophase	Homologous chromosomes remain separate. No formation of chiasmata. Nop crossing over.	Homologous chromosomes pair up Chiasmata form. Crossing over may occur.
Metaphase	Pair of chromatids line up on the equator of the spindle	Pairs of chromosome lineup the equator.
Anaphase	Chromatids separate. Separating chromatids identical.	Centromeres do not divide. Whole chromosomes separate. Separating chromosome and their chromatids may not be identical due to crossing over.

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Telophase	Same number of chromosomes present in daughter cells as parent cells. Both homologous chromosomes present in daughter cells if diploid.	Half the number of chromosome present in daughter cells. Only one of each pair of homologous chromosomes present in daughter cells.
Occurrence	Mayoccurin haploid, diploidor polyploid cells	Only occur indiploidor polyploidy cells

MEIOTIC ERRORS (NON-DISJUNCTION)

- In chromosomal non-disjunction, the chromosomes fail to segregate during anaphase and telophase and do not finish with equal distribution of chromosome among all the daughter nuclei.
- This results either increase or decrease in the number of chromosomes. This non-disjunction may be in autosome (Down's syndrome) or in sex chromosome Turner's syndrome & Klinefelters syndrome).

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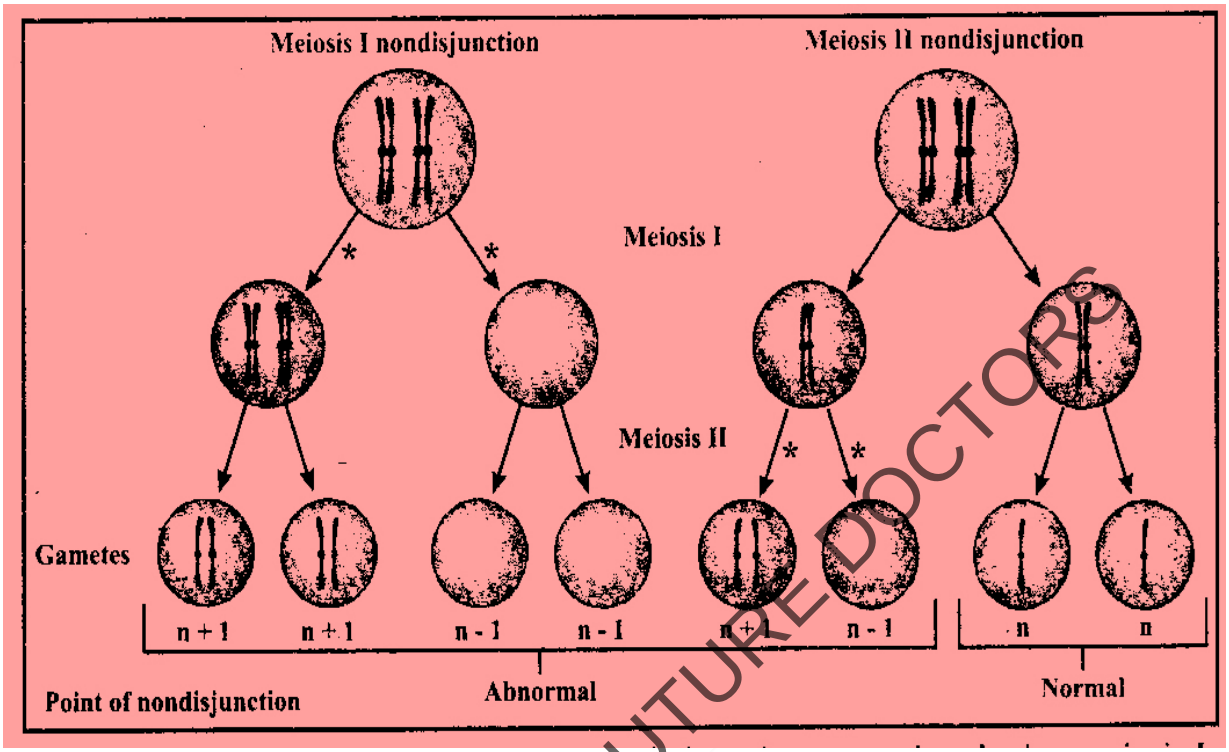

Fig. Non-disjunction of autosomes
(a) Non-disjunction occurring during meiosis I and meiosis II,
with the resulting gametes (asteriks mark points of non-disjunction)

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DOWN'S SYNDROME

Down's syndrome is named after the nineteenth century physician Down. It affects about 1 in 700 babies at birth. It was first shown to be due to an extra chromosome number 21. The presence of three copies of a chromosome is known as trisomy 21.

Symptoms:

Most children with Down's syndrome show typical facial features and some other characters which include:

- The face is typically flat and rounded.
- Eyelids slant upwards du~ to a fold of skin over the inner comer of the eye.

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- Mental retardation often severe.
- Short stature and relatively small skull due to poor skeletal development.
- Heart defects occur in about one-quarter of Down's children.
- Increased risk of infection, particularly respiratory and ear infections.
- Coarse, straight hair.
- Squat hands with a characteristic crease which runs all the way across the palm.
- Intestinal problems and leukaemia are slightly more common than normal.

KLINEFELTER'S SYNDROME

In 1942 an American Dr. Klinefelter identified this syndrome. Typical Symptoms are as follows:

- Infertility sperm are never produced, although ejaculation is possible.
- Usually taller than average.
- Some breast development.
- Smaller testes than normal.
- Higher than usual FSH secretion for males.
- Trunk may show signs of obesity.
- Little facial hair.
- Voice pitched higher than normal.

It is due to an extra X chromosome. The genotype has 47 chromosomes instead of 46.

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Treatment:

The condition is usually diagnosed only after puberty. Male hormones can be given. Breasts then return to normal size and a normal sex life is possible but sterility remains.

TURNER'S SYNDROME

This syndrome was first described by an American, Turner, III 1938. Patients are incompletely developed females. Typical symptoms are:

- Infertility - ovaries are absent
- Shortness of stature, averaging 1.5 m (less than 5 feet)
- Small uterus
- Webbed neck may occur
- Puffy fingers with deep set finger nails

In 1659, Turner's syndrome was shown to be due to a. missing X chromosome. The genotype is therefore XO instead of the normal XX and the sufferer has 45 chromosomes instead of 46.

Treatment:

From the age of puberty women can be given female sex hormones to make them develop breasts and have periods. This does not cure infertility but is done for social reasons to make the person feel more 'normal'. Growth can be stimulated with growth hormone.

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TABLE: Frequency of Syndromes

Syndrome	Sex	Chromosome	Frequency	
Down	M or F	Trisomy 21	1/40	1/700
Patau	M or F	Trisomy 13	1/33	1/15000
Edward	M or F	Trisomy 18	1/200	1/6000
Turner	F	XO	1/18	1/6000

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Metafemale	F	XXX (or XXXX)	0	1/1500
Klinefelter	M	XXY (or XXXY))	0	1/1500
Jacobs	M	XXYY	?	1/1000

CANCER

- Cancers are a result of uncontrolled mitosis.
- There are more than a hundred different forms of cancer.
- Lung cancer is the most common form of cancer in men while breast cancer in women.
- Cancerous cells divide repeatedly, out of control and a tumour develops which is an irregular mass of cells. The cells usually show abnormal Changes in Shape.
- Cancers start when changes occur in the genes that control cell division.
- The particular term for a mutated gene that causes cancer is an oncogene.
- A factor which brings about any mutation is called a mutagen. If this mutagen is cancer causing then it is carcinogen/carcinogenic.
- Some of the factors, which can increase mutation rates are:

a) **Ionizing Radiation:** This includes X-rays, gamma rays and particles from the decay of radioactive elements. They cause the formation of damaging ions inside cells, which can break DNA strands. Ultraviolet light can also damage the genes. Due to depletion of the ozone layer, more ultraviolet light is penetrating to the Earth's surface and could result in an increase in cases of skin cancer.

b) Chemicals: Many different chemicals are carcinogenic (e.g tar of tobacco smoke).All these chemicals Damage DNA molecules.

c) Virus Infection: Some cancers in animals/humans are by viruses.

d) Hereditary tendency: Cancer is more common in some families than others indicating a genetic link. The disease itself is not inherited but the factors that cause the disease are inherited.

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Basic Types of Tumours:

i) **Benign tumours:** These do not spread from their site of origin, but can compress and displace surrounding tissues, for example warts, ovarian cysts and some brain tumours.

ii) **Malignant (cancerous) tumours:** These are far more dangerous since they spread throughout the body invade other tissues and ultimately destroy them. Malignant tumours interfere with the normal functioning of the area where they have started to grow. They may block the intestines, lungs or blood vessels. Cells can break off and spread through the blood and lymphatic system to other parts of the body to form secondary growths. The spread of cancers in this way is called metastasis. It is the most dangerous characteristic of cancers.

Characters of Cancer Cells:

- Cancer cells can be distinguished from normal cells because they are less differentiated than normal cells. Similarly they show the characters of rapidly growing cells, for example high nucleus to cytoplasm ratio prominent nucleoli and many mitosis.
- The presence of invading cells in otherwise normal tissue is an indication of malignancy.

Causes of Cancer:

Cancer is caused mainly by mutations in the somatic cells. The cancer results from the accumulation of as few as three to as many as twenty mutations, in genes that regulate cell division.

These mutations bring two basic changes in the cancer cells.

i) First the metastatic cells break their contact with other cells and overcome the restrictions on cell movement provided by basal lamina and other barriers. Ultimately metastatic cells can invade other parts of the body.

ii) **Secondly:** they proliferate, unlimitedly, without minding the checks or programmes of the body.

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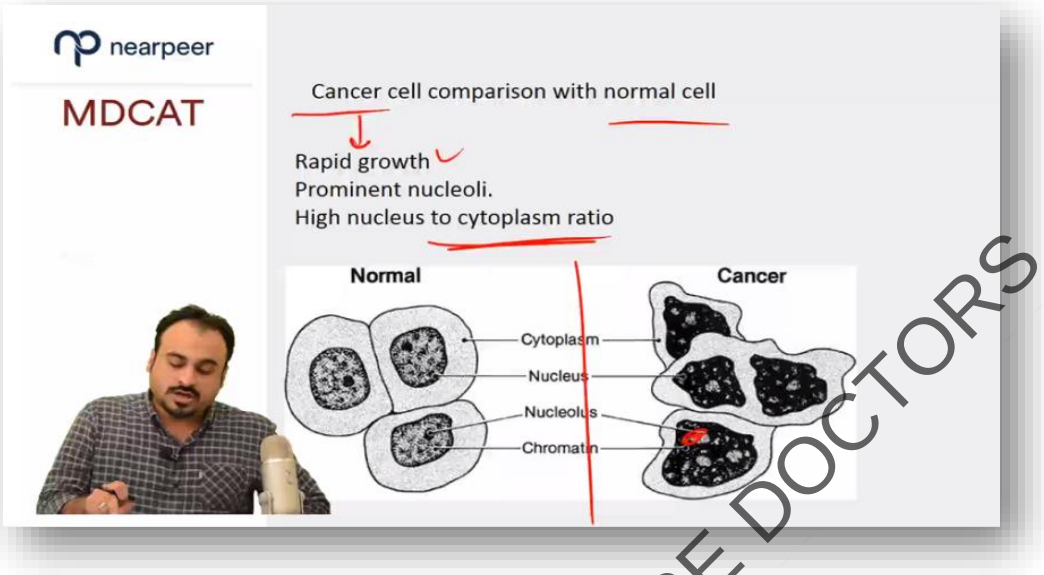

I APOPTOSIS

- Normally the death of the cell is programmed.
- Internal program of events and sequence of morphological changes by which cell commit suicide is collectively called as apoptosis (Greek word that means dropping off or falling off).
- During this the dying cells shrink and condense ultimately split up, thus release small membrane founded apoptotic bodies, which are generally phagocytosed by other cells. Intracellular constituents are not released freely and the surrounding cells are not affected.
- Programmed cell death helps in proper control of multi-cellular development, which may lead to deletion of entire structure (e.g., the tail of developing human embryos) or part of structure (e.g., tissue between developing digits).
- Cell death even controls the number of neurons, because most of the neurons in the human body die during development.

Cell death in multi-cellular organisms is controlled by two different ways:

i) The cell commit suicide in the absence of survival signals (trophic factors).

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ii) The cells are murdered by killing signals from other cells.

NECROSIS

- The cell death due to tissue damage is called necrosis.
- During necrosis the typical cell swells and bursts, releasing the intra, -cliular contents, which can damage neighboring cells and cause inflammation.

Watch video **1.14 Cancer** at **www.nearpeer.org** and understand the important aspects of this topic through video lecture.

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QUESTIONS FOR PRACTISE

1. Prophase is followed by:

(a) metaphase (b) anaphase

(c) interphase (d) telophase

2. Telophase is the reverse of:

(a) metaphase (b) anaphase

(c) interphase (d) prophase

3. Division of the cytoplasm is called:

(a) karyokinesis (b) cytokinesis

(c) diakinesis (d) cytoplasmokinesis

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4. Meiosis is a special type of cell division in which diploid number (2n) of chromosomes:

(a) reduced to half (b) reduced to quarter

(c) remains same (d) becomes tetraploid

5. In animals meiosis takes place during the formation of:

(a) spores (b) sperms only

(c) gametes (d) eggs only

6. Exchange of segments between homologous chromosomes is called:

(a) move over (b) crossing over

(c) non-linkage (d) changing over

7. The sub-stage of prophase which can last for months or years is:

(a) zygotene (b) pachytene

(c) diplotene (d) diakinesis

8. In mitosis, the mitotic apparatus is formed during:

(a) telophase (b) prophase

(c) metaphase (d) anaphase

9. Term applied to the asters that surround the centrioles together with mitotic spindles is:

(a) mitotic apparatus (b) meiotic apparatus

(c) Golgi apparatus (d) cellular apparatus

10. Spindles are composed of mainlya protein called:

(a) fibrin (b) insulin

(c) tubulin (d) globulin

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11. In addition to tubulin protein, spindles also have traces of:

(a) DNA (b) NAD

(c) RNA (d) ATP

12. Condensation of euchromation during cell division facilitates:

(a) DNA replication (b) movement of chromosomes

(c) crossing over between chromatids (d) all of them

13. Synapsis starts in:

(a) leptotene (b) zygotene

(c) pachytene (d) diplotene

14. Which syndrome appears only in males?

(a) Down (b) Patau

(c) Edward (d) Jacobs

15. Kinetochore is special area of:

(a) centromere (b) centriole

(c) DNA (d) centrosome

16. Mitosis may occur in:

(a) only haploid cells (b) haploid or diploid cells

(c) only diploid cells (d) in all kind of cells every time

17. What happens first with the cancer cell?

(a) its detachment from basal lamina (b) slow cell division

(c) controlled cell division (d) benign formation

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18. The period of life cycle of a cell between two-consecutive divisions is termed as:

(a) G_1 phase (b) S-phase

(c) G_2 phase (d) interphase

19. Inan average cell cycle of human M-phase takes about:

(a) 9 hours (b) 4.5 hours

(c) 10 hours (d) 30 minutes

20. At cytokinesis in a plant cell, a membranous structure is formed from vesicles derived from the Golgi complex, known as the:

(a) nucieoplast (b) phragmoplast

(c) chloroplast (d) cytoplast

21. The stage of mitosis at which chromatids separate as independent structures (chromosomes) is the:

(a) prophase (b) anaphase

(c) metaphase (d) telophase

22. The phase of meiosis during which the non-sister chromatids of homologous chromosomes exchange their segments:

(a) leptotene (b) diplotene

(c) pachytene (d) zygotene

23. The phase of meiosis during which nucleoli disappear in the cell is called:

(a) diplotene (b) diakinesis

(c) pachytene (d) leptotene

24. Down's syndrome in human beings is due to:

(a) an extra sex chromosome (b) a missing chromosome

(c) an extra autosome (d) a missing autosome

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25. Umers syndrome is due to:

(a) an extra 'x' chromosome (b) an extra autosome

(c) a missing 'x: chromosome (d) a missing autosome

26. The formation of chiasmata is an important feature of meiotic divisions because it:

(a) ensures that the same genetic characteristics appear in daughter cell as in the parents.

(b) ensures that the number of genes in the new chromosomes remains constant.

(c) provides opportunities for new genotypes to arise.

(d) allows attachment of the chromatids to the spindle fibres

27. The absence of centrioles from higher plant cells means that during somatic cell division there is:

(a) no apparent organizer of mitotic spindles

(b) no equatorial arrangement of chromosomes at metaphase.

(c) no new cell wall laid down at telophase.

(d) no true mitosis but an amitotic division.

28. In prophase of mitosis, which one of the following events occurs in animal cell but not in plant cells?

(a) centrioles migrate to opposite sides of the nucleus

(b) chromosomes become invisible due to condensation

(c) the nuclear envelope (membrane) breaks down

(d) nucleoli in the nucleus disappear

29. The amount of DNA in a mammalian cell in early prophase of mitosis is 2x. What is the amount of DNA in the daughter cell?

(a) x/4 (b) x

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(c) x/2 (d) 2x

30. When is the DNA contents of a cell becomes double:

(a) G_2 phase (b) G_1 phase

(c) M-phase (d) S-phase

31. Bivalent or tetrad formation takes place in:

(a) leptotene (b) zygotene

(c) pachytene (d) diplotene

32. During which phase in somatic cell division does replication of the chromosomes take place?

(a) interphase (b) middle prophase

(b) early prophase (d) late prophase

33. During which stage of meiosis do homologous chromosomes separate?

(a) prophase I (b) prophase II

(b) anaphase I (d) anaphase II

34. When identical twins marry identical twins, the children of both couples are genetically:

(a) different because of random segregation during parental meiosis

(b) different because of the high probability of random mutation

(c) identical because of a low probability of mutation

(d) 100 % identical children in both couples

35. At prophase of mitosis, a eukaryotic chromosome consists of two chromatids. What is the structure of a single chromatid?

(a) one molecule of single-stranded DNA coiled around protein molecules

(b) two molecules of single-stranded DNA each coiled around protein molecules

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(c) one double helix of DNA coiled around protein molecules

(d) two double helixes of DNA each coiled around protein molecules

36. Cancer cell can be distinguished from normal cell because they:

(a) are well differentiated than normal cells

(b) have high cytoplasm to nucleus ratio and prominent cellular organelles

(c) exhibit the characteristics of rapidly growing cells

(d) all of them

37. Which one is related with apoptosis?

(a) death of cell due to intracellular contents releasing from surrounding cells

(b) death of cell due to tissue damage

(c) death of cell due to external signals/absence of survival signals

(d) autophagy due to autophagosomes

38. A person with 44 + xyy combination of chromosome is the case of:

(a) down's syndrome (b) metafemale

(c) Jacob's syndrome (d) Down's syndrome

39. No visible centriole in:

(a) most higher plants (b) some higher plants

(c) most lower plants (d) some lower plants

40. Before the start of meiosis ii, there is:

(a) small interphase

(b) large interphase

(c) no interphase

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(d) ometimes interphase occur with replication

UNIT NO. 1 (THE CYCLE)

1	**A**	**2**	**D**	**3**	**B**	**4**	**A**	**5**	**C**	**6**	**B**	7	**B**	8	**B**	9	**A**	**10**	**C**
11	C	**12.**	B	**13**	B	**14**	D	**15**	A	**16**	**B**	17	A	18	D	19	D	20	B
21	B	**22**	C	**23**	B	**24**	C	**25**	C	**26**	**C**	27	A	28	A	29	B	30	D
31	B	**32**	A	**33**	B	**34.**	A	**35**	D	**36**	**C**	37	C	38	B	39	A	40	A

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BIOLOGICAL MOLECULES

MAJOR CONTENTS

Content:

- → Carbohydrate
- → Proteins
- → Lipids
- → Nucleic Acids
- → Deoxyribonucleic Acid. (DNA)
- → Ribonucleic Acid (RNA)
- → Enzymes
- → Additional/Related Readings

Learning Outcomes:

(a) Discuss carbohydrates: Monosaccharides (Glucose), Oligosaccharides (Cane sugar, sucrose), Polysaccharides (Starches).
(b) Describe Proteins: Amino acids, Primary, Secondary, Tertiary and Quaternary structure of proteins.
(c) Describe Lipids: Acylglyceroles, waxes, Phospholipids, Terpenoids.
(d) Describe the structure along its back bone composition and function of DNA as hereditary material, Replication of DNA (Semi-conservative), Role of triplet codons, transcription (making up of mRNA), Translation (protein synthesis: role of ribosomes, mRNA, tRNA).
(e) Give the structure and types of RNA (mRNA, rRNA, tRNA).
(f) What is enzyme and its role in reducing activation energy?
(g) Define the following terms:
Enzymes, Coenzyme, Co-factor, Prosthetic group, Apoenzyme and Holoenzyme
(h) Explain the mode I mechanism of enzyme action.
(i) Describe the effects of temperature, pH, enzyme concentration and substrate concentration on the rate of enzyme catalyzed reaction.
(j) Explain the effects of reversible and irreversible, competitive and non-competitive inhibitors on the rate of enzyme activity.

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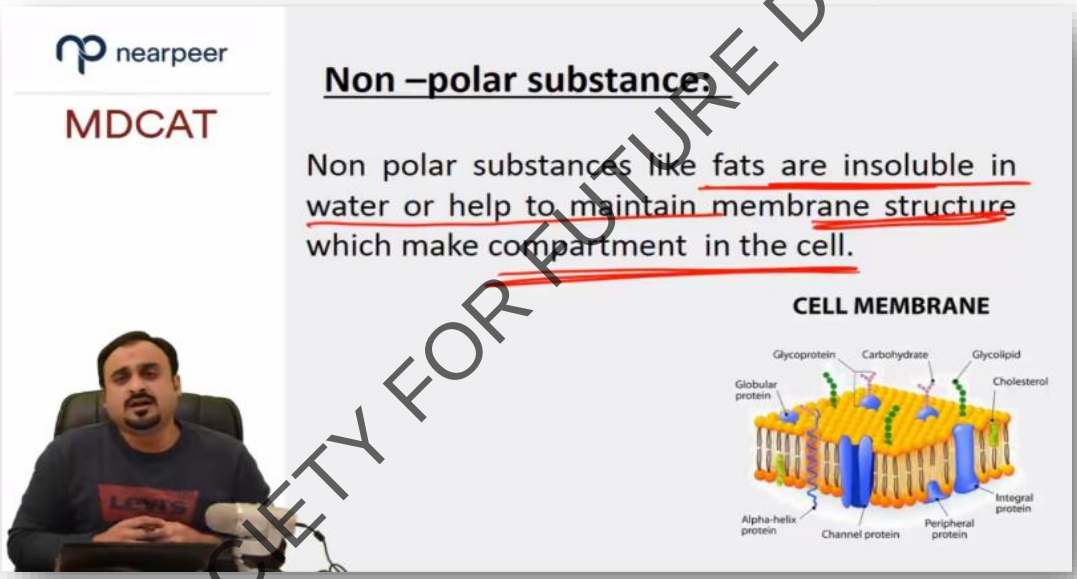
BIOCHEMISTRY

- Biochemistry is a branch of biology which deals with the study of chemical components and the chemical processes in living organisms.
- All living organisms are made of organic and inorganic compounds.
- Inorganic substances in living organisms are water, carbon dioxide, acids, bases, and salts etc.



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CHEMICAL COMPOSITION		% Total Cell Weight	
		Bacterial Cell (prokaryote)	**Mammalian Cell (Eukaryote)**
(i)	Water	70	70
(ii)	Proteins	15	18
(iii)	Carbohydrate	3	4
(iv)	Lipids	2	3
(v)	DNA	1	0.25
(vi)	RNA	6	1.1
(vii)	Other organic molecules (enzymes, hormones, metabolism)	2	2
(viii)	Inorganic ions ($Na^{+,}$ K^{+}, Ca^{++}, Mg^{++}, Cl^{-}, SO etc.)	1	1

SOME BASICS OF BIOCHEMISTRY:

- Living organisms contain macromolecules formed from a small number of simple molecules.
- These simple molecules suggest that all life had a common origin.
- The characteristics of an organism are determined by the information contained in its DN.
- The DNA contains information that the cell can use to make proteins. Many proteins are enzymes, which control the physical and chemical activities of an organism.
- The chemical activities that go on inside an organism can organism can be given the general term metabolism.
- Metabolic reactions can be divided into two general categories: anabolic and catabolic. Anabolic reactions build up large molecules from smaller ones. While: catabolic reactions do the reverse, breaking down larger molecules.
- Anabolic reactions usually involve condensation reactions ill which building-block molecules are joined together and a water molecule is released.

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- Catabolic reactions, Such as those that occur during digestion, usually involve hydrolysis reactions in which larger molecules are split as they react with water.
- In photosynthesis, plants use the energy from sunlight to build up organic molecules such as sugars from simple ones such as carbon dioxide and water.
- All organisms need a supply of energy, which they obtain via respiration. In respiration organic molecules are oxidized into simpler molecules, usually carbon dioxide and water. The resulting energy is used to fuel many energy-requiring processes within the organism.

CARBOHYDRATES

- Carbohydrates are polyhydroxy aldehydes or ketones, or complex substances which on hydrolysis produce polyhydroxy aldehyde or ketone subunits.
- Three major groups' of Carbohydrates are: Monosaccharides, Oligosaccharides & Polysaccharides.
- General formula for Carbohydrates is $C_x(H_2Q)_y$. General formula for monosaccharides is $(CH_2O)_n$. General formula of oligosaccharides is $Cx(H_2O)_y$ – General formula of polysaccharides is $Cx(H_2O)_y$ –.
- **Monosaccharides:** These are generally Trioses, Tetroses, Pentoses. Hexoses & Heptoses. Examples of trioses are dihydroxy acetone and glyceraldehydes. These are also intermediates in respiration and photosynthesis. Examples of Hexose", Glucose, Galactose, Fructose etc.

Oligosaccharides: These have 2 – 10 Monosaccharides. If two Monosaccharides then it is a Disaccharide. Examples of Disaccharides are: Maltose, Lactose and Sucrose etc.

- **Polysaccharides:** These have more than ten Monosaccharides. Examples arc' Cellulose .Starches and Glycogen etc. Most abundant polysaccharide is Cellulose.
- Polysaccharides are usually branched.

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- Cellulose present in wood, cotton and paper.
- Starches present in cereals and root tubers etc.
- In biology the most important hexose is glucose. Our blood normally contains 10.08 % glucose.
- F or the synthesis of 10 g of glucose 717.6 Kcal of solar energy is used.
- Cellulase is secreted by bacteria, yeasts and protozoa.

Glucose is a/dose sugar. Fructose is ketose sugar. Fructose is sweeter as compared to glucose.

CARBOHYDRATE	TYPES	SOURCES	FUNCTION
Monosaccharide	Glucose, fructose, Galactose	fruits and Vegetable	Provide energy converted to glycogen for storage
Disaccharide (double/complete sugar)	Sucrose, Maltose, Lactose	Sugar cane, Beat root, Milk	Excess is stored as fat
Polysaccharide	Starch, Cellulose, Glycogen	Rice, Cereal, Bread	Used in synthesis of many complex molecules

STARCH:

- Starch is compact, insoluble and IS a mixture of two compounds, amylase and amlyopectin.
- Amylose is an un-branched polymer in which glucose monomers are joined by α-1 4-glycosidic linkages. They are soluble in hot-water.
- Amylopectin molecule α-1, 4-glycosidic linkages and α-1, 6-glycosidic linkages. This allows branching. They arc "Insoluble in hot or cold water.

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GLYCOGEN:

- In humans, glycogen is the main storage carbohydrate. Its structure is similar to amylopectin, but it is even more frequently branched.
- In humans, glycogen is stored in large amounts in the liver and the muscles. During prolonged exercise, when the immediate supply of glucose is used up, the body restores its supplies by breaking down glycogen.
- If an average person goes without food, his or her glycogen stores last for about a day. When glycogen runs out, the body turns to using its lipid store. This is why eating less while taking more exercise is the quicker way to lose weight.
- One of the major changes associated with improving fitness is an increase in the amount of the enzyme glycogen synthetase in the muscles. This allows glycogen to be built up faster after it has been used.

CELLULOSE:

- Cellulose is a structural polysaccharide. It gives strength and rigidity to plant cell walls.
- Individual cellulose molecules are long un-branched chains containing many β-1, 4-glycosidic linkage. The molecules are straight, side by side and are called microfibrils.
- Cellulose is probably the most abundant structural chemical on Earth but few animals can digest it because they do not make the necessary enzyme, cellulose. Herbivorous animals, whose diet contains large amounts of cellulose, can deal with it because they have cellulose-producing microorganisms in their digestive system.

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LIPIDS

- Lipids are heterogeneous group of compounds that include fats and oils.
- As they are non-polar molecules, most lipids are insoluble in water but soluble in non-polar solvents such as alcohol and ether. Important exceptions are phospholipids, which have polar heads,
- Lipids contain the elements carbon, hydrogen, oxygen and sometimes phosphorus and nitrogen.
- They are intermediate-sized molecules that do not achieve the giant sizes of the polysaccharides, proteins and nucleic acids.

LIPID STRUCTURE AND FUNCTION:

- The triglycerides, which act mainly as energy stores in animals and plants, are a large important group of lipids.
- Triglycerides consist of one molecule of glycerol and three fatty acids.
- The glycerol molecule is common to all triglycerides and so the properties of different triglycerides depend on the nature of the fatty acids. Monounsaturated fatty acids possess one C=C bond and polyunsaturated contain more than one.

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TABLE: Some Common Fatty Acids

Fatty Acids	No. of Carbon Atoms	No. of Double Bonds	Abundant In	Melting Point / ° C⁺
Palmitic acids	16	0	Palm oil	63.1
Stearic acids	18	0	Cocoa	69.6
Lauric acids	12	0	Coconut, Palm oil	44.2
Oleic acids	18	1	Olive, Rapeseed	13.4

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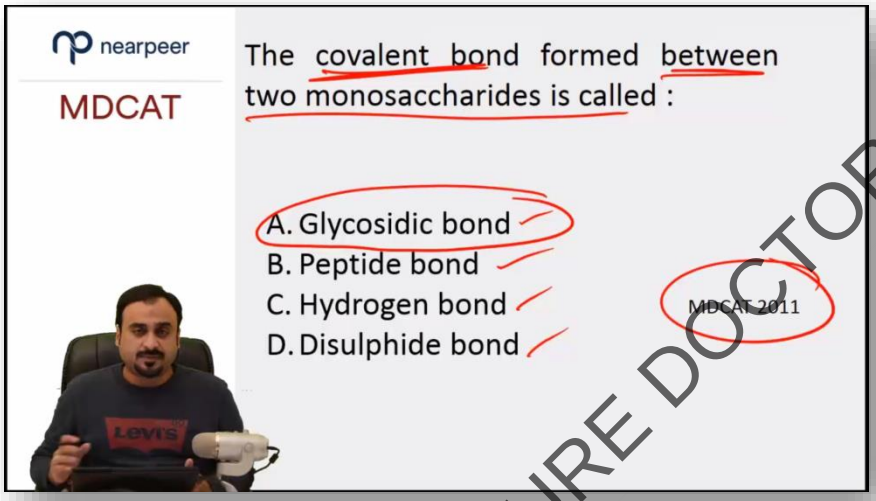
Linoleic acid	18	2	Sunflower, Maze	– 5.0



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PHOSPHOLIPIDS:

- Phospholipids are derivatives of phosphatidic acid. The phosphatidic acid is composed of glycerol, fatty acids and phosphoric acid.
- Phosphatidylcholine is one of the common phospholipids.
- Phospholipids have a similar structure to triglycerides but one of the fatty acids IS replaced by polar phosphoric acid.
- This gives the molecule a polar head and a non-polar tail. When placed in water, phospholipids arrange themselves with their hydrophobic (water-hating) tails pointing inwards and their hydrophilic (water-loving) heads pointing outwards. This is very important because it results in double layers called bilayers. Phospholipid bilayers form the basis of all biological membranes.

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CHOLESTEROL:

- This lipid is a normal component of every cell in our body. As well as eating food that contains cholesterol, we can also synthesis cholesterol in the liver.
- The more there is in the diet the less the liver needs to make.
- Vegetarians who eat no animal products are easily able to make all the cholesterol they need.

STEROID HORMONES:

- Steroid hormones have a similar structure to the cholesterol from which they are made.
- They include testosterone, progesterone and the estrogens.

WAXES:

- Waxes are lipids that are often used to waterproof surface, so preventing water loss.
- The cuticle of a leaf and the protective covering on an insect's body are both waxes.
- Waxes are mixtures of long chain alkanes (C_{25} to C_{35} odd numbers), alcohols, ketones and esters of long chain fatty acids.
- They have no nutritionl value because they cannot be digested by lipases (lipid digesting enzymes).

SUMMARY OF LIPIDS:

1. Lipids are a heterogeneous group of compounds related to fatty acids.
2. Lipids are classified as acylglycerols, waxes, phospholipids, sphingo lipids, glycolipidandterpenoid-lipids (including carotenoids and steroids).

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3. Acylglycerols are esters of fatty acids and alcohol.

4. An ester is produced as a result of a reaction of an alcohol with an acid and a water molecule is released.

5. Fatty acids having no double bond are called saturated fatty acids while the fatty acid having double bonds between carbon atoms are called unsaturated fatty acids.

6. Palmitic acid (C_{16}) is much more soluble in the organic solvent than butyric acid (C_4).

7. Fats and oils are lighter than water and have a specific gravity of about 0.8.

8. Higher fat contents of food causes slower movements of feces through the bowels. Bacteria in food convert the undigested fats into cancer causing compounds.

9. Terpenoids is a large group of compounds which are made up of simple repeatinisoprenoid units (C_5H_8).

Fats	Sources	Function
Saturated	• Butter, Animal Fat	• Provides energy
		• Medium for intake of vitamin A, D, E and K
Unsaturated	• Fish Oil, vegetable Oil	• Synthesis of cell membrane
		• Insulation layer under skin
		• Protects organs from physical injury

MCQ:

The unique properties of each amino acid are determined by its particular:

(a) group

(b) amino group

(c) kinds of peptide bonds

(d) numberof bonds to other amino acids

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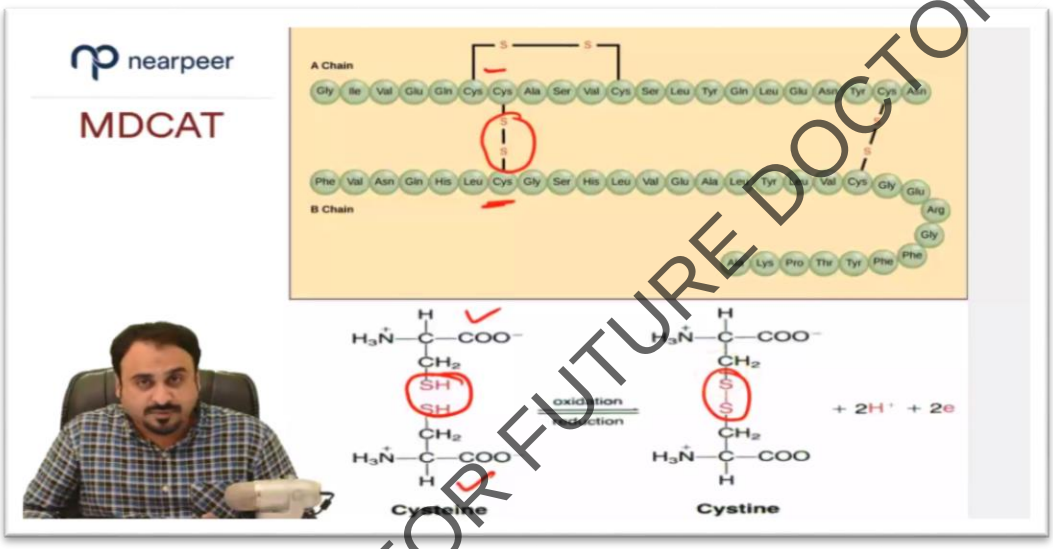
PROTEINS



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1. Proteins are polymers of amino acids. the compounds containing carbon, nitrogen, oxygen and hydrogen.

2. Proteins are the most abundant organic compounds in cells. They are over 50 of total dry weight of the cell.

3. About 170 types of amino acids are present in the cells and tissues of these about 25 types are involved in the formation of proteins. However most of the proteins are made of 20 types of amino acids.

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4. The linkage between C of carboxyl group of one amino acid and N of amino group of next amino acid is called peptide bond.

5. Glycylalanine has two amino acids and is called dipeptide.

6. Each protein has specific properties which are due to: Number of amino acids. Kinds of amino acids specific sequence of amino acids and the shape of protein molecule.

7. Sanger was the first scientist who determined the sequence of amino acids in a protein molecule.

8. Insulin is composed of 51 amino acids in two chains. One with 21 amino acids and the other with 30 amino acids. Both the chains are linked by disulphide bonds.

9. Hemoglobin is composed of four chains two alpha and two beta chains. Each alpha chain contains 141 amino acids which each beta chain contains 146 amino acids.

10. There are over 10.000 proteins in the human body. These are formed by the specific arrangements of 20 types of amino acids.

11. The sequence of amino acids is determined by the order of nucleotides in the DNA.

12. In the sickle cell hemoglobin only one amino acid (Glutamic acid) in each beta chain out of the 574 amino acids does not occupy the normal place in the proteins. Actually glutamic acid is replaced by valine. Therefore hemoglobin fails to carry sufficient oxygen. The result is the death of the patient.

13. Secondary structure of proteins is the coiling of primary polypeptide chains.

14. α helix is very uniform geometric structure with 3.6 amino acids in each turn of the helix

15. Tertiary protein structure is formed when a polypeptide chain bends and folds upon itself forming a globular shape.

16. Quaternary proteins are polymers of several tertiary structures.

17. All enzymes are proteins (e.g. amylase, lipase, pepsin etc). Enzymes control the cell metabolism.

18. Some hormones are proteins (e.g. insulin). Hormones regulate metabolic processes.

19. Antibodies (Immunoglobulins) are proteins which protect the body from pathogens.

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20. Blood clotting proteins (like fibrinogens) prevent the loss of blood from the body after injury.

21. Movement of organs and organisms are caused by proteins (e.g. actin and mysosin et. are involved).

22. Movement of chromosomes during anaphase of cell division, are caused by proteins (tubuis are involved).

23. The term protein is for the finished, functional molecule.

24. Some proteins consist of one polypeptide, others consist of two or more than two hemoglobin for example, contains four polypeptides.

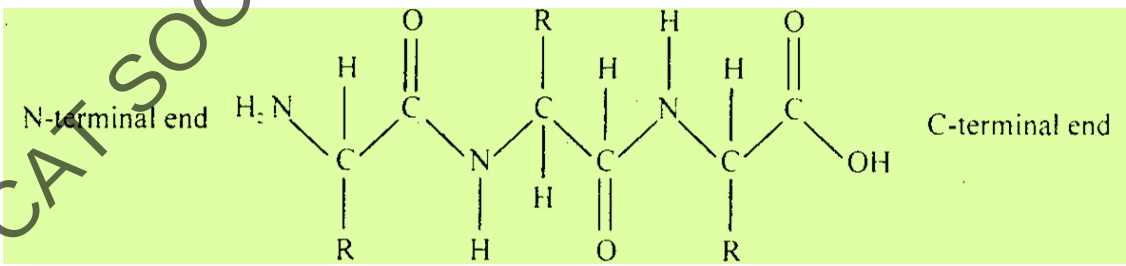
25. Amino acids join together in long chains to form proteins by means of peptide bond. This is an example of a condensation reaction.

FOUR LEVELS OF PROTEIN STRUCTURE:

All proteins are complex molecules and biochemists look at their structure at their different levels; primary, secondary, tertiary and quaternary.

Primary Structure:

- The primary structure of proteins depends upon the number, kind (types) and sequent of amino acids in a protein molecule.



A simple primary structure of a tiny protein:

- Real proteins usually consist of a lot more than five amino acids. The hormone insulin for example for example the relatively small protein has 51 amino acids.

- The code for the primary structure of any protein is contained in the gene. This code determines the order in which amino acids are assembled. This order then dictates the

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way they will twist and turn to produce the three-dimensional shape that allows the protein to carry out its specific function.

Secondary Structure:

- The first level of three dimensional twisting is described as the secondary structure of the protein.
- When combinations of amino acids join together in a chain they fold into particular shapes and patterns (such as spirals).
- These shapes form because the amino acids twist around to achieve the most stable arrangement of hydrogen bonds. The main types of secondary structure in proteins are:
    - The α-helix, a spiral, is the most common type of secondary structure. The hydrogen bonds stabilize the α-helix.
    - The β-pleated sheet, a flat structure that consists of two or more amino acid chains running parallel to each other, linked by hydrogen bonds.
- The secondary structure of a protein depends on its amino acid sequence; some amino acids produce α-helices. Others usually make β-pleated sheets.

Tertiary Structure:

- The tertiary structure of a protein is its overall three-dimensional shape and is produce as a result of the following:
- The sequence of amino acids that produces a-helices &β-sheets bends at particular places.
- The hydrophobic nature of many amino acid side chains. Globular proteins are surrounded by water and so the hydrophobic side chains tend to point inwards.
- Tertiary structure is maintained by ionic bonds, hydrogen bonds and disulfide (-S-S-) bonds.
- Functional proteins, such as enzymes and antibodies, must have an exact shape-and sometimes the ability to change shape - to fulfill their role in the organism.

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- Many structural proteins depend on their tertiary structure for strength. The large number of disulphide bridges in keratin, of example, makes body structures such as hair and nails very tough.

- If a protein consists of only one polypeptide, the tertiary structure is the final shape of the molecule. If, however, the protein has more than one, it has a further, quaternary level of structure.

Quaternary Structure:

Quaternary proteins are polymers of several tertiary structures.

In quaternary structure, the highly complex polypeptide tertiary chains are aggregated held together by:

(i) hydrophobic interactions

(ii) hydrogen bonds and

(iii) ionic bonds

FIBROUS AND GLOBULAR PROTEINS:

- The final three-dimensional structure of proteins results in two main classes of protein - fibrous and globular:

  - Fibrous proteins contain polypeptides that bind together to form long fibres or sheets. They are physically tough and are insoluble in water.

  - Globular proteins are usually individual molecules with complex tertiary and quaternary structures. They are spherical, or globular in shape, hence the name. Most are soluble in water and they have a biochemical function.

How stable are proteins?

- As the final shape of globular proteins is maintained by relatively weak molecular interactions such as hydrogen bonds, proteins are very sensitive to temperature increases and other changes in their environment.

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- As the temperature goes up beyond 40° C, molecular vibration increases and bonds that are holding together the tertiary or quaternary structure break, changing the shape of the molecule. This is known as denaturation.
- Different proteins are denatured at different temperatures. Some begin to be denatured after about 40-45° C or even below but many are not totally denatured until 60° C or even higher.
- It is an oversimplification to say organisms die at temperatures over 44° C because their proteins become denature. In practice organisms die because of a metabolic imbalance caused when enzymes work at different rate.
- Proteins can also be denatured by adverse chemical conditions. Chemicals that affect weak bonds change the overall structure. Even a slight change in protein shape mean loss of function, some proteins are particularly sensitive to changes in pH.

NUCLEIC ACIDS

- Nucleic acids are so called because they are slightly acidic and present mainly in the nucleus.
- The two types of nucleic acid, DNA and RNA both contain carbon, hydrogen, oxygen, nitrogen and phosphorus.
- Nucleic acids are polymers of nucleotides.
- Nucleotides are the building blocks of nucleic acids. A nucleotide consists of three units:
    - A sugar (ribose or deoxyribose)
    - A phosphate group
    - A nitrogen-containing base
- In a typical nucleotide the nitrogenous base is attached to position 1 of pentose sugar, while phosphoric acid is attached to carbon at position 5 of pentose sugar.
- DNA has nucleotides in which the sugar is deoxyribose, while RNA contains the sugar ribose.

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DEOXYRIBONUCLEIC ACID(DNA)

- A German chemist, Friedrich Miescher, discovered DNA in 1869. Miescher extracted a, white substance from the nuclei of human cells and fish sperm. He called this substance nuclein because it was associated with the nucleus. Since nuclein was acidic, it was called as nucleic acid.
- Most of the DNA in a eukaryotic cell is in the nucleus and in very less amount in Mitochondria and Chloroplasts.
- The nucleotides in DNA contain the nitrogenous (nitrogen-containing) bases which are adenine, guanine, cytosine or thymine.
- Names of four nucleotides of DNA are:

  (a) d-adenosine monophosphate (d-AMP)

  (b) d-guanosine monophosphate (d-GMP)

  (c) d-cytidine monophosphate (d-CMP)

  (d) d-thymidine monophosphate (d-TMP)

When DNA replicates (copies itself), it makes new strands by adding nucleotides. These are available as free molecules in the cytoplasm. Generally, cells can synthesize their own nucleotides.

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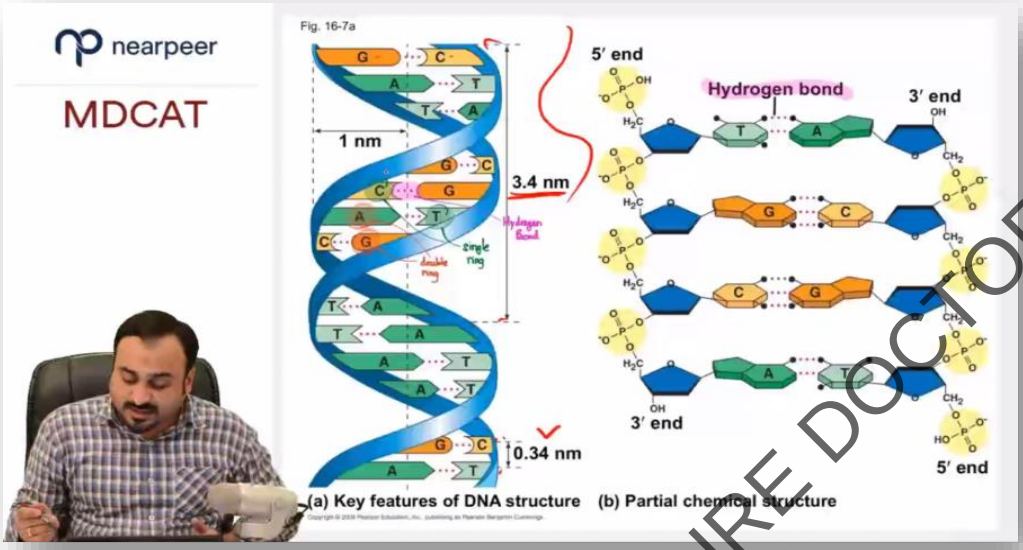

How DNA Carries the Genetic Code?

DNA has two remarkable characteristics:

- It is a store of genetic information.
- It can copy itself exactly, time after time.

How the bases pair?

- Adenine and guanine are purines (large/double ring) while thymine and cytosine are pyrimidines (small/single ring).
- Because of the shape of the two types of molecules, each purine always bonds with only one pyrimidine. So, in DNA, adenine always bonds with thymine, and cytosine with guanine. In RNA, cytosine bonds with guanine and adenine bonds with uracil:

DNA:	A = T	**RNA:**	A = U
	G=C		G = C

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- The base pairs are held together by hydrogen bonds. There are two H-bonds between A and T (or U) and three between C and G.
- A nucleotide has ester bond. A polynucleotide chain has phosphodiester bonds.
- In phosphodiester linkage, one phosphate group is linked to the two sugars by means of a pair of ester (P-O-C) bonds.
- According to Erwin Chargaff the quantity of A and T are almost equal. Similarly the quantity of G and C are almost equal. It means A with T and G with C in DNA double strand.
- British Chemist Rosalind Franklin carried on an X-ray diffraction analysis of DNA in the Lab of Maurice Wilkins.
- Maurice Wilkins (British biochemist) prepared DNA fibres.
- The diffraction pattern suggested that the DNA molecule had a shape of a helix with a diameter of2 nm and a complete helical turn every 3.4 nm.
- James Watson and Francis crick proposed structure of the DNA molecule.
- In DNA the sides are formed by alternating sugar-phosphate units, while the base pairs form the cross-bridges, like the rungs of a ladder. Each base pairing causes a twist in the helix and there is a complete 360^{o} turn every 10 base pairs.
- DNA & Histones form Eukaryotic chromosomes.
- A gene is a unit of biological inheritance.
- The E. coli genome consists of 4,639,221 base pairs. It codes for about 4288 proteins.
- The first microbe whose genome is completely sequenced is Haemophilus influenza. It was published in July 28, 1995.

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RIBONUCLEIC ACID (RNA)

- RNA is synthesized 'by DNA in a process known as transcription.

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- RNA is present in the Nucleus/nucleolus, ribosomes, cytosol and in smaller amounts in other parts of the cell.
- The RNA molecule has single strand. It may fold back on itself to give double helix.
- ATP is highly unstable nucleotide. It is used as energy currency by the cell.
- All types of RNA's are synthesized' from DNA in the nucleus and then are moved out in the cytoplasm to perform their specific functions.
- Three of the bases in RNA - adenine guanine and cytosine - are the same as those it DNA. The fourth is different: RNA contains uracil instead of thymine.
- RNA molecules are much smaller than DNA molecules.
- DNA can consist of over 300,000,000 nucleotides. RNA usually consists of a few hundred.
- RNA is also less stable.
- DNA molecules are the permanent store for genetic information and last for many years. In contrast, RNA molecules have a short-term function and are easily replaced.
- There are three forms of ribonucleic acid (RNA) in the cell:
- Messenger RNA (mRNA) can be thought of as a mobile copy c;f gene. Small lengths of mRNA are assembled in the nucleus using a single gene within the DNA as a template. When a complete copy of the gene has been produced the mRNA moves out of the nucleus to the ribosome, where the protein is synthesized according to the code taken from the DNA. For a protein molecule of 1000 amino acids, the length of mRNA will be 3,000 nucleotides. The mRNA is about 3to 4 % of the total RNA in the cell.
- Transfer RNA is found in the cytoplasm and is a carrier molecule, bringing amino acids to the ribosomes for assembly into a new amino acid chain according to the order specified on the mRNA code. There is one specific tRNA for each kind of amino acid. So there are at least 20 kinds of tRNAs in the cell. tRNAs are about 10 to 20% of the total RNA in the cell. Human cells contain about 45 different kinds of tRNA molecules.
- Ribosomal RNA makes up part of the ribosome. Ribosomal RNA is up to 80 % of the total RNA in the cell. In ribosome, rRNA is 40 – 50 %. During translation, rRNA provides the site where polypeptides arc assembled.

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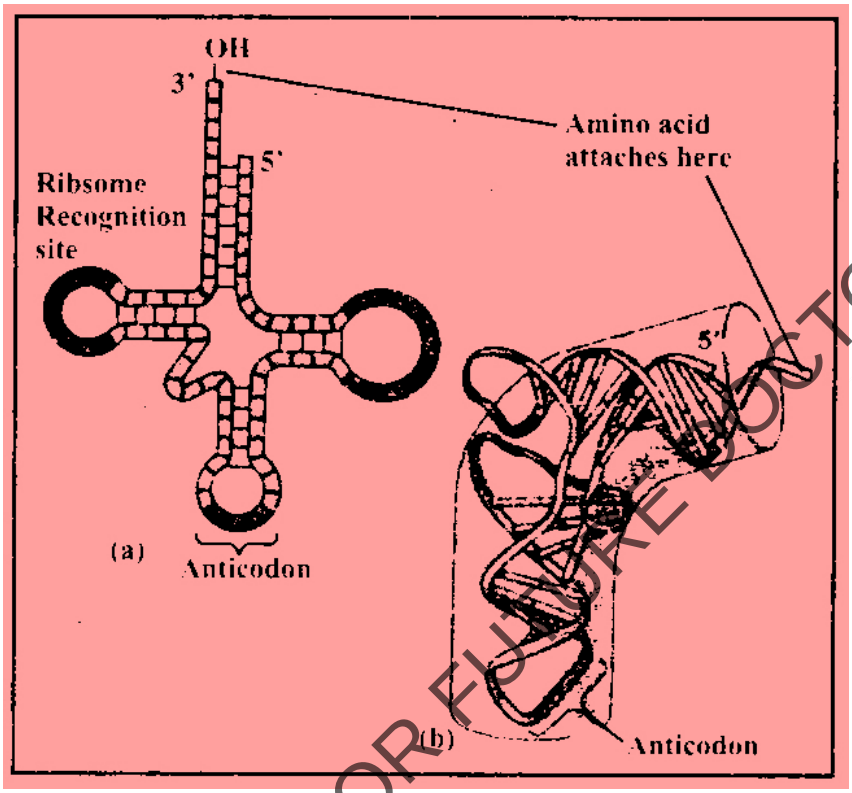

Fig. The structure of tRNA:
(a) two dimensional schematic
(b) three dimensional structure

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DNA REPLICATION

The process of replication is as follows:

- **Sites of Replication:** The DNA replication begins at one or more sites on the DNA molecule, where there is a specific sequence of nucleotides

Opening up the DNA double Helix:

Stage 1: **Initiating Replication:** The binding of initiator proteins starts opening of the helix

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Stage 2: **Unwinding the Duplex:** Unwinding is by Helicase.

Stage 3: **Stabilizing the Single Strands:** The unwound portion of the DNA double helix is stabilized by single strained binding protein.

Stage 4: **Continuous unwinding:** For replication to precede continuous unwinding is necessary at 1000 nucleotides / sec.

- **Boiling a Primer:** New DNA cannot be synthesized on these exposed templates until a primer is constructed. It is a short stretch of RNA, added by a specialized enzyme primer.
- **Assembling Complementary Strands:** The DNA polymerase III and other enzymes begin a complex process that catalyzes the addition of nucleotides to the growing complementary strands of DNA.
- There are three DNA polymerasenamelyI, II and III bacteria.
- DNA polymerase I is a relatively small enzyme that plays a supporting role in DNA replication.
- The true E. coli replicating enzymes is DNA polymerase III which is 10 times larger far more complex in structure. The enzyme is a dimer and catalyzes replication of one DNA strand.
- Each dimer has 3 subunits α subunit adds the nucleotides. B_2 subunits binds and Σ subunit is involves in proof reading/correction.
- DNA polymerase III adds nucleotides only to 3 end of a DNA strand. This means that replication always precedes 5' → 3' direction on a growing DNA strands.
- Because the two parents of a NA molecule are antiparallel, the new strands must be elongated by different mechanism.

Replication in the Leading Strand:

Leading strand, which elongates toward the replication fork, is built up simply by adding nucleotides continuously to its growing 3 end.

Replication in the Lagging Strand:

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- The lagging strand which elongates away from the replication fork is synthesized discontinuously (in 5' → 3' direction) as a series of short segments called Okazaki fragments that are later connected.
- These segments, called Okazaki fragments are about 100 – 200 nucleotides long in eukaryotes and 1000 – 2000 nucleotides long in prokaryotes.
- The DNA polymerase 1 fills in the gaps between Okazaki fragments.
- After the gaps between Okazaki fragments are filled in; the enzyme DNA ligase joins the fragments to the lagging strand.
- The DNA is further unwound, new RNA primers are constructed, and DNA polymerase III then jumps ahead 1000 – 2000 nucleotides (toward the replication fork) to begin constructing another Okazaki fragment.

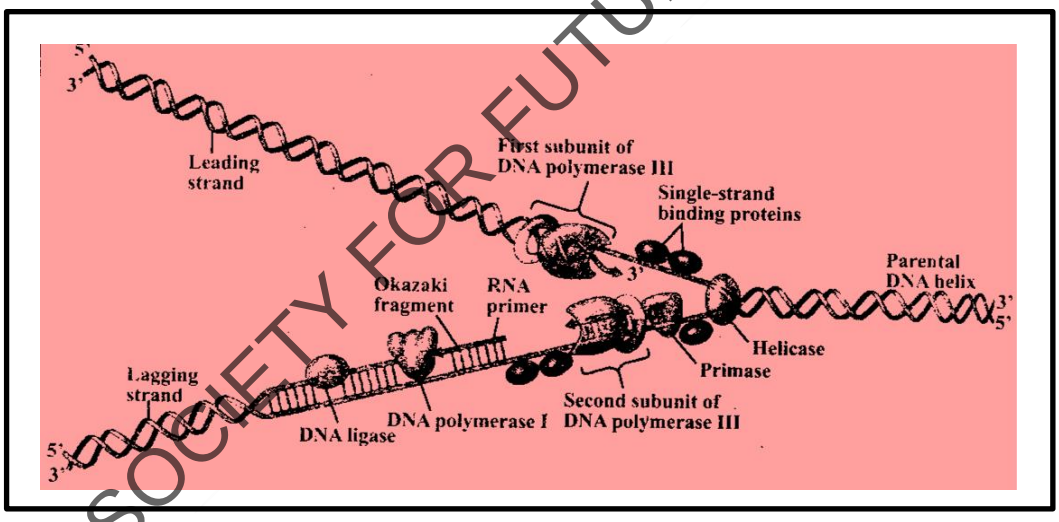

Fig. A DNA replication fork

TRANSCRIPTION

- This is the process in which mRNA copy of the DNA sequence (encoding α the gene) is produced with the help of an enzyme RNA polymerase.
- Only one of the two strands of DNA is transcribed. This strand is called template strand or the antisense strand. The opposite strand is called coding strand or the sense strand.

RNA Polymerase Enzymes:

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- The RNA polymerase enzymes synthesize mRNA from 5' → 3' direction. The there is only one type of RNA polymerase enzyme in prokaryote which synthesizes all the three types of RNAs viz. rRNA, mRNA and tRNA.
- However in the eukaryotes there are three types of RNA polymerases:

  (i) **RNA polymerase I:** It synthesize rRNA

  (ii) **RNA polymerase II:** It synthesize mRNA

  (iii) **RNA polymerase III:** It synthesize tRNA

Polymerase Binding (Start of Transcription):

- Transcription starts at the RNA polymerase binding site called promoter on the DNA template strand.

  In prokaryote within promoter there are two binding sites TTGACA also called – 35 sequence and TAT AAT sequence also called – 10 segment. These have affinity for the RNA polymerase. In, eukaryotes these sites are at – 2 and – 70 sites.
- The binging of RNA polymerase to the promoter is the first step in gene transcription.
- One of the subunits of RNA polymerase is the sigma factor, which is responsible for correct initiatin of transcription process.
- Once the transcription has started the sigma factor is released and the remaining part of the enzyme(core enzymes) moves over the template strand and completes the transcription of the gene.

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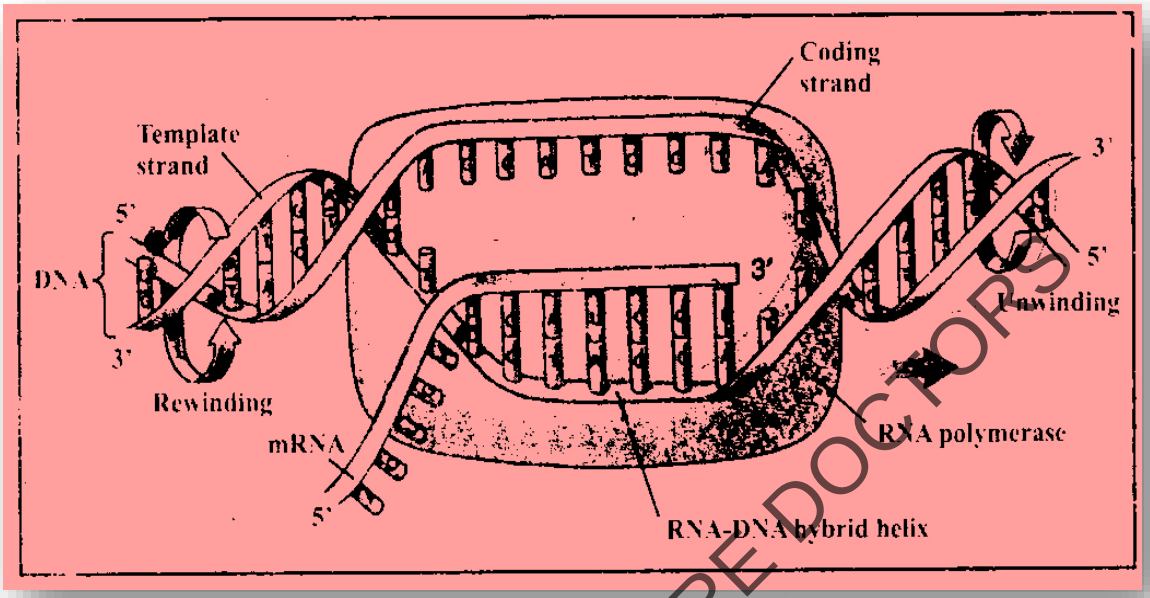

Fig. Model of a transcription bubble

- The DNA strands open up at the place where enzyme is attached to the template strand forming transcription bubble.
- The transcription bubble moves down the DNA, leaving the growing strand protruding from the bubble.
- The stop sequences at the end of the gene terminate the synthesis of mRNA.
- The simplest stop signal is a series of GC base pairs followed by a series of AT base pairs. The RNA formed in this region forms a GC hairpins followed by four or more U r bonucleotides. The hair pins RNA polymerase to stop synthesis.

Travel of mRNA from Nucleus to Cytoplasm:

- In bacteria the newly synthesized mRNAis directly released into the cytoplasm.
- In eukaryotes however, it has to travel large distance from inside the nucleus to ribosomes outside in the cytoplasm. The eukaryotic mRNA is therefore modified several ways to aid this journey.

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- A cap and a tail is added so that the molecule may remain stable during long journey ribosome.
- The capin the form of methyl GTP, which is linked to 5' with the first nucleotide. However the tail is in the form of poly. A tail linked to 3' end of the RNA. These caps and tails save the mRNA from variety of nucleases and phosphates.

GENETIC CODE

- Genetic code is a combination of 3 nucleotides, which specify a particular amino acid.
- The four nucleotides of DNA can be arranged in 4^3 or 64 different combinations of hr. more than enough to code for the 20 amino acids.

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TABLE: THE GENETIC CODE

	Second Letter								
First ---------- Third									
Letter	U		C		A		G		Letter
C	UUU UUC	Phenaylalnine	UCU UCC	Serine	UAU UAC	Tyrosine	UGU UGC	Cysteine	U C
	UUA UUG	Leucine	UCA UCG		UAA UAG	Stop Stop	UGA UGG	Stop Tryptophan	A G
C	CUU CUC CUA CUG	Leucine	CCU CCC CCA CCG	Proline	CAU CAC CAA CAG	Histidine Glutamine	CGU CGC CGA CGG	Arginine	U C A G
A	AUU AUC AUA AUG	Isoleucine Methioning; Start	ACU ACC ACA ACG	Treonine	AAU AAC AAA AAG	Asparegine Lysine	AGU AGC AGA AGG	Serine Arginine	U C A G
G	GUU GUC GUA GUG	Yaline	GCU GCC GCA GCG	Alanine	GAU GAC GAA GAG	Aspartate Glutamate	GGU GGC GGA GGG	Glycsine	U C A G

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- Out of 64 codons, three codons UAA, UAG and UGA do not code for any amino acid and hence are known as nonsense codon. These codons are usually present at the end of the gene and hence are also called stop codons.
- Every gene starts with initiation codon AUG, which encodes the amino acid methionine.
- The genetic code is universal. It is the same in almost all the organisms. For example AGA specifies arginine in bacteria, in humans and all other organisms whose genetic cock has been studied. Because of the universality of codon the genes can be transferred from one organism to another and be successfully transcribed and translated in their new host.

TRANSLATION

- **Binding of mRNA with Ribosome:** Translation begins when the initial portion of a mRNA molecule binds to an rRNA molecule in a ribosome.The mRNA lies on the ribosome in such a way that only one of its codons is exposed at the polypeptide site at any time.
- **Binding of tRNA:** A tRNA molecule possessing the complementary three nucleotide sequence or anticodon, binds to the exposed codon on the mRNA. Because this tRNA molecule carries a particular amino acid that amino acids and no other is added to the polypeptide in that position.
- **Reading of mRNA:** As the mRNA molecule moves through the ribosome excessive condones on the mRNA are exposed and the series of tRNA molecules bind one after another to the exposed codons.

  Each of these tRNA molecules carries an attached amino acid which is added or the end of the growing polypeptide chain.
- **Role of Synthetase Enzyme:** Particular tRN Amolecules is attached to specific amino acids by an activating enzyme called aminoacyl-tRNA synthetase. There is one specific enzyme exists for each of the 20 common amino acids.

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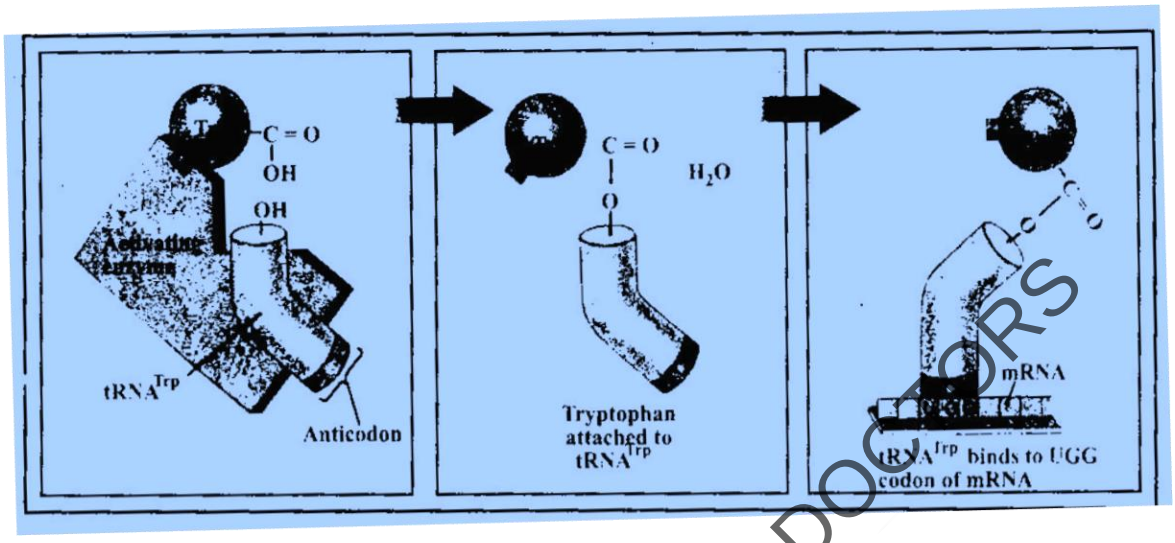

Fig. Activating enzymes "read" the genetic code

Formation of Polypeptide Chain:

a) **Initiation Complex in Prokaryotes and Eukaryotes**: In prokaryotes, polypeptide synthesis begins with the formation of initiation complex. First a tRNA molecule carrying a chemically modified methionine (called n-formyl methionine) binds to the small ribosomal subunit.

Proteins called initiation factor position the tRNA on the ribosomal surface at the P site (peptidyl site) where peptide bonds will form.

Nearby two other sites will form:

(i) A site (for aminoacyl site), where successive amino acid bearing tRNAs will bind.

(ii) E site (for exit site) where empty tRNAs will exit the ribosome. This initiation complex, guided by another initiation factor, binds to AUG on the mRNA.

Initiation in eukaryotes is similar, although it differs in two important ways.

(i) In eukaryotes, the initiating amino acid is methionine rather than N-formyl methionine.

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(ii) The initiation complex is for more complicated than in bacteria, containing nine or more protein factors.

(b) **Attachment of Next tRNA:** After the initiation complex has formed, the large ribosome subunit binds, exposing the mRNA codon adjacent to the initiating AUG codon, and so positioning it for interaction with another amino acid-bearing tRNA molecule.

(c) **Elongation Factors:** When a tRNA molecule with the appropriate anti-codon appears, proteins called elongation factors assist in binding it to the exposed mRNA codon at the A site.

(d) Attachment of Two Amino Acids: When the second tRNA binds to the ribosome, it places its amino acid directly adjacent to the initial methionine, which is still attached to its tRNA molecule, which in tum is still bound to the ribosome.

The two amino acids undergo a chemical reaction, catalyzed by the large ribosomal subunit, which releases the initial methionine from its tRNA and attaches it instead by apeptide bond to the second amino acid.

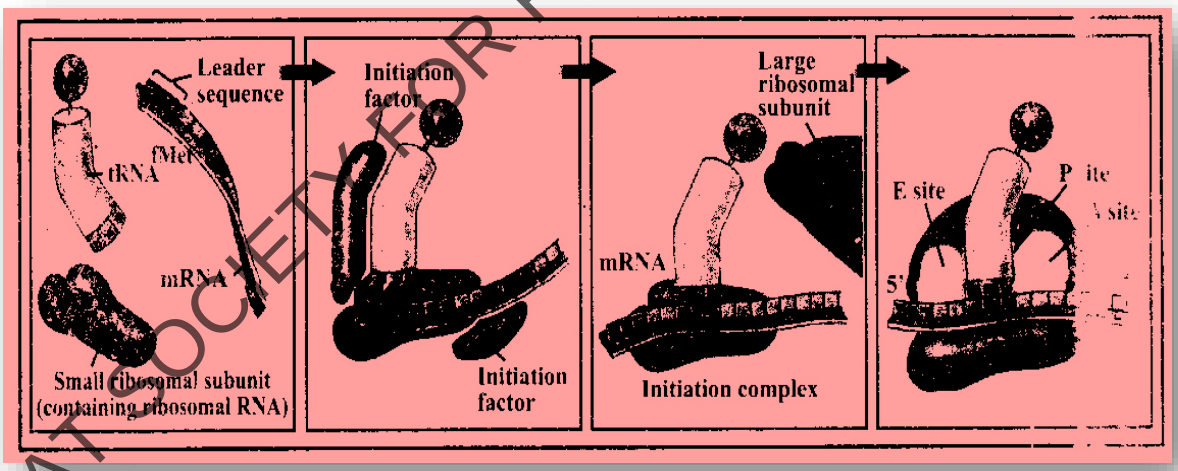

Fig. Formation of the initiation complex

(e) **Translocation of Ribosome:** The ribosome now moves (translocate)three more nucleotides along the mRNA molecule in the 5' → 3' direction, guided by other elongation factors.

This movement relocates the initial tRNA to the E site and ejects it fromthe ribosome repositions the growing polypeptide chain (at this point containing two amino acids to the P site and exposes the next codon on the mRNA at the A site.

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When a tRNA molecule recognizing that codon appears, it binds to the codon at the A site, placing its amino acid adjacent to the growing chain. The chain then transfers to the new amino acid, and the entire process is repeated.

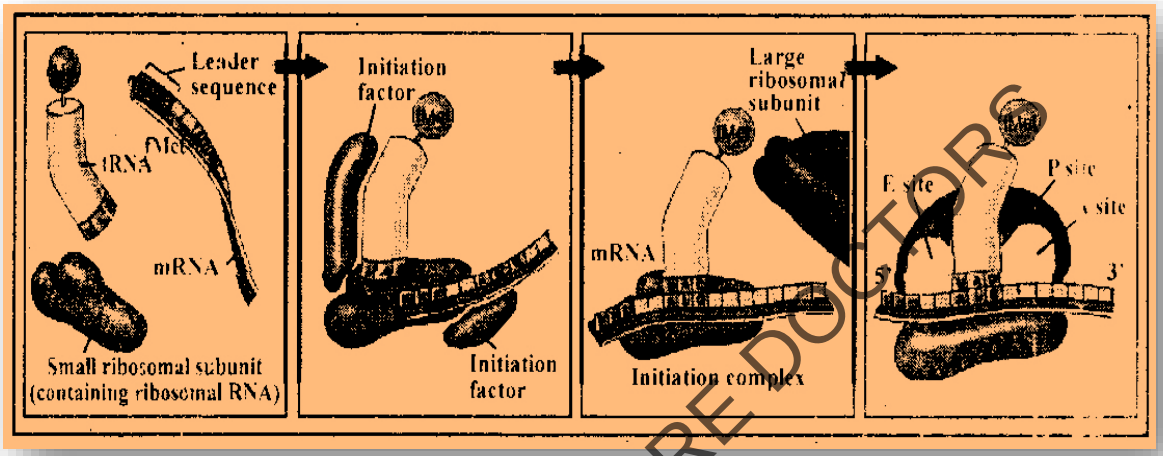

Fig. The translocation process

(f) **Termination:** Elongation continues until a chain-terminating non sense codon is exposed, Nonsense codons do not bind to tRNA, but they are recognized by release factors protein, that release the newly made polypeptide from the ribosomes.

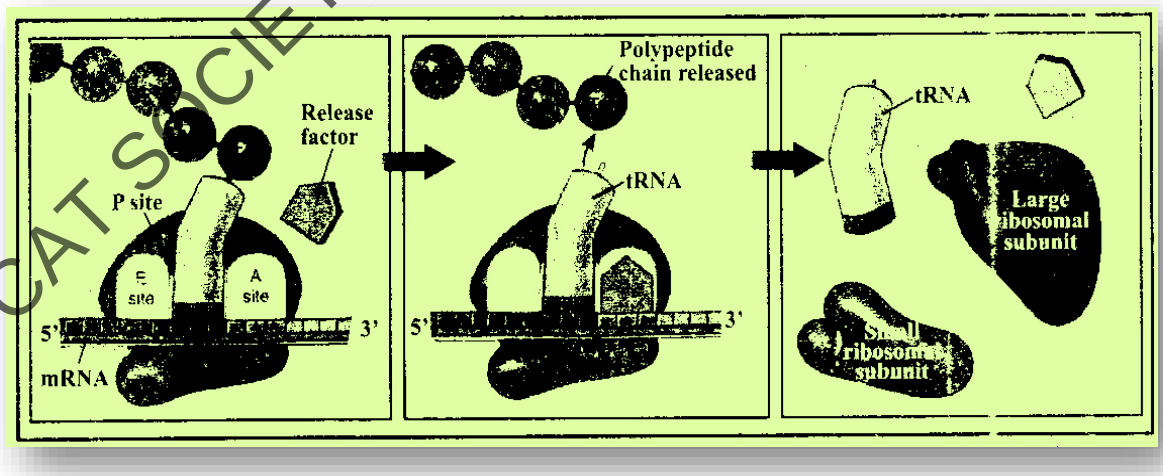

Fig. Termination of protein synthesis

1. All the chemical reactions taking place within a cell are collectively called metabolism

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Or

The sum total of catabolic and anabolic reactions taking place in the cell at a given time.

2. Those reactions in which simpler substances are combined to form complex substances are called anabolic reactions. Those reactions in which larger complex molecules are broken down into simpler ones are catabolic reactions. Energy released during suchreactions.

3. The complex carbohydrate molecules become stable due to C –O association in glucosidic linkages.

4. Chromosomes are thread like structures that appear inside the nucleus at the time or cell division.

5. Chromosomes were first observed by the German embryologist Walther Fleming in 1882, when he was examining the rapidly dividing cells of salamander larvae.

6. The characteristics of the set of chromosomes of a cell or organism is called karyotype OR the particular array of chromosomes that an individual possesses is called itskaryotype.

7. Significance of Karyotype:

   (a) We can identify different species.

   (b) We can differentiate different members of a species.

   (c) We can sort out/identify the disorders.

8. Each chromosome contains hundreds or thousands of genes. These genes play important role in the development and functioning of an organism.

9. Typically a chromosome is made of chromatids, centromere (primary constriction) and a secondary constriction.

10. Each chromatid is un-separated replica of the chromosome.

11. On the basis of centromeric position, the chromosomes are of four types:

    (i) Telocentric Chromosomes: These chromosomes have centrome at one end.

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(ii) Acrocentric Chromosomes: These chromosomes have a very short arm at one end.

(iii) Sub Metacentric Chromosomes: The chromosomes have unequal arms.

(iv) Metacentric Chromosomes: The centromere is in the middle of chromosomes therefore the arms are equal or almost equal.

12. A chromosome is composed of DNA (40 %) and protein (60 %). A significant amount of RNA is also associated with chromosomes because these are the sites of RNA synthesis.

13. A typical human chromosome contains about 140 million (1.4×10^8) nucleotides in its DNA.

14. A chromosome is made of DNA and basic proteins called histones. DNA and histones together form a structure called nucleosome. The nucleosomes look like beads on a string.

15. The DNA duplex is coiled around a core of eight histone proteins forming a complex known as a nucleosome. There are 200 nucleotides in one nucleosome.

16. Some of the portions of chromosome remain permanently condensed, so that their DNA is never expressed. These highly condensed portions of the chromatin are called heterochromatin.

17. The portion of the chromosome which is condensed only during cell division is called euchromatin. At all other times euchromatin is open and its genes can be expressed.

18. Two different molecules, belonging to different groups, combine to form conjugated molecules.

19. When carbohydrates combine with proteins, glycoproteins are formed. Cellular secretions are mostly glycoporteins. When carbohydrates combine with lipids glycolipids are formed.

20. Glycolipids are present in cell membranes along with glycoproteins.

21. Lipoprotein is formed by lipids and proteins. It forms the basic structure of all types ofmembranes in the cells.

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22. Nucleic acids are combined with basic proteins to form nucleoproteins. Thenucleoproteins/nucleohistones are present in chromosomes. These proteins play important role in regulation of gene expression.

23. **Promoter:** A specific nucleotide sequence on the DNA molecule to which RNA polymerase attaches to initiate transcription of mRNA from a gene.

24. **Replication Fork:** A Y-shaped end of a growing replication bubble in DNA molecule undergoing replication.

25. **RNA Ploymerase:** An enzyme that catalyzes the assembly of a mRNA molecule sequence of which is complementary to a DNA molecule used as a template.

26. **RNA Primer:** In DNA replication a sequence of about 10 RNA nucleotides complementary to unwound DNA that attaches at a replication fork; the DNA polymerase uses the RNA primer as a starting point for addition of DNA nucleotides to from the new DNA strand the RNA primer is later removed and replaced by DNA nucleotides.

27. **Satellite DNA:** A non-transcribed region of chromosome with a distinctive base composition a short nucleotide sequence repeated many thousands of time.

28. **Transcription factor:** One of a set of proteins required for RNA polymerase to bind to a eukaryotic promoter region become stabilized and begin the transcription process.

29. **Telomere:** A specialized non-transcribed structure that caps each end of the chromosome.

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QUESTIONS FOR PRACTICE

No.	Questions	A	B	C	D
1.	Which is true about Turpentine oil:	it is lipid	terpenoid	obtained from plants	all of these
2.	Lipids found in our body as:	triglyceride	phospholipid	cholesterol	all of these
3.	What is the base of steroid?	cholesterol	protein	lipids	carbohydrates
4.	What is not true about Hemoglobin?	it is globular protein	it has secondary level of protein structure	it is functional protein	it is a dimmer

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5.	The cytosol is not:	plasma gel	liquid matrix of cytoplasm	pure organic	organic and inorganic
6.	The second most abundant organic molecule of a cell is:	water	proteins	carbohydrates	lipids
7.	During the digestion of starch:	H_2O is produced	H_2O is consumed	CO_2 produced	CO_2 consumed
8.	The H of water produced during peptide bond formation comes from:	amino group	carboxyl group	α-carbon	sometimes from amino group and sometimes from carboxyl group
9.	Which one is more sweet in taste?	glucose	fructose	lactose	maltose
10.	The pyransoe ring of glucose in water is produced between carbon numbers:	1and 2	1 and 4	1 and 5	1 and 6
11.	Pick-out the odd one out:	maltose	galactoes	glucose	fructose
12.	Which of the following atoms is found in protein?	S	F	Mg	P
13.	The next to simplest amino acid is:	alanine	lysine	glycine	aspartic acid
14.	The final product of hydrolysis of protein is:	CO_2 and H_2O	Peptones	Polypeptides	Amino acids
15.	Formation of Glycogen is a type of:	hydration synthesis	dehydration synthesis	hydration analysis	dehydration analysis
16.	Which one is a nucleotide?	DNA	NAD	AMP	NADP
17.	dAMP is a constituent of:	tRNA	DNA	mRNA	rRNA
18.	Adenosine comprises:	adenine and phosphate	adenine and phospholipids	adenine and sugar	adenine and tyrosine
19.	Which one of the following is not a pure carbohydrate?	cellulose	hemicellulose	chitin	glycogen

No.	Questions	A	B	C	D
20.	The richest source of energy is:	glucose	fructose	fats	proteins
21.	Examples of structural lipids are:	phospholipids	glycolipid	sterols	all of these
22.	Which one is disaccharide?	glucose	fructose	galactose	lactose
23.	Which is nitrogen base?	choline	ethanol amino	serine	all of these
24.	The viscosity of protoplasm is comparable with that of:	glycerol	glycerine	light machine oil	all of these

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25.	The property of contraction and relaxation of cytoplasm is attributable to special type of:	carbohydrates	lipids	proteins	nucleic acids
26.	Amount of water in living cells varies from:	75 – 89	70 – 89	60 – 89	65 – 89
27.	Histones are:	single protein	different kinds of proteins	conjugated molecules	carbohydrates
28.	3-D protems are due to:	primary structure	tertiary structure	secondary structure	both primary and secondary structure
29.	Primary product of photosynthesis:	carbohydrates	proteins	lipids	nucleotides
30.	Total number of amino acids in insulin is:	61	41	71	51
31.	Amino acids of hemoglobin are arranged in dimmers, each dimer with:	574 amino acids	287 amino acids	141 amino acids	146 amino acids
32.	A chain containing two amino acids is known as:	dipeptide	peptide	amino-peptide	diamino
33.	The simplest amino acid is:	alanine	lysine	glycine	aspartic acid
34.	The essential amino acid means:	formed with in the body	enter from outside the body	can change from one to another kind of amino acid	20 kinds of amino acids
35.	The simplest fatty acid is:	acetic acid	butyric acid	palmatic acid	oleic acid
36.	The Nucleotide with single ring is:	adenine	guanine	cytosine	both a and b
37.	Histone present in:	DNA	RNA	chromosome	glycolipids
38.	Number of Nucleotides in A TP:	1	2	3	4
39.	Most diverse macromolecules in a cell:	carbohydrate	protein	lipid	DNA
40.	Isoprenoid unit has no:	N	P	O	All of these
41.	Number of Nucleotides in NADP:	1	2	3	4

No.	Questions	A	B	C	D
42.	Which one is conjugated molecule?	protein	carbohydrate	glycoprotein	lipid
43.	Amylopectin not abundant in:	wheat	maize	both a and b	pulses
44.	Fruit sugar is usually:	glucose	fructose	maltose	lactose
45.	Example of vitamin/nucleotide/co-enzyme is:	FAD	NAD	NADP	All of these
46.	Base pairs in E. coli:	4288	14000	4639221	Four
47.	What is unique of DNA?	replication	organic	has n bases	all of these
48.	Reverse of Dehydration synthesis is:	hydrolysis	oxidation	reduction	oxidation-

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					reduction
49.	Phospholipids are:	polar	non-polar	polar on one end and non-polar on the other end	sometimes polar and sometimes non polar
50.	Collagen is protein 'and:	trimer	dimmer	monomer	tripeptide
51.	Glycerol is the backbone molecule for:	disacchardies	DNA	triglycerides	ATP
52.	All the information for the structure and functioning of a cell is stored in:	DNA	tRNA	mRNA	rRNA
53.	Basic unit of DNA is:	nucleotide	amino acid	nucleic acid	double helix
54.	Second most abundant compound in living organisms is:	protein	lipids	DNA	carbohydrate
55.	Tetroses are rare in nature and occur in:	some bacteria	few bacteria	Bacteria	most bacteria
56.	Evaporation of only two ml out of one liter of water lowers the temperature of the remaining 998 ml by _____ ^{o}C.	0.01	0.1	1.0	2.0
57.	Which of the following atoms is not found in protein?	C	O	H	P
58.	Generally all the organic compounds contain the elements:	iron and oxygen	carbon and oxygen	carbon and hydrogen	carbon and nitrogen
59.	Potential source of energy for cell activities:	C – H	H – H	C – O – C	C – C
60.	At 25° C the concentration each of H^+ and OH ions in pure water is about:	10^{-7} ml/litre	10^{-7} mole/litre	10^{-7} mg/litre	10^{-7} moles/ml

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UNIT NO. 2 (BIOLOGICAL MOLECULES) EXERCISE No. 1

1	**D**	**2**	**D**	**3**	**A**	**4**	**B**	**5**	**C**	**6**	**C**	7	B	8	C	9	B	10	C
11	A	**12.**	A	**13**	A	**14**	D	**15**	C	**16**	**C**	17	B	18	C	19	B	20	C
21	D	**22**	D	**23**	D	**24**	D	**25**	C	**26**	**D**	27	B	28	C	29	A	30	D
31	C	**32**	A	**33**	C	**34.**	B	**35**	A	**36**	**C**	37	C	38	A	39	B	40	D
41	B	**42**	C	**43**	D	**44**	B	**45**	D	**46**	**C**	47	A	48	A	49	C	50	A
51	C	**52**	A	**53**	A	**54**	A	**55**	A	**56.**	**C**	57	D	58	C	59	A	60	B

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No.	Questions	A	B	C	D
1.	A chromosome with unequal length of its arms is called:	metaccntric	sub metacentric	acrocentric	telocentric
2.	What was the number of wild type flies in F2 generation of Morgan's experiment?	728	1550	3470	4252
3.	In Hershey and Chase experiment 32p labeled bacteriophages allowed to infect the bacteria. During analysis 32p activity was detected:	in culture medium	on the surface of bacterial cell	inside the bacterial cell	both the surface and inside of bacterial cell
4.	In Meselson and Stahl experiment, the DNA from sample at 20 minutes, after start of experiment (labeling) made sediments at the:	top	intermediate	bottom	top-and intermediate
5.	Sickle cell anemia is the example of _____ type of mutation.	transposition	deletion	insertion	base substitution
6.	Which of the following act as a stop codon?	UGG	UGC	UAG	UGU
7.	In mitochondria UGA codon act to specify _____ instead stop codon.	argenine	valine	glutamic acid	trytophan
8.	If the amount of adenine in ONA of a bacterial cell is 36 of the total nitrogenous bases. What will be the amount of guanine in the DNA of a cell in next generation?	14 %	28 %	36 %	64 %
9.	If a mRNA is synthesized with all the different codons, what is the minimum number of amino acids in the protein that is formed by mRNA:	64 amino acids	62 amino acids	60 amino acids	61 A.A
10.	In eukaryotic mRNA molecule there are 90 nucleotide involved in translation process. What is the number of amino acid in the protein formed by this mRNA molecule?	29 amino acids	30 amino acids	45 amino acids	90 amino acids
11.	The complementary mRNA triplet for the DNA triplet GAT would read:	CAT	CUA	CTG	TAG
12.	The two-pyrimidine bases most commonly found in DNA are:	cytosine and thiamine	cytosine and uracil	adenine and thymine	cytosine and thymine

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13.	In a nucleotide, the phosphate group is attached to the sugar at carbon number:	1	2	3	5

No.	Questions	A	B	C	D
14.	It has been established that, in many cells, ribosomes occur in chains along mRNA molecules. What is the advantage of this arrangement when compared with a situation in which ribosomes occur singly?	a greater variety of polypeptides can be produced	fewer tRNA molecules are used in protein synthesis	larger number of polypeptides can be produced	polypeptides can be produced more rapidly
15.	Biochemical analysis of a sample of DNA showed that 40 of the nitrogenous bases was cytosine, what percentage of the bases would be adenine:	5 %	10 %	20 %	40 %
16.	A synthetic mRNA molecule is made by using only two types of nucleotide, containing adenine and cytosine. How many different codons could it contains?	6	4	8	16
17.	A protein includes 17 of the 20 different amino acids commonly occurring in proteins, what is the minimum number of different kinds of tRNA molecules involved in the synthesis of this protein:	17	51	20	102
18.	If the nucleus of a -human motor neuron contains 6.8 picograms (pg) of DNA, what mass of DNA is in the nucleus of an actively dividing human skin cell likely to contain at the end of interphase?	3.4 pg	13.6 pg	6.8 pg	20.4 pg
19.	What is the action of the enzyme DNA ligase?	DNA is broken up at specific sites	DNA Fragments are joined together	DNA Replication occur	DNA Transcription Occur
20.	A mRNA codon for the amino acid alanine is GCC. How many alanine molecules are present in the polypeptide, containing 8 amino acids coded for by the following DNA template: TCGGCCTACCGGGCCCATGCCAAT	zero	one	two	three
21.	During DNA replication, lagging strand is formed by:	P 1	P II	P III	All of these

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No.	Questions	A	B	C	D
22.	Genetic code for Glycine is:	GGU	UAG	UGA	AUG
23.	RNA Polymerases in Prokaryotes are of:	one type	two type	four type	three type
24.	In RNA nucleotides are attached by:	peptide bonds	phosphodiester bond	hydrogen bond	covalent bond
25.	Most amino acids are identified by:	one codon	more than one codons	two codons	three codons
26.	The basic unit of heredity is:	DNA	Replication	Codon	Gene
27.	Okazaki fragments are formed in:	leading strand	lagging strand	transcription	translation
28.	The addition of a few bases in a gene is:	point mutation	transposition	deletion	inversion
29.	The tail of mRNA of eukaryotic cells is protected by:	poly a	7 methyl gtp	four or more u	7 methyl atp
30.	Each okazaki fragment is synthesized by DNA:	polymerase I	polymerase II	polymerase III	primase
31.	Down's syndrome is due to:	an extra X chromosome	an extra autosome	a missing X chromosome	a missing autosome
32.	The' replication of DNA in a semi conservative manner was practically demonstrated in 1958 by Mathew Meselson and:	Rosalind Franklin	Franklin Stahl	Maurice Wilkins	Griffith
33.	The chromosome is:	gene	genes + protein	gene + protein	DNA + genes
34.	Gene action in neurospora was studied by:	beadle and best	baddle and tatum	beadle and tatum	banting and tatum
35.	The one gene one enzyme explanation of gene action was developed by:	Morgans and Muller	Beadle and Best	Beadle and Tatum	Banting and Tatum
36.	The only difference between the normal and sickle cell hemoglobin is that at one place in the chain of amino acids glutamic acid, in the latter, is replaced by:	histidine	leucine	proline	valine
37.	The existing of familial diseases was first proposed by:	Archibald Garrot	William Bateson	G.W Beadle	both a and b
38.	The DNA strands open up at the place where enzyme is attached to the template strand forming:	rRNA	Transcription bubble	mRNA	tRNA

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39.	At the time of DNA replication, the primer is recognized by:	DNA polymerase I	DNA polymerase II	DNA polymerase III	any of them

No.	Questions	A	B	C	D
40.	RNA Polymerases in Eukaryotes are of:	one type	two type	three type	four type
41.	The basic monomers used in DNA replication are:	glucose	DNA nucleotides	fatty acids	amino acids
42.	To make a karyotype, chromosomes are photographed during:	meiosis	interphase	fertilization	mitosis
43.	When a mutation is limited to the substitution of one nucleotide pair for another, it is called a:	translocation	point mutation	inversion	deletion
44.	The creation of Mutations is called:	mutagenesis	evolution	development	mutagens
45.	Which mutations have evolutionary importance?	in blood cell	in germ line cells	in stem cells	in somatic cells
46.	During translation, peptide bond is formed in the initiation complex of ribosome at:	P site	A site	E site	Any of them
47.	Garrod investigated that in the disease alkaptonuria, the patient produces urine containing:	uric acid	gentisic acid	homogentisic acid	heterogentisic acid
48.	The length of a strand of DNA from a single human chromosome is about:	5 mμ	5 mm	5 mμ	5 cm
49.	In phosphodiester, phosphate is linked to two sugars by means of a pair of ester bonds which are:	P – O – C	C – O – C	N – H	C – N
50.	Mendel's work was rediscovered by:	Karl Correns	Walter Sutton	Thomas Hunt Morgan	Charles Darwin
51.	First evidence that genes reside on the chromosomes was presented by:	Sutton	Morgan	Correns	Mendel
52.	DNA was first discovered by:	Alfred Hershey	Martha Cahse	J.W. Watson	Friedrich Miescher

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UNIT NO. 2 (BIOLOGICAL MOLECULES) EXERCISE No. 2

1	B	**2**	C	**3**	C	**4**	C	**5**	D	**6**	**C**	7	D	8	A	9	D	10	A
11	B	**12.**	D	**13**	B	**14**	D	**15**	B	**16**	**C**	17	D	18	*	19	A	20	C
21	B	**22**	B	**23**	D	**24**	A	**25**	A	**26**	**B**	27	B	28	D	29	B	30	A
31	A	**32**	C	**33**	B	**34.**	B	**35**	C	**36**	**B**	37	C	38	D	39	D	40	B
41	C	**42**	C	**43**	B	**44**	D	**45**	B	**46**	**A**	47	B	48	A	49	C	50	D
51	A	**52**	A	**53**	B	**54**	C	**55**	D										

Get Solved **FLPs** and **Practice Questions** of each topic in the respective module at **www.nearpeer.org**

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ENZYMES

WHAT ARE ENZYMES?

- Any molecule that increases the rate of a chemical reaction without being used up during that reaction is catalyst. Biological catalysts are primarily protein molecules known as enzymes. Enzymes control reactions in living cells.
- An active enzyme may speed up a particular reaction but living organisms do not need all reactions to be going at the maximum rate all of the time. Enzymes interact with other molecules to produce an organized system.
- Many of the complex chemicals that living organisms need cannot be made in a single: reaction. Instead, a series of simpler reactions occur one reaction after another, forming a metabolic pathway, for example, different pathways in Photosynthesis & Respiration.

MODELS TO EXPLAIN HOW ENZYMES WORK:

1. The Lock and Key Hypothesis:

- Enzyme function depends ~n an area on the molecule known as the active site.
- The active site is a groove or pocket in the surface of the enzyme into which the substrate molecule fits. Typically, the active site is formed by 3 to 12 amino acids.
- The size, shape and chemical nature of the active site corresponds closely with that of the substrate molecule.

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According to this hypothesis the active site is a rigid structure. There is no modification or flexibility in the-active-site before during or after the enzyme action and it is used only as a template. This hypothesis/model does not support all reactions.

2. Induce Fit Hypothesis:

- On the basis of new evidences Koshland (1959) proposed this hypothesis/model.
- The active site in many enzymes is not exactly the same shape as the substrate, but moulds itself around the substrate as the enzyme-substrate complex is formed. Only when the substrate binds to the enzyme in the active site the correct shape is developed. It means that when a substrate combines with an enzyme it induces changes in the enzyme structure. This change allows the enzyme to do its catalytic activity more effectively.

How fast do enzymes work?

The speed at which an enzyme works is expressed as its turnover number. This is the number of substrate molecules turned into product in one minute by one molecule of enzyme. Values range from less than a hundred to many millions.

Naming and Classifying Enzymes:

International Union of Biochemistry has developed a scheme for naming and classifying enzymes. Enzymes are mostly named by adding the suffix -ase to the name of their substrate. The rest of the name indicates the nature of the reaction. For example, alcohol dehydrogenase - catalyzes the removal of hydrogen from alcohol (ethanol).

Six Main Categories of Enzymes:

- **Oxidoreductases:** These are involved in oxidation and reduction (redox) reactions. In aerobic respiration, most of the cells ATP is generated by redox reactions.
- **Transferases:** These catalyze the transfer of a chemical group from one compound another. Transfer of an amino group from an amino acid to another organic acid in the process of transamination.
- **Hydrolases:** These catalyze hydrolyses (splitting by use of water) reactions. Most digestive enzymes are hydrolases.

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- **Lyases:** These catalyze the breakdown of molecules by reactions that do not involved hydrolysis.
- **Isomerases:** These catalyze the transformation of one isomer into another, for instance the conversion of glucose 1,6 bisphosphate into fructose 1,6 bisphosphate.
- **Ligases:** These form bonds between compounds using ATP. For example, DNA ligase is involved in the synthesis of DNA.

HOW INHIBITORS HELP TO CONTROL METABOLISM?

- Many metabolic pathways are self-controlling. When a substance is needed, a particular pathway is activated to produce it. When enough has been produced, the pathway is deactivated.
- This happens because some enzymes in a metabolic pathway are inhibited by the end product. When the product is once more in short supply, the inhibition is lifted and the pathway becomes active again. This self-regulation is an example of negative feedback. This is a fundamental principle important in homeostasis.

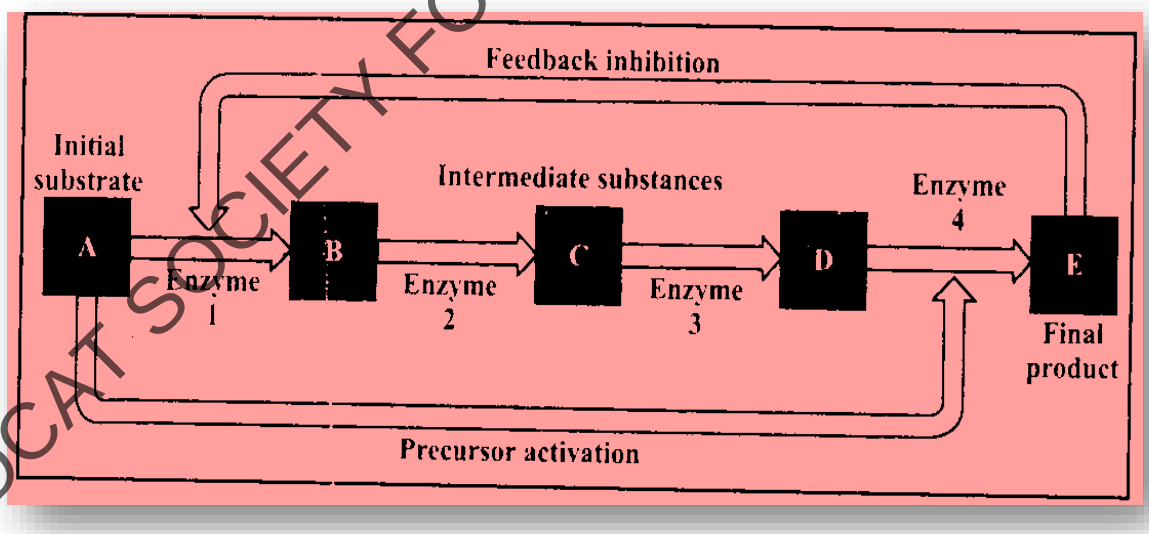

Fig: Enzyme to enzyme chain (association)

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Enzyme Inhibitors:

An inhibitor is a chemical substance which can react (in place of substrate) with the enzyme but is not transformed into product(s) and thus blocks the active site temporarily or permanently (for example poisons, like cyanide, antibiotics, antimetabolites and some drugs).

OR

Enzyme inhibitors are molecules that interact in some way with the enzyme to prevent it from working in the normal manner.

Inhibitors may be nonspecific or specific.

Specific inhibitors may be irreversible or reversible. (Competitive and noncompetitive)

Nonspecific Inhibitors:

A nonspecific inhibition affects all enzymes in the same way. Non-specific methods of inhibition include any physical or chemical changes which ultimately denature the protein portion of the enzyme.

Two main types are:

(i) **Temperature:**

Usually, the reaction rate increases with temperature, but with enzyme reactions, a point is reached when the reaction rate decreases with increasing temperature. At high temperatures the protein part of the enzyme begins to denature, thus inhibiting the reaction.

(ii) **Acids and Bases:**

Enzyme activity is also controlled by pH. As the pH is decreased or increased the nature of the various acid and amine groups on side chains is altered with resulting changes in the shape or structure of the enzyme.

Specific Inhibitors:

Specific inhibitors may be irreversible or reversible (competitive and noncompetitive).

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Irreversible Inhibitors:

- These form strong covalent bonds with an enzyme.
- These inhibitors may act at near or remote from the active site.
- They may not be displaced by the addition of excess substrate.
- The basic structure of the enzyme is modified to the degree that it ceases to work.
- Since many enzymes contain sulfhydral (– SH), alcohol, or acid groups as part of their active sites, any chemical which can react with them acts as an irreversible inhibitor. Heavy metals such as Ag^{+}, Hg^{2+},Pb^{2+} have strong affinities for –SH groups.

Reversible Inhibitors:

They form weak linkages with the enzyme. Their effect can be neutralized completely or partly by increase in the substrate concentration.

They are of two types which are competitive and non-competitive.

(i) **Competitive Inhibitors:**

They have structural similarity with the substrate and are selected by the binding sites cannot activate the catalytic sites. As a result product(s) are not formed.

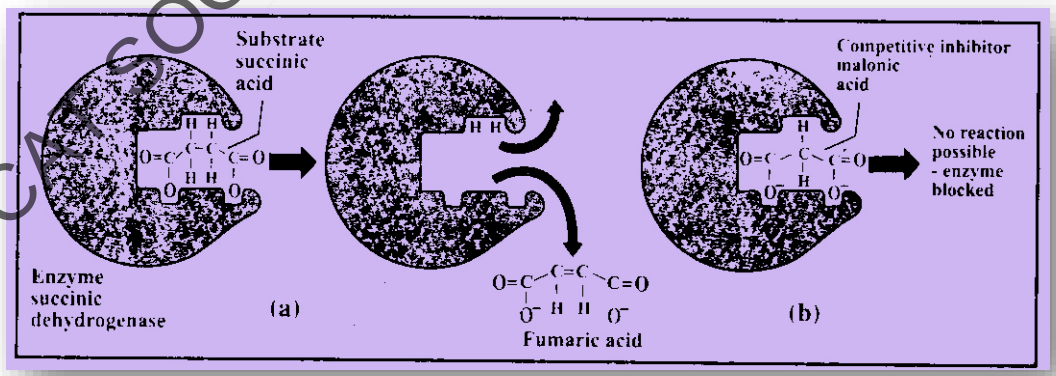

Fig.Mechanism of competitive inhibition.

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(a) Formation of enzyme-substrate complex resulting in the formation of product.

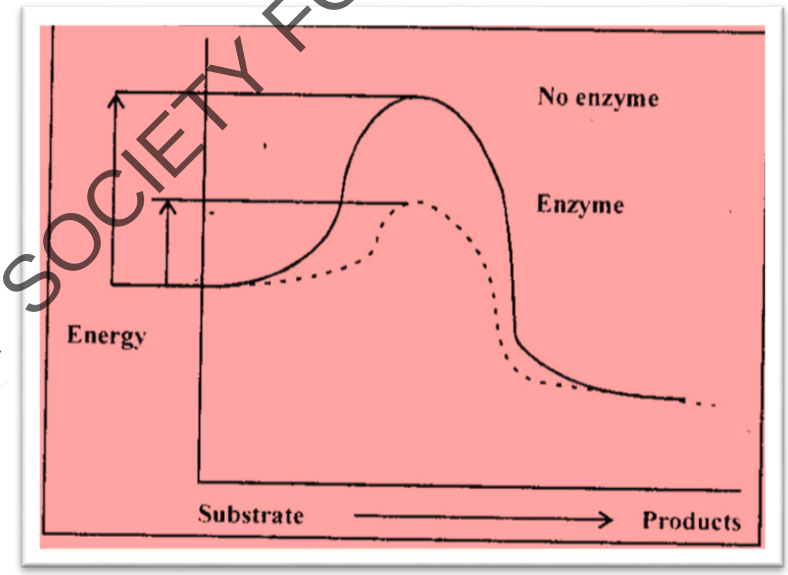
(b) Inhibitor malonic acid does not fit the active site, hence no product is formed.

(ii)**Non-Competitive Inhibitors:**

They form enzyme inhibitor complex at a point other than the active site. They are the enzyme structure in such a way that even if a substrate binds the active site catalysis does not occur.

Enzymes and Activation Energy:

To start chemical reactions some energy is required. This energy is called activation energy. The way enzymes operate is by lowering the amount of activation energy required for a chemical reaction to start. This happens because enzymes weaken a covalent bond within a substrate molecule. In other cases this lowering of activation energy happens because the enzyme holds the substrate molecules in a particular.



This diagram shows that without the enzyme, much more activation energy is required to get chemical reaction to take place.

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BASIC FACTS ABOUT ENZYMES

1. The catalytic activity of an enzyme is due to active site. It is a small portion of enzyme consisting of few amino acids.

2. The enzyme and its substrate react with each other through active sites.

3. The active site is a three dimensional cavity bearing a specific charge.

4. Most of the enzymes have a non-protein part known as a co-factor.

5. Cofactor is directly involved in chemical reaction for catalysis. Cofactor acts as "bridge" between enzyme and its substrate. Sometimes the co-factor provides energy to drive the reactions.

6. There are three kinds of a cofactor:

   (a) The detachable inorganic ion (metal ion) working as co-factor is known as an activator e.g. Cu/Zn.

   (b) The covalently bonded non-protein part of enzymes is known as prosthetic group e.g., Lipids.

   (c) If the non- protein portion is loosely attached to the protein part it is known as coenzyme e.g. Vitamins.

7. An enzyme with its coenzyme or prosthetic group removed is called Apo enzyme.

8. An activated enzyme consisting of polypeptide chain and a cofactor is known a, Holo enzyme.

9. The conditions under which enzymatic activity is destroyed by disrupting bonds between the atoms in an enzyme are: High temperature and extreme changes in pH.

10. Enzymes are also produced in the cells near the site of function.

11. Many enzymes are dissolved in the cytoplasm. Others are bound to the sub-cellular organelles.

    For example:

    (a) Enzymes for photosynthesis are present in the Chloroplasts.

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(b) Enzymes for cellular respiration are present in the Mitochondria.

(c) Some enzymes of protein synthesis are present in Ribosomes.

12. All metabolic activities occurring in the cells are carried out by specific enzymes.

13. Enzymes are sensitive to a small change in pll, temperature and substrate concentration.

14. Some enzymes are damaging if they become active in the wrong place. Pepsin produced in inactive pepsinogen form. If it is produced in the active form .it may cause cancer.

15. Mechanism of enzyme action is called catalysis.

16. The active site of the enzyme is made up of binding site and catalytic site.

17. The binding site helps in identification/Recognition and binding of a proper substrate: form E-S complex. This reaction activates the catalytic site. The catalytic site catalyzes the transformation of substrate into product(s). The enzyme after catalysis detaches from the products unchanged.

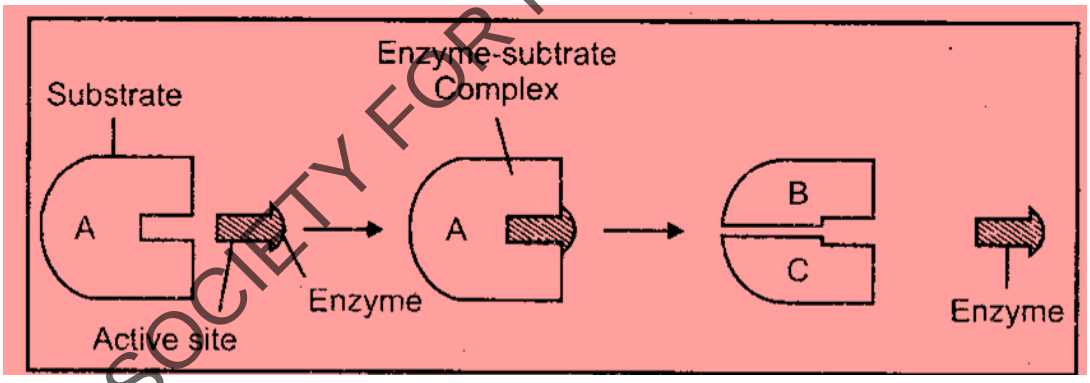

Fig. mode of action of enzymes.

18. An enzyme has specific function because its chemistry and configuration (shape) is specific. Any factor that can change the chemistry and shape of an enzyme can affect its rate of catalysis.

19. Some factors that can affect the rate of enzyme action are: enzyme concentration, substrate concentration, temperature, and pH value.

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20. If substrate concentration is unlimited then the rate of reaction depends on the amount of enzyme present at a specific time. If the amount of enzyme is doubled the reaction rate is also doubled.

21. **Reason:** The increase in enzyme number causes increase in active sites. More active sites will convert more substrate into product(s), in a given time.

22. At low substrate concentration the reaction rate is directly proportional to the substrate.

23. If the enzyme concentration is constant the rate of reaction increases with an increase with substrate concentration.

24. The temperature at which activity of enzyme is maximum is called as optimum temperature. The increase in temperature causes increase in reaction rate of enzyme up to a certain limit. For enzymes of human body 37°C is the optimum temperature.

25. Heat provides activation energy. Heat also supplies kinetic energy to the molecules. At high temperature globular structure is lost and the enzyme is denatured. Globular structure is necessary for enzyme activity.

26. The enzymes function at narrow pH range is called optimum pH. A slight change in 'pH can change the ionization of the amino acids at the active site and the ionization of the substrates. Now enzyme activity is either retard or blocked completely. A great change in pH causes the bonds in the enzyme to break. The result is the denaturation of enzyme.

27. A condition in which all of the active sites of enzymes are occupied by substrate molecules is called Enzyme saturation.

28. A complex consisting of an enzyme and its reactant (substrate) which is held together by weak bonds is called Enzyme-substrate (ES) complex. The formation of an ES is the first step in enzyme catalysis.

29. A type of metabolic pathway control that regulates the rate at which the cells synthesize amino acids (or other monomers) and use them in building proteins (or other polymers) is called Feedback inhibition.

30. An organic molecule that functions as a coenzyme is the Vitamin.

31. Allosteric enzyme is an enzyme that undergoes reversible changes in shape and in catalytic activity.

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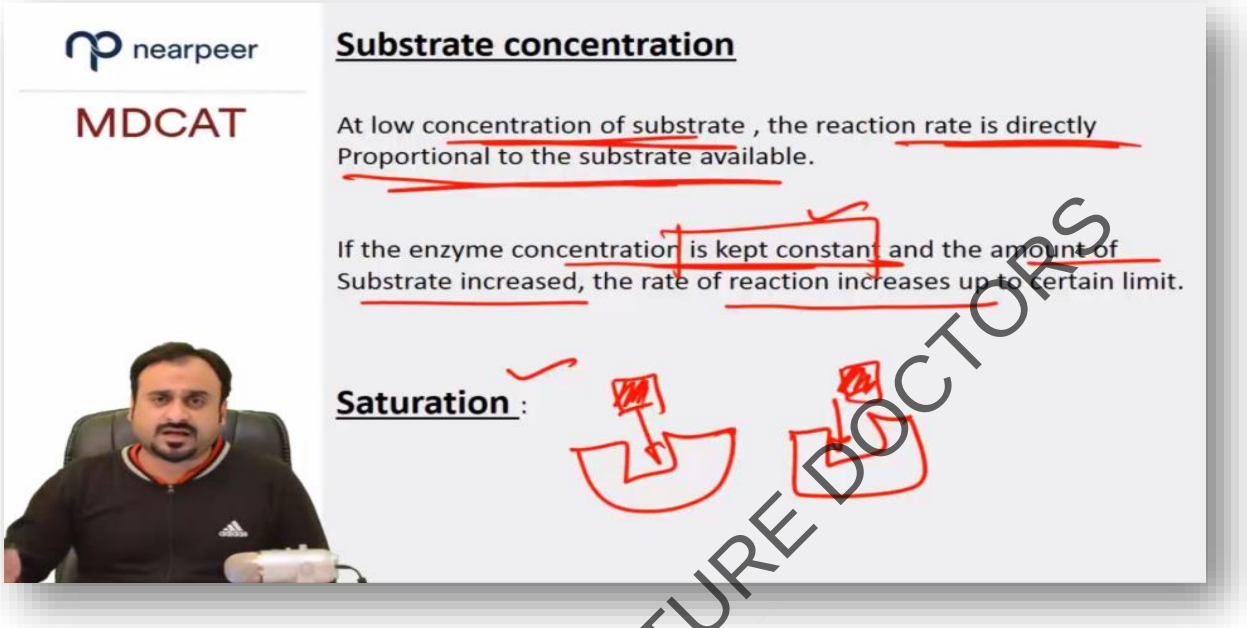

For easy understanding of **Enzymes** with reference to **MDCAT preparation**, watch Enzymes Model video at **www.nearpeer.org**

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QUESTIONS FOR PRACTICE

No.	Questions	A	B	C	D
1.	A metabolic pathway is a:	Route taken by chemicals through a solution	Sequence of enzyme controlled reactions	Route taken by a single particular enzyme	Routes taken by all enzymes in a specific medium
2.	Energy must be added for a chemical reaction to start. This is energy of:	Activation	Entropy	Enthalpy	Oxidation
3.	Sucrase (invertase) acts on:	Sucrose	Sucrose and starch	Any disaccharide	Any organic Monomer
4.	Starch is converted into maltose by:	Diastase	Invertase	Maltase	Hydrozenase
5.	Blocking of active site of an enzyme temporarily is a type of:	Non-competitive inhibition	Irreversible inhibition	Competitive inhibition	Feedback Inhibition
6.	A group of enzymes called hydrolases acts upon:	Lipids	Proteins	Carbohydrate	All of these
7.	A complete enzyme is:	Holoenzyme	Apoenzyme	Coenzyme	Cofactor only
8.	Which enzyme digests the major food source in Bean and Sunflower?	Amylase	Lipase	Diastase	Protease
9.	Co-enzyme is often formed from:	protein	vitamin	lipid	inorganic ion
10.	Enzymes which are slightly different in molecular structure but can perform similar activities are called:	dehydrogenases	kinases	isozyme	apoenzyme
11.	Active enzymes present in:	viroids	prions	viruses	mycoplasma
12.	Temp. is going from 15 to 41° C, rate of reaction is going:	down	up	down then up	up then down
13.	Active site of enzyme is produced by:	globular structure	charges	fibrous structure	both a and b
14.	In feedback inhibition, a metabolic pathway is switched off by:	accumulation of end product	competitive inhibition	lack of substrate	rise in temperature
15.	Enzyme groups recognized by IUB:	2	4	6	8
16.	Cyclic pathway controlled by enzymes present in:	chloroplast	mitochondria	nucleus	both a and b
17.	Protein into peptones by:	pepsin	trypsin	Erypsin	both a and b
18.	Which one is hydrolase?	amylase	polymerase	Enolase	all of these

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19.	Which one is present in the seed?	hormone	vitamin	enzymes	all of these
20.	Common function of enzyme, vitamin and Hormone is:	used	specific	Helpful	oxidative
21.	Enzyme reaction per second is:	100	1000	10000	100000

No.	Questions	A	B	C	D
22.	Enzyme study is:	invivo possible	invitro possible	impossible	it is possible to study enzymes both invivo and invitro
23.	An enzyme at below 5° C is:	activated	un-activated	denatured	destroyed
24.	Co-enzyme is often a:	protein	vitamin	lipid	inorganic ion
25.	A co-factor may be activator, prosthetic group of:	enzyme	coenzyme	ion	lipid
26.	A non-protein part of enzymes is known as a:	co-factor	lipid	factor	carbohydrate
27.	The substance with which enzyme acts is called:	coenzyme	product	both a and b	substrate
28.	For substrate succinic acid, the competitive inhibitor is:	malic acid	succinate	malonic acid	fumaric acid
29.	Some enzymes consist solely of:	carbohydrates	nucleic acids	fats	proteins
30.	All enzymes are proteins which are:	globular	fibrous	a helix	a helix and b-pleated
31.	According to _____ model the active site is a rigid structure	fluid mosaic	lock and key	induce fit	unit membrane
32.	Koshland (1959) proposed:	induce fit model	lock and key model	fluid mosaic model	unit membrane model
33.	At low concentration of substrate the reaction rate is directly proportional to the:	substrate available	enzyme available	coenzyme available	cofactor available
34.	The catalytic activity of an enzyme is restricted to its small portion:	active site	passive site	cofactor	only binding site
35.	An activated enzyme made of polypeptide chain and a co-factor is:	substrate	co-enzymes	apoenzyme	holoenzyme
36.	A method of injecting enzymes to replace those that are missing because of genetic mutations:	enzyme replacement therapy	enzyme therapy	enzyme production	one gene one enzyme hypothesis
37.	The study of enzymes is called:	enzymology	metabolism	molecular biology	biochemistry

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38.	Study of fermentation is:	anaerobics	zymology	fermentology	biochemistry
39.	The enzymes recognized are:	more than 10	more than 100	more than 1000	more than 10000

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UNIT NO. 2 (ENZYMES)

1	**B**	**2**	**A**	**3**	**A**	**4**	**A**	**5**	**C**	**6**	**D**	**7**	**A**	**8**	**B**	**9**	**B**	**10**	**C**
11	D	**12.**	D	**13**	D	**14**	A	**15**	C	**16**	**D**	17	D	18	A	19	B	20	D
21	D	**22**	B	**23**	**B**	**24**	B	**25**	B	**26**	**A**	27	D	28	C	29	D	30	A
31	B	**32**	A	**33**	A	**34.**	A	**35**	D	**36**	**A**	37	A	38	A	39	B	40	C

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MICROBIOLOGY

MAJOR CONTENTS

Content:

→ Virus
→ Bacteria
→ Fungi
→ Further/Related Readings

Learning Outcomes:

(a) Which are the viral diseases in humans?
(b) Reteroviruses and Acquired Immunodeficiency diseases
(c) Describe the Life cycle of Bacteriophage (in detail with its all steps) including:
- Lytic cycle
- Lysogenic cycle

(d) Describe the structure and types of bacteria
(e) Discuss in detail:
- Gram + ve bacteria
- Gram – ve bacteria
- Nutrition in bacteria

(f) What are the uses and misuses of antibiotics?
(g) What are molds (fungi)?
How they are useful and harmful to mankind, give examples?
(h) Describe the Life cycle of fungus (Rhizopus).

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VIRUSES

- The word virus is derived from Latin word venome which means poisonous fluid. Virus can be defined as:
- Non-cellular, submicroscopic infectious agents which contain either RNA or DNA, enclosed by proteinaceous coat, and reproduce only in living cells (obligate intracellular: parasites)
- Viruses use biosynthetic machinery of the host to make their materials and then transfer too their cells. Study of virus is known as virology

DISCOVERY OF VIRUS

- Some viral diseases have been known from centuries.
- The first infectious disease against which presentation was developed was a viral disease.

1. Work of Edward Jenner:

In 1796. Edward Jenner discovered an effective method for the prevention of a viral disease small pox. He removed material from cowpox lesion on the hand of milkmaid and injected into an 8 years old boy (James Phipps). After six weeks the boy was injected with pus from a small pox victim. He did not develop the disease. Jenner used material for vaccination from cowpox lesions and successfully vaccinated 23 persons. As the material was obtained from cow (called vacca in Latin), this method was named as vaccination by Louis Pasteur.

2. Work of Charles Chamberland:

- Charles Chamberland (1884) found that bacteria cannot pass through porcelain filters. However agents responsible for rabies can pass through these filters.
- Any toxic substance that caused disease was called virus. These unseen filterable agents of rabies were called as filterable viruses.

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- Rabies is a disease which is transferred to human by bites of rabid dogs, foxes, cats, bats and other animals.

3. Work of Ivanowski:

- In, 1892, lvanowski discovered that the agent which caused tobacco mosaic disease was filterable.
- He obtained bacteria free filtrate from infected plants and placed it on healthy leaves of tobacco.
- The filtrate caused the disease in healthy plants.
- Later these ultramicroscopic agents were also observed in victims of many diseases including foot and mouth disease (1898) and yellow fever (1901).
- In 18?8 the Dutchman Beijerink formed the name 'virus' (Latin for poison) to describe the infectious nature of certain filtered plant fluids.
- Although progress was made in isolating highly purified samples of viruses and in identifying them chemically as nucleoproteins (nucleic acids combined with proteins). the particles still proved mysterious because they were too small to be seen with the light microscope. They were among the first biological structures to be studied when the electret, microscope was developed in the 1930s.
- Stanley (1935) crystallized the tobacco mosaic virus.

CHARACTERISTICS OF VIRUSES

Viruses are small infectious agents and can be seen under electron microscope. They nave following characteristics:

1. Size:

They range in size from 250 nm of Pox viruses to 20 nm of Parvoviruses.

2. Filterable:

They are **10 to 1000** times smaller than bacteria. So they can pass through the pores of filter from which bacteria cannot pass.

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3. **Obligate** Intracellular **Parasites:**

Viruses cannot grow on artificial media. They can reproduce in animal cells, plant cells or in microorganisms.

Here they reproduce by replication (a process by which many copies or replicas of virus are formed). Therefore the viruses are obligate intracellular parasites.

4. **No Metabolic Machinery:**

Viruses have no metabolic machinery for the synthesis of their nucleic acid and protein They depend on the host cell to complete vital functions.

5. **Disease Production:**

They can cause disease in the host during reproduction.

6. **Resistant to Antibiotics:**

They are generally resistant to many antibiotics such as penicillin, streptomycin and others. Each type of virus will recognize and infect only certain types of cell. In other words, viruses are highly specific to their hosts.

STRUCTURE OF VIRUS

VIRION:

- The complete, mature and infectious particle is known as virion.
- It has following parts:

1. **Genome:** The virions are composed of a central core of nucleic acid (DNA or RNA) which is also called genome.

2. **Capsid:**

The genome is surrounded by a protein coat, the **capsid.**

Nucleic acid and capsid is collectively called **nucleocapsid.**

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Capsid gives definite shape to virion.

Capsid is made up of protein subunits known as **capsomeres.**

The number of caspomeres varies in a particular virus.

Examples:

- 162 capsomeres in the capsid of herpes virus.
- 252 capsomeres in the capsid of adenovirus which cause some common colds.

Enveloped or Naked Vireons:

(i) In some animal viruses the nucleocapsid is covered by a membrane called envelope. This membrane is derived from the host cell.

(ii) The viruses which are not enveloped are known as naked vireons.

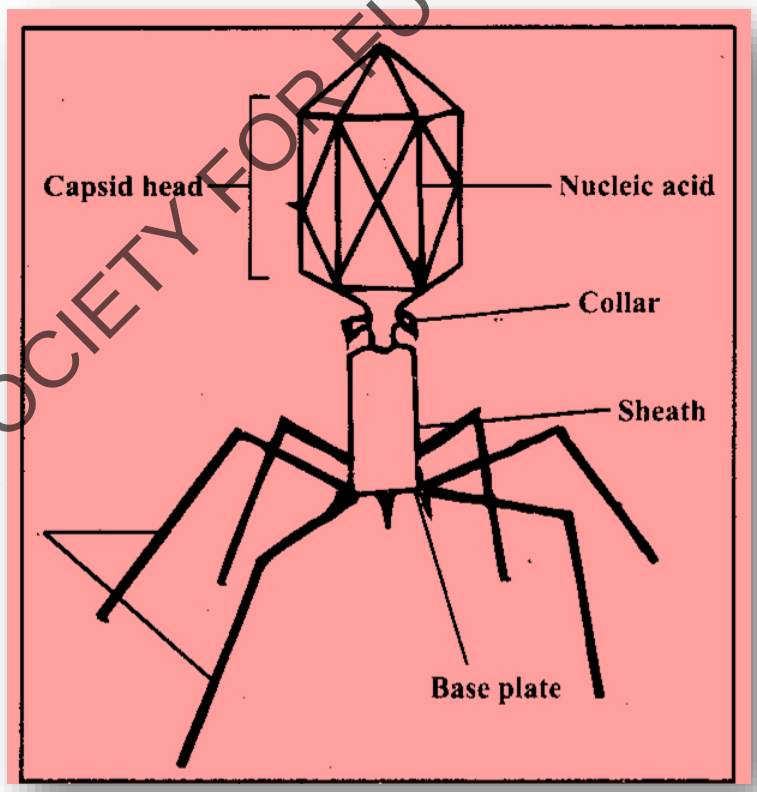

Fig. A bacteriophage

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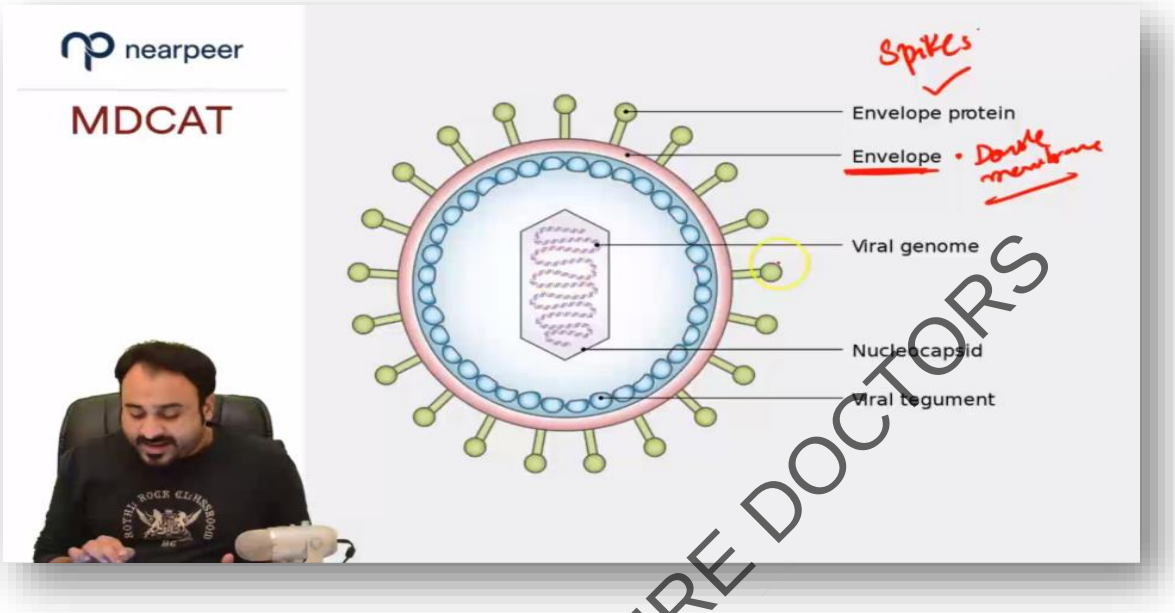

Watch colorful version of virus with animated texts and learn this concept in a fun way. Visit: **www.nearpeer.org** and select **Module 4** of **BIO**.

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SHAPES OF ANIMAL AND PLANT VIRUSES

Animal and plant viruses may be:

- polyhedron (having many sides)
- helical (spiral)
- enveloped or
- complex

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SHAPES OF BACTERIOPHAGES:

These have two shapes (structural forms):

- **Cubical:** These arc regular solid or **icosahedral** (having 20 triangular faces).
- **Helical Symmetry:** They are rod shaped. Many phages consist of head and tail. The heads are polyhedral but tails are rod shaped.

STRUCTURE OF BACTERIOPHAGE

Bacteriophage meaning bacteria eater, earlier workers studied few phages that infect Escherichia coli. Of these the best phages are T phages (T for type).Two main types of T phages are T_2 and T_4.

Structure of T_4:

The structure under electron microscope looks like a tadpole and consists of head and tail.

- **Head:** The head is elongated having Pyramidal (having two triangular structures with common. base), hexagonal or prism shaped structure to it straight tail is attached. Head contains double stranded DNA.
- **Tail:** The structure of tail is more complex than head. Tail has a core of protein which is surrounded by a sheath of another protein. On one side of the sheath is collar and on the other side is end plate (Base plate). Six tail fibers are attached to the end plate. These fibers are for attachment.

Volume of the Phage:

- It is about 111000 of the host.

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CLASSIFICATION OF VIRUSES

Different types of plant, animal and. bacterial viruses are classified on the basis of morphology, cover and nucleic acid properties.

- **Genetic Material:** The genetic material may be DNA or RNA
- **Cover:** The genetic material may be naked, enveloped or complex.
- **Morphology:** On the basis of morphology viruses are classified into rod shaped (T.M.V), spherical (poliovirus), tadpole like (bacteriophage) and many more figure.

RETROVIRUSES (ON COVIRUSES)

RNA tumor viruses are widely distributed in nature: These produces tumor in the fowls, rodents, cats and many other animals. The most familiar virus is the human immune deficiency virus (HIV) which causes acquired immune deficiency syndrome (AIDS).

- **Structure:** They are single stranded RNA viruses which are spherical in shape and about 100 nm in diameter. They are enveloped by host plasma membrane.
- **Characteristics:**
    - Retroviruses have following characteristics:

(i) Host Specificity:

- A few retroviruses are non-specific and can infect any cell. Most of them infect host cell that have required receptors.
- In the case of AIDS virus, the host ceil has a receptor that allows viral adsorption and penetration of many types of leukocytes (white blood cells) and tissue cells.

(ii) Reverse Transcriptase:

The retroviruses have a special enzyme called reverse transcriptase. It can convert a single stranded RNA genome into double stranded viral DNA.

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(iii) Mode of Action:

The DNA of the retrovirus infects the host cells. They also unite with host genome as a provirus that can be passed to progeny cells. In this way some of the retroviruses can converts normal cells into cancer cells.

DISEASES CAUSED BY VIRUSES

1. Small Pox:

(i) Virus: It is caused by pox viruses: This virus is DNA enveloped.

(ii) History: This disease occurred as epidemic in China in 12th century B.C. Until the early 20th century, it was common.

(iii) Symptoms/Effects: This disease results in the formation of raised fluid-filled vesicles on the body. These become pustules later on and form pitted scars, the pocks.

(iv) Prevention: By 1950's immunization and other control measures had decreased the disease. However it is still present in the third world countries where many people are affected.

2. Herpes Simplex:

(i) Virus:

It is caused by Herpes virus (DNA virus). It is naturally occurring disease of mankind.

(ii) Symptoms / Effects: This disease most occurs in the mouth. on the lips, and at other skin sites. In this disease vascular lesions are formed in the epithelial layers of ectodermal tissues.

3. Influenza:

(i) Virus: Influenza viruses are enveloped RNA viruses.

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(ii) **Epidemic Disease:** It is very common in man and occurs in epidemic form.

4. MUMPS AND MEASLES:

(i) **Virus:** Mumps and Measles viruses belong to group paramyxoviruses. They are large, enveloped, RNA viruses.

(ii) **Occurrence:** It is highly contagious (communicable) wide spread, but rarely fatal. About 60 of adults are immune to it.

- Measles is a common disease among children and adults all over the world. This disease develops immunity in its victim.

5. Polio:

(i) **Virus:** Poliomyelitis is caused by polio virus. It is the smallest known virus. It contains RNA in spherical capsid.

(ii) **Occurrence:** It is present all over the world. It occurs mostly in children. The age at which primary infection occurs depends upon social and economic factors.

6. Acquired Immuno Deficiency Syndrome (AIDS)

(i) **Discovery:** The AIDS was reported by some physicians in early 1980's in the young males. All these young patients were homosexuals.

- This disease was also discovered in non-homosexual patients who were given blood (blood transfusion) or blood products.
- In 1984 the agent causing the disease was identified by research teams from Pasteur Institute in France and National Institute of health in USA.
- In 1986 the virus was named as human immunodeficiency virus (HIV).

(ii) **Symptoms:**The patient has complex symptoms such as severe pneumonia, a rare vascular cancer, sudden weight loss, swollen lymph nodes and general loss of immune system.

(iii) **Pathogenicity:**The major cell infected by HIV is the helper T -lymphocyte. It is the major part of the immune system.

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The decrease of helper T-lymphocytes results in failure of the immune system. Now the infected person is susceptible to other diseases. Cells of central nervous system can alsobe infected by HIV.

(iv) **Host Specificity:**It has been found recently that HIV infect and multiply in monkey but do not cause disease in them. It means that HIV is host specific.

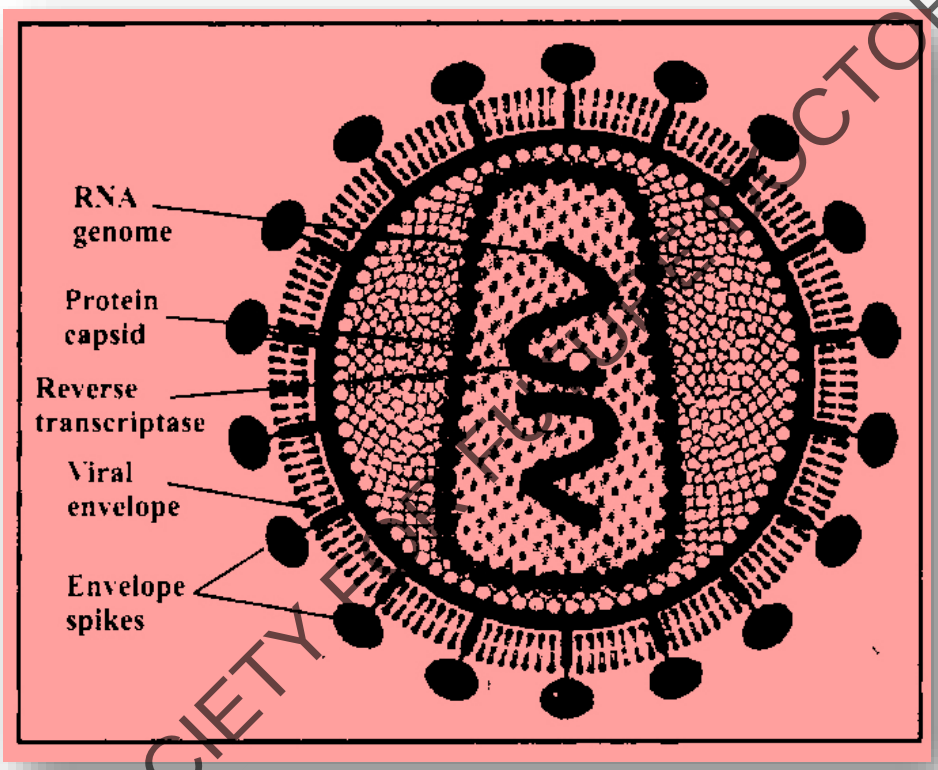

Fig. Human immunodeficiency virus (HIV)

(v) **Transmission:** The HIV is transmitted by:

(a) Sexual contact

(b) Contact with blood

(c) Breast feeding and

(d) Healthcare workers can also acquire HIV during professional activities.

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(vi) **Prevention:** Important preventive measure is avoiding the direct contact with HIV. Intravenous injection if drugs with common syringes must be prevented. Sterile needles/syringes and utensils must be used.

(vii) **Vaccination:** Now the vaccine against HIV has been formed and its experimental supply to humans started in early 200 I in South Africa.

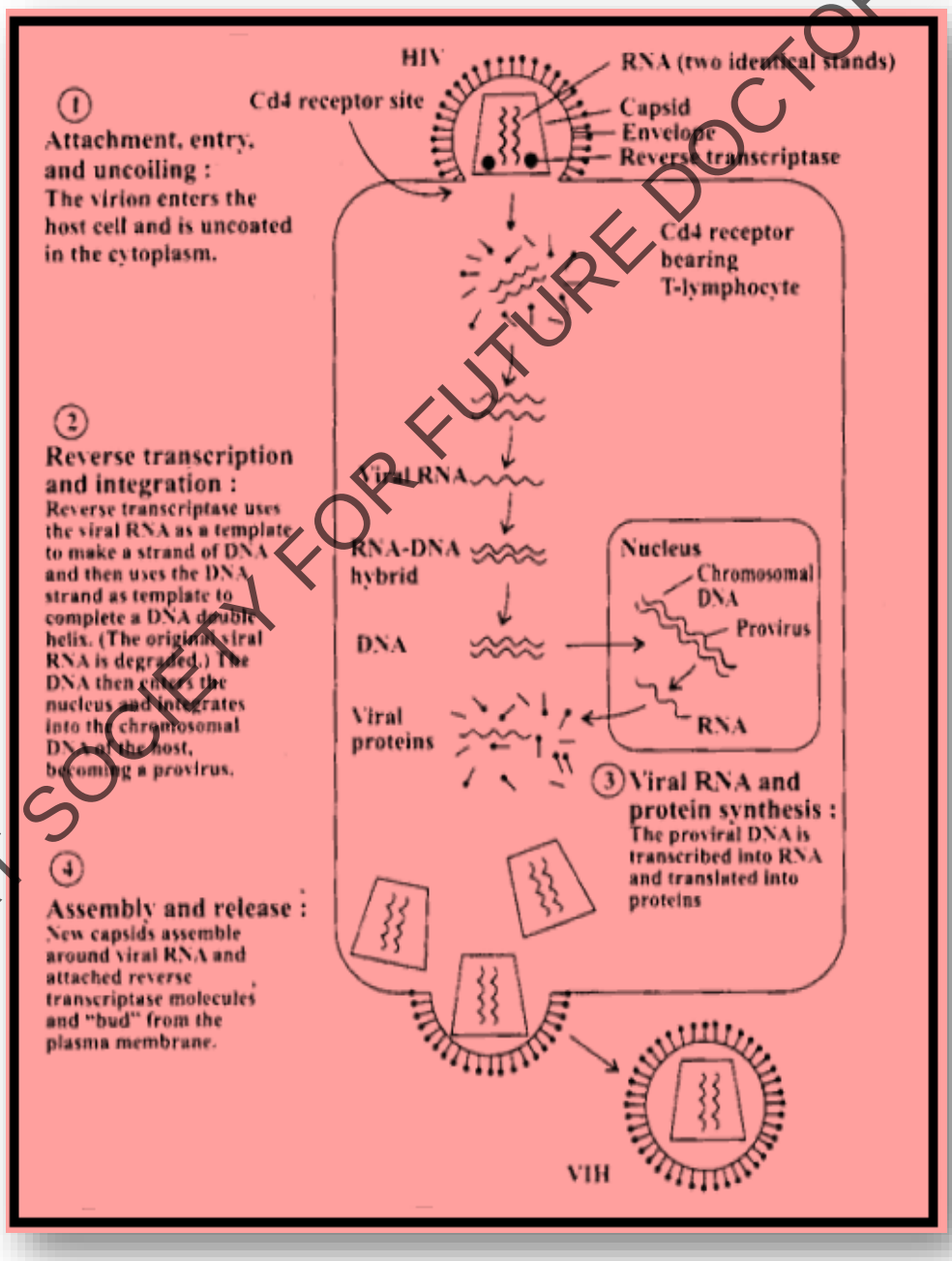

Fig. Infection cycle of HIV

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7. Hepatitis:

(i) Pathogenicity:

It is an inflammation of the liver. It is usually caused by viral infection, toxic agents or drugs.

(ii) Symptoms:

Following are symptoms:

- Jaundice
- Abdominal pain
- Fatigue and
- Sometimes fever
- It may be mild or can be sharp and can lead to liver cancer.
- Liver enlargement

TYPES OF HEPATITIS:

Following are different types of hepatitis:

(a) Hepatitis A:

It was formerly called infectious hepatitis.

Hepatitis A virus (HAV) is an RNA virus (non-enveloped).

The disease is mild, short term and less virulent.

It is transmitted by contact with feces from infected individuals.

Vaccine is available for HA V.

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(b) Hepatitis B:

It is also called serum hepatitis. Hepatitis B (HBV) is the second major form of hepatitis.

(i) Virus:

Hepatitis B virus (HBV) is a DNA virus.

(ii) Occurrence:

It is very common in Asia, China, Philippines, Africa and the Middle bt~;l.

(iii) Transmission:

It is transmitted by the exchange of body fluids, for example blood serum, breastmi and saliva.

During birth it is transmitted from mother to child.

It is also transmitted by sexual contact.

(iv) Symptoms:

During acute attacks of Hepatitis B different symptoms appear like fatigue, loss appetite and jaundice.

Infected persons can recover completely and become immune to the virus.

People with chronic hepatitis infection are at the risk of liver damage.

Prevention:

Hepatitis can be controlled by:

- Taking hygienic measures,
- **Vaccination.** (Genetically engineered vaccine is available for HBV) and screening of blood/organ/tissue of the donor.

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(c) Hepatitis C:

- It was formerly called non-A. non-B hepatitis.

(i) **Virus:**

- Hepatitis C virus (HEV) is also RNA virus (enveloped)

(ii) **Symptoms / Effects:**

- It causes infusion hepatitis, which is less severe than hepatitis A or hepatitis B. However hepatitis C often leads to chronic liver disease.

(iii) **Transmission:**

- Through blood from mother to child during pregnancy and afterward and by sexual contact.

Note: Vaccine is not available for HCV.

(e). Hepatitis D:

- It is also called as delta hepatitis.

(f). Hepatitis E:

- HEV is transmitted through the feces of an infected person.
- **Halbur** and coworker (2001) said that hepatitis E could be transmitted through pig.

(g). Hepatitis F and G:

- Hepatitis F & G are caused by unidentified virus.

(8). PRIONS

- These are infectious proteins discovered in 1983. They contain the information that codes for their own replication. All other organisms contain their genetic information in nucleic acid (DNA or RNA).

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- **EFFECTS:** Prions are responsible for: mad cow infection and mysterious brain infection in man.

LIFE CYCLE OF BACTERIOPHAGES:

- The bacteriophage replicates only inside the bacterial cell.
- There are many steps in replication.

Attachment (Adsorption) of Phage to the Host Cell:

- First of all the bacteriophage attaches to the bacterial cell at receptor site. The receptor sites are present on the cell wall of bacterium.
- During attachment week chemical union occurs between virion and the receptor site.

Penetration:

- In this step the tail releases the enzymelysozyme. This enzyme dissolves a portion of the bacterial cell wall.
- The tail sheath contracts and tail core is forced into the cell through cell wall and cell membrane.
- The virus injects its DNA into the cell (just as the syringe is used to inject the vaccine).
- The protein coat, consisting of head and tail, remains outside the cell.
- Many animal viruses enter the host cell as a whole.
- After penetration one of the following cycles takes place:

(i) Lytic cycle
(ii) Lysogenic cycle

➢ **Lytic Cycle:**

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- During lytic cycle following steps occur:

(a) Multiplication:

- Soon after entering the bacterium, the viral DNA takes the control of the biosynthetic machinery of the host.
- The host is forced to synthesize viral DNA and proteins. As a result viruses begin to multiply.
- Within 25 minutes about 200 new bacteriophages are formed.

(b) Lysis:

- After the formation of bacteriophages, the bacterial cell bursts (lysis occurs).
- Newly formed bacteriophages are released to infect other bacteria. A new lytic cycle may start.
- The phage that causes lysis of the host cell is called lytic or virulent phage.

➢ **Lysogenic Cycle:**

❖ In some cases instead of lytic cycle, lysogenic cycle takes place. It occurs as follows:

(a) Formation of Prophage: The viral DNA does not take over the control of host's machinery.

The DNA is incorporated into the bacterial chromosome. Phage at this state is called prophage and this process is known as lysogeny.

The phage which causes lysogeny is called temperate (lysogenic) phage.

Lysogenic bacteria are resistant to infection by the same or related phages.

(b) Replication: During lysogeny the bacterium lives and reproduces normally.

Viral DNA is the part of bacterial chromosome and passes to each daughter cell generation after generation.

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(c) **Induction:** Sometimes the viral DNA detaches from the chromosome of the host and lytic cycle starts. This process is called induction. Induction is spontaneous or environmentally induced excision of the prophage from the bacterial chromosome.

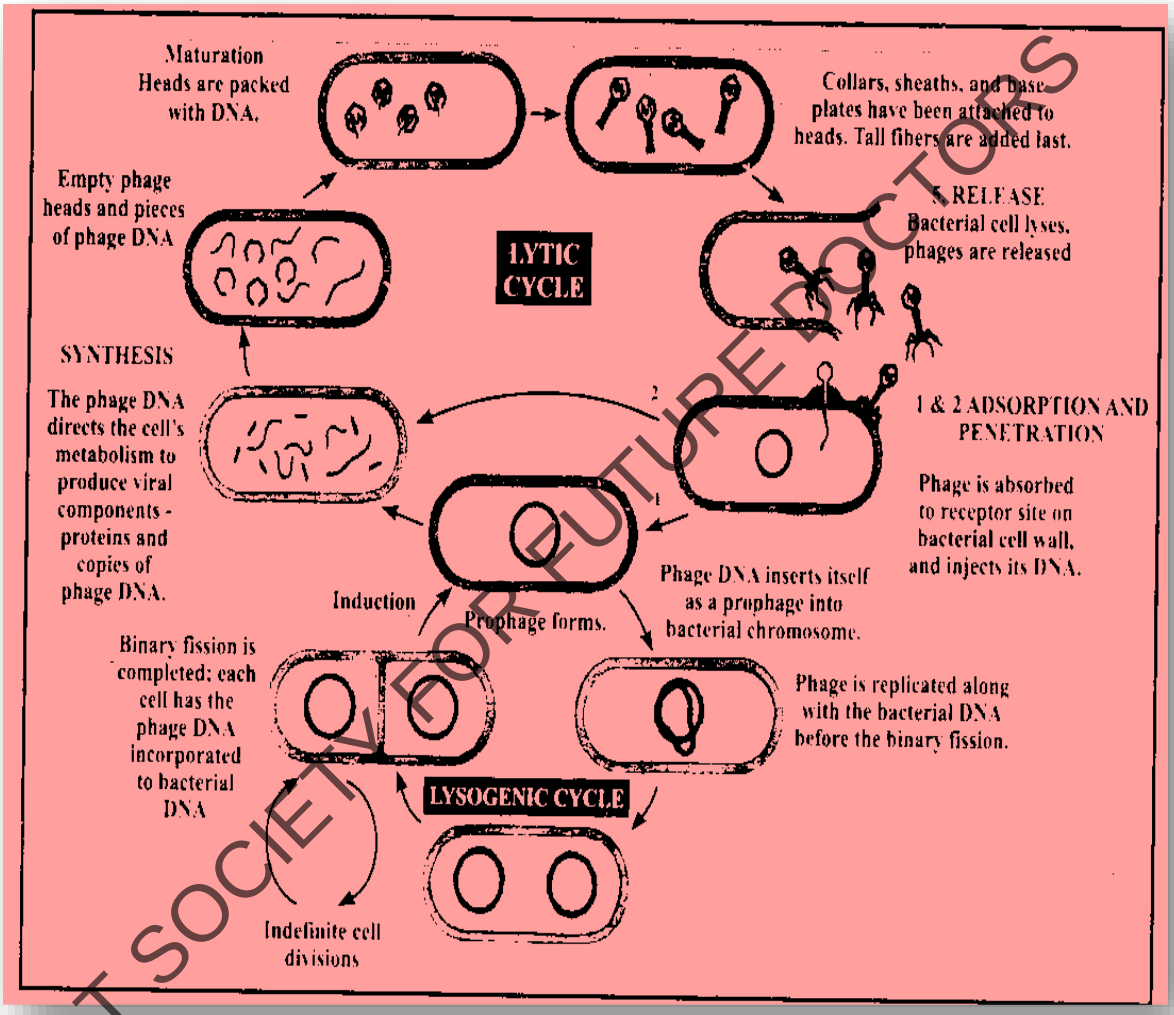

Fig: replication of a hacteriophage

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ADDITIONAL / RELATED READINGS

1. Taxonomy is the branch of biology which deals with the naming and classification of individuals.

2. The arrangement of organisms into systematic groups is called as classification.

3. More than 1.5 million species of animals and more than 0.5 million species of plants are known.

4. All organisms are related to one another at some point in their, evolutionary histories.

5. Classification is based on homologies, comparative biochemistry, cytology and genetics. However the major base of classification is homologies.

6. A species is a group of natural population which can interbreed freely among them and produce fertile off springs, but are reproductively isolated from another such groups in nature.

7. Each species has its own structure, ecology and behavior.

8. Species is the basic unit of classification. The taxonomic groups from species to kingdom form a classification ladder.

9. During 18th century, Carious Linnaeus (1707-1778), a Swedish botanist, provided a system for naming and classifying the organisms.

10. Linnaeus published the list of names of plants in 1753. His system became popular and in 1758 he published the list of names of animals. Many of his names are in use today.

11. Linnaeus's system of giving each species a scientific name comprising two words is known as binomial nomenclature.

12. The scientific names are mostly taken from Latin word. The scientific name is latinized or Italicized.

13. Examples of scientific names:

    (i) Onion Alliumcepa

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(ii)	Amaltas	Cassia fistula
(iii)	Man	Homo sapiens
(iv)	Potato	Solanum tuberosum
(v)	Tomato	Solanum esculentum

14. E-Chatton (1937) described two terms:

- ❖ Procariotique to describe bacteria and blue-green algae.
- ❖ EU-CARITIQUE to describe animal and plant cells

15. Robert Whittekar (1969) proposed five kingdom system of classification. It is based on three levels of cellular organization (prokoryotes, Single call Eukaryotes and Multicellular Eukeryotes) and three types of nutrition (photosynthesis, absorptionand ingestion).

16. KINGDOM MONERA includes prokaryotic unicellular organisms. (bacteria andcyanobacteria).

17. KINGDOM PROTISTA includes eukaryotic unicellular organisms such as Euglena and Amoeba. This kingdom also includes simple multi-cellular organisms that were directly evolved from unicellular protists. However most protists are unicellular.

18. KINGDOM PLANTAE includes eukaryotic multi-cellular autotrophs. They prepare their food by photosynthesis. Examples are mosses, ferns, gymnosperms and angiosperms.

19. KINGDOM FUNGI are heterotrophic having absorptive method of nutrition. Most fungi are decomposers that live on organic material, secrete digestive enzymes and absorb small organic molecules which are produced by digestion. These are also called eukaryotic multi-cellular reducers (e.g. mushrooms).

20. KINGDOM ANIMALIA consists of eukaryotic, multi-cellular consumers. Animals live by ingesting and digesting food within special cavities. They can move and lackcellulose. Examples are birds and reptiles.

21. Lynn Margulis and Karlene Schwartz (1988) modified five kingdom classification of Whittakar by considering: cellular organization, mode of nutrition, cytology, genetics and organelles of symbiotic origin (mitochondria, chloroplast).

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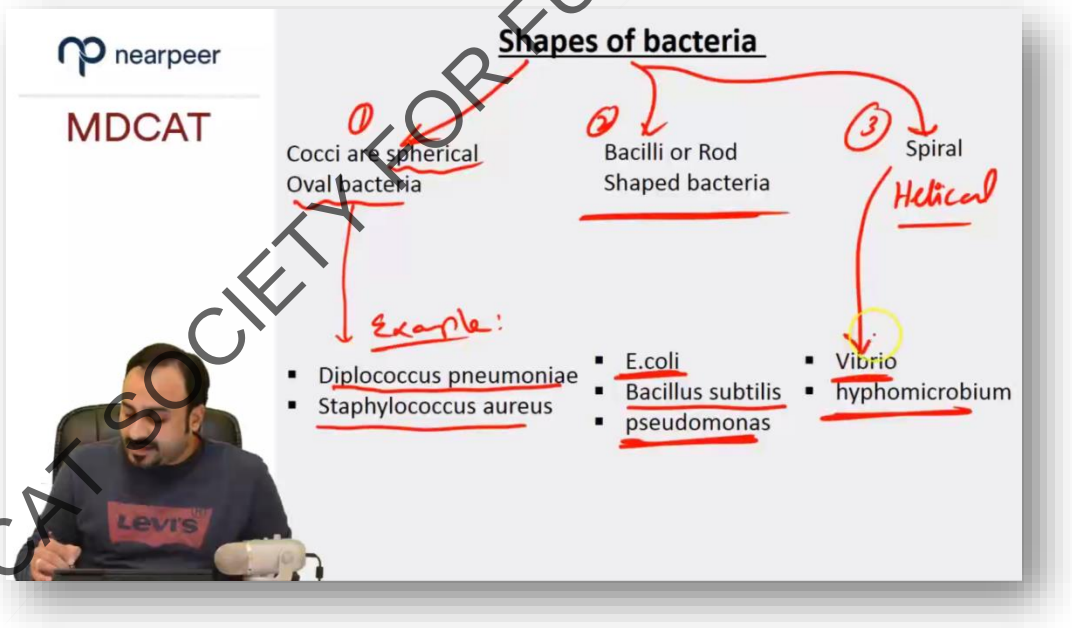
22. Binomial Nomenclature: The assignment of names to organisms using two Latin words. the first denoting the genus and the second descriptive name, the two. together constitute the name of species e.g., Homo sapiens.

23. Carcinoma: A tumor arising in one of the epithelial sheets that cover the outer and inner surfaces of the body.

24. Kingdom: The most inclusive taxonomic grouping, such as the classification of all plants into the Kingdom Plantae.

25. Lytic pathway: The serial events in which viral genes within a host cell begin to replicate independently, mature virus particles assemble and the host cell bursts, releasing the particles, which may then infect other host cells.

26. Viroid: A minute particle of RNA that lacks a' protein coat and is capable of causing disease in both plants and animals.



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Watch **Video No. 7** of **Module 4** at **www.nearpeer.org** for better understanding of **Bacteria**.

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QUESTIONS FOR PRACTISE

1. Most of scientific names are:

(a) Greek (b) Latin

(c) Greek and Latin (d) English

2. A virion is:

(a) virus (b) capsid

(c) genome (d) viroid

3. Smallest virus is:

(a) wound tumour virus (b) picoma virus

(c) TMV (d) influenza virus

4. Viral genetic material is:

(a) DNA only (b) RNA only

(c) DNA and RNA (d) DNA or RNA

5. A virus is obligate parasite of:

(a) metabolic machinery (b) cell

(c) nucleus (d) metabolic machinery and nucleus

6. RNA particles producing symptoms similar to viral disease are known as:

(a) viroids (b) virion

(c) prions (d) all of these

7. Enzymes are present in:

(a) mycoplasma (b) spirochaetes and slime molds

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(c) virus (d) all of these

8. A phage that infects algae is:

(a) phycophage (b) virulent page

(c) temperate phage (d) viroids

9. Influenza virus contains:

(a) DNA (b) RNA

(c) both DNA and RNA (d) proteins

10. Hydrophobia is caused by:

(a) difflugia (b) mycoplasma

(c) virus (d) bacteria

11. How does a t phage enters its DNA it's the host?

(a) tail piece has a TP (b) contraction of protein

(c) injection like process (d) all of these

12. Virus that infects eschericia coli is called:

(a) viroid (b) bacteriophage

(c) prions (d) phycophage

13. The virus responsible for aids is a kind of:

(a) mosaic virus (b) immuno virus

(c) retrovirus (d) viroid

14. Capsomeres in TMV are made up of:

(a) RNA only (b) amino acids

(c) RNA and proteins (d) proteins and DNA

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15. A process absent in virus is:

(a) mutation (b) energy production

(c) replication (d) all of these

16. Genetic transfer through virus is called:

(a) transduction (b) transformation

(c) conjugation (d) transposition

17. The most appropriate character to substantiate living nature of virus is:

(a) mutability (b) infectivity

(c) multiplicity (d) transmissibility

18. Bacteriophages were discovered first time in 1915 by:

(a) T wart (b) D Herelle

(c) Ivanowsky (d) Stanley

19. Smallest disease causing agent in plants:

(a) virion (b) viroids

(c) prions (d) mycoplasma

20. Who made modification in five kingdom classification system?

(a) Margulis and Schwartz (b) Robert Whittacker

(c) Linnaeus (d) Ernst Hackel

21. Scientific name of potato is:

(a) solanum tuberosum (b) Solanum Tubersum

(c) Solanum tuberosum (d) Solanum tuberosum

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22. Halbur and Coworker (2001) said that hepatitis _____ could be transmitted through pig.

(a) E (b) C

(c) B (d) D

23. The filterable agents were first purified in 1935, when Stanley was successful in crystallizing the viruses of:

(a) AIDS (b) polio

(c) tobacco mosaic (d) hepatitis

24. The major cell infected by HIV is the lymphocyte.

(a) helper– T (b) B

(c) killer – T (d) both T and B

25. First of all the bacteriophage attaches to the bacterial cell at _____ site.

(a) receptor (b) landing

(c) attacking (d) inducing

26. The enzyme which dissolves a portion of the bacterial cell wall and is released by the tail of bacteriophages is the:

(a) arginase (b) protease

(c) lysozyme (d) amylase

27. The capsomeres in the capsid of herpes virus are:

(a) 162 (b) 362

(c) 262 (d) 462

28. Transfer of lysogenic into lytic is:

(a) isolation (b) induction

(c) stimulation (d) coordination

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29. What type of heterotrophic organisms have absorptive mode of nutrition?

(a) all fungi (b) some fungi

(c) protozoans (d) all protists

30. Who discovered in 1796 an effective method for the prevention of a viral diseasesmall pox?

(a) Ivanowski (b) Edward Jenner

(c) Chamberland (d) Louis Pasteur

31. Foot and mouth disease and yellow fever is caused by:

(a) fungus (b) bacteria

(c) virus (d) protozoan

32. Most commonly herpes simplex occurs in the mouth, on the lips and at other _____ sites.

(a) receptor (b) binding

(c) active (d) skin

33. Scientific name has advantages of:

(a) same name applied to different organism

(b) same organism have different name in different areas

(c) has no scientific basis

(d) has scientific basis and universally accepted

34. In 1866 Ernst Hocckel proposed a third kingdom called:

(a) monera (b) plantae

(c) fungi (d) protoctista (protista)

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35. The five kingdom system of c1assification was proposed by:

(a) E-Chatton (b) Robert Whittaker

(c) Linnaeus (d) Margulis and Schwarts

36. In the scientific name of onion, allium cepa, the allium belongs to its:

(a) family (b) genus

(c) species (d) order

37. Virus kinds are about:

(a) 1000 (b) 2000

(c) 3000 (d) 4000

38. Virus tail has:

(a) ATP (b) tail fibers

(c) tail sheath and tail core (d) all of these

39. Which hepatitis is by RNA virus which is enveloped?

(a) E (b) C

(c) B (d) D

40. Icosahedral means:

(a) less than 10 faces (b) 20 faces

(c) 5 faces (d) more than 20 faces

41. The shape of bacteriophages:

(a) cubical and helical (b) helical and polyhedron

(c) cubical (d) cubical and polyhedron

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42. Which of the following illness is not caused by a retrovirus?

(a) smallpox
(c) Hepatitis B
(b) herpes simplex
(d) all of these

43. Which statement is true about viruses?

(a) each virus has both DNA and RNA in it
(b) most virus are obligate parasite
(c) viruses exhibit all of the characteristic associated with living organisms
(d) a protein capsid surrounds the nucleic acid in each virus

44. Serum hepatitis is hepatitis:

(a) A
(b) B
(c) C
(d) D

45. Hepatitis can be controlled by:

(a) adopting hygienic measures
(b) with routine vaccination
(c) screening of the blood/organ/tissue of the donar
(d) all of these

46. In small pox, raised fluid filled vesicles are formed on the body, which become pustules later on and form pitted scars which are the:

(a) pox
(b) cow pox
(c) small pox
(d) pocks

47. Temperate phage may exist as:

(a) prophage
(b) capsid
(c) viroid
(d) retrovirus

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48. Aids is caused by:

(a) HIV (b) HTLV

(c) HAV (b) all of these

49. Example of spherical virus is:

(a) polio virus (b) bacteriophage

(c) TMV (b) all of these

50. Biodiversity is due to:

(a) organic evolution (b) mutation

(c) mutation and organic evolution (d) development + mutation +evolution

51. A set of related families would be grouped into:

(a) species (b) order

(c) phylum/division (d) class

52. The mode of nutrition related to animals in 5 kingdom classification is:

(a) photosynthesis (b) absorption

(c) ingestion (d) chemosynthesis

53. Which of the following illness is not caused by a virus?

(a) T.B (b) herpes simplex

(c) AIDS (d) flu

54. Which describes about viruses?

(a) viruses are composed of DNA or RNA (b) virus are obligate parasite

(c) viruses are submicroscopic agents (d) all of these

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55. Which disease is caused by paramyxo viruses?

(a) herpes simplex (b) influenza

(c) polio (d) measles and mumps

56. Which is an infectious protein particle?

(a) virion (b) prion

(c) capsid (d) retrovirus

57. What is the most effective protection against viral infections?

(a) disinfectants (b) natural immunity of the host

(c) antibiotic (d) microbistatics

58. The function of the enzyme reverse transcriptase in HIV infection is to:

(a) produce new viral RNA from the host cell's DNA

(b) attach the virus to the host cell's plasma membranes

(c) produce DNA (from the RNA) that can be incorporated into the host cell's DNA

(d) convert host RNA into viral RNA

59. Largest virus is:

(a) wound tumour virus (b) pox virus

(c) TMV (d) influenza virus

60. A viroid has:

(a) RNA (b) DNA

(c) RNA + DNA (d) only protein

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UNIT NO. 3 (MICROBIOLOGY)

1	B	2	A	3	B	4	D	5	B	6	A	7	D	8	A	9	B	10	C
11	D	12.	B	13	C	14	B	15	B	16	A	17	A	18	A	19	B	20	A
21	A	22	A	23	C	24	A	25	A	26	C	27	A	28	B	29	A	30	B
31	C	32	D	33	D	34.	D	35	B	36	B	37	D	38	D	39	B	40	B
41	A	42	D	43	D	44	B	45	D	46	D	47	A	48	A	49	A	50	C
51	B	52	C	53	A	54	D	55	D	56.	B	57	B	58	C	59	B	60	A

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KINGDOM PROKARYOTAE (MONERA)

It consists of organisms with prokaryotic cells.

In Greek the word Pro means "before" and karyon means nucleus. So prokaryotcs are cells that do not have true nucleus structure. It mainly includes bacteria.

Microbiologists place bacteria in two major groups:

1. Eubacteria (In Greek it means "true bacteria")
2. Archaeobacteria (In Greek it means "ancient bacteria"). It is a small division.

SIZE OF BACTERIA

- The size is from 0.1 to 600 µm.
- The smallest bacteria are present in the genus Mycoplasma with the size of 100 to 200nm in diameter. It is about the size of the largest viruses (poxviruses).
- Escherichia coli is 1.1 to 1.5 µm wide and 2.0 to 6.0 µm long.
- Some spirochetes may reach 500 µm in length.
- Staphylococci and Streptococci a.e. 0.75 – 1.25µ in diameter.
- A huge bacterium (Epulopiscium fishclsoni) has been discovered in the intestine of the brownsurgeonfish (Acanthurus nigrofuscus). Its size is 600 µm by 80 µm (a little smaller than a printed hyphen). It is now clear that a few bacteria are much larger than the average eukaryotic cell.

SHAPES OF BACTERIA

Most of the bacterial species have constant characteristic shapes. However, some are pleomorphic and presentin many shapes. On the basis of shapes bacteria can be classified as cocci, bacilli and spirilli.

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1. Cocci

- The Cocci are spherical or oval bacteria.
- These are arranged according toplanes of division.

(i) Division in One Plane:

If division is in one plane it produces two types of arrangements.

a. Diplococcus Arrangement: When cocci are present in pairs then arrangement is diplococcus (Diplococcus pneumoniae).

b. Streptococcus Arrangement: When cocci are present in long chain of cells then the arrangement is streptococci.

(ii) Division in Two Planes:

When the division of cell is in two planes it will produce a tetrad arrangement. A tetrad isa square of 4 cocci.

(iii) Division in Three Planes:

When the division is in three planes it will produce a sarcina arrangement. Sarcina is acube of 8 cocci.

(iv) Division in Random Planes:

When division occurs in random planes it will produce a staphylococcus arrangement. Here the cocci are arranged in irregular grape-like clusters (Staphylococcus aureus).

2. Bacilli

Bacilli are rod-shaped bacteria. They all divide in one plane producing four kinds of arrangements:

(i) Bacillus: It is a single cell of bacteria.

(ii) Streptobacillus: It is a chain of bacilli.

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(iii) **Diplobacillus:**When rod shaped bacteria occur in pairs then it is called diplobacillus

(iv) **Coccobacillus:**When rod shaped bacteria are like coccus.

Examples of Rod Shaped Bacteria: Escherichia coli. Bacillus subtilis, Pseudomonas

3. Spirilli (Spiral Shaped Bacteria)

These bacteria are spirally coiled.

Spirals can be in one of three forms, a vibrio, a spirillum, or a spirochete.

(i) **Vibrio:** It is curved or comma-shaped rod.

(ii) **Spirillum:** It is a thick, rigid spiral.

(iii) **Spirochete:** It is a thin, flexible spiral.

Examples of Spiral Shaped Bacteria: Vibrio, Hyphomicrobiwn

Other Shapes of Bacteria:

- Some other shapes of bacteria are trichome forming, sheathed, stalked, square, star shaped, spindle shaped, lobe shaped and filamentous bacteria.
- All bacteria have cell membrane, cytoplasm, ribosome and chromatin bodies.
- Most of bacteria have a cell wall, which gives shape to the bacterial cell.
- The structures like capsule, slime, flagella, pili, fimbriae and granules are found in some/different bacteria.

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STRUCTURE OF A BACTERIAL CELL:

- We will study structure of a bacterial cell under the following headings:

1. Flagella and their Functions

- These are very thin hair like structures that come out through the cell wall. The flagella originate from basal body. It is a structure just beneath the cell membrane in the cytoplasm. Flagella are made up of protein flagellin.
- Classification of bacteria on the basis of presence, attachment and number of flagella
- On the basis of presence, attachment and number of flagella.bacteria are classified as:

(i) **Atrichous:** The bacteria without any flagella are called atrichous

(ii) **Monotrichous:** These have a single polar flagellum

(iii) **Lophotrichous:** These have a tuft of flagella at one pole only.

(iv) **Amphitrichous:** These have tuft of flagella at both poles

(v) **Peritrichous:** In this condition flagella surrounds the whole cell.

Most of bacteria and spiral shaped bacteria have flagella. Cocci very rarely have flagella.

Functions of Flagella:

(i) **Motility:** Primary function of flagella is to help in motility.

(ii) **Chemotaxis:** They also help to detect and move in response to chemical signals (stimulus). It is a type of behaviour called as chemotaxis.

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2. Pili and their Functions

(i) **Definition:** These are hollow, non-helical, filamentous appendages.

(ii) **Presence:** True pili are only present on gram-negative bacteria.

(iit) **Size:** Pili are smaller than flagella.

(iv) **Chemical Composition:** They are made up of special protein called pilin.

(v) **Functions:**Pill are not involved in motility.

- Following are their functions:

(a) **Mating Process (Conjugation):**

They are involved in mating process called conjugation

(b) **Attachment:**

Some pili are used for attachment of bacteria to various surfaces.

3. The Cell Envelope (The Outer-Wrapping of Bacteria)

- In bacteria the complex of layers external to the cell protoplasm is called as cell envelope. It includes capsule, slime and cell wall.

(i) **Capsule:** Some bacteria produce capsule. It is tightly bound to the cell.

- Capsule is made up of repeating polysaccharide units, or of protein, or of both. It has a thicker, gummy nature that gives sticky characters to the colony.

(ii) **Slime:**It is a loose, soluble cover of macromolecules called as slime capsule. It is presentsome bacteria.

- Slime provides greater pathogenicity to bacteria and protects them against phagocytosis

(iii) **Cell Wall:** Beneath the extracellular substances and external to cytoplasmic membrane is cell wall It is a rigid structure and determines the shape of bacterium.

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- Cell wall also protect the cells from osmotic lysis.
- Cell wall is only absent in mycoplasmas.

Gram Stain Technique on the Basis of Differences in Cell Wall:

- Christian Gram developed the technique of gram stain on the basis of differences in the cell wall.
- On the basis of this technique bacteria can be divided into two groups:

❖ **Gram Positive Bacteria:**These are the group of bacteria that stained purple. They retain the primary dye due to the formation ofCV-I complex in the cell wall.

❖ **Gram Negative Bacteria:** These bacteria are stained pink because they retain secondary dye in the cell wall.

Comparison of Gram Positive and Gram-Negative Cell Wall:

Difference in staining is due to difference in structure of cell walls of two groups. It is clear from the following table:

Characteristics		Gram Positive		Gram negative	
Number of Major Layers					
(i)	Chemical mark up	(a) (b) (c) (d)	Peptidoglycan (50% of dry weight in some bacterial cells) Techoic acid Lipotechoic acid Lipids (1 – 4 %)	(a) (b) (c) (d)	Lipopolysaccharides Lipoproteind Peptidoglycan 10 % dry weight of some bacterial cells Lipids (11 – 12 %)
(ii)	Overall thickness		20 – 80 nm		8 – 11 nm
(iii)	Outer membrane		NO		Yes
(iv)	Periplasmic space		Present in some		Present in all
(v)	Permeability		More permeable		Less permeable

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Chemical Composition of Cell Wall:

- The cell walls of most bacteria have a macromolecule called peptidoglycan.
- Its amount varies in different types of bacteria.
- Peptidoglycan is composed of long glycan chains cross-linked with peptide fragments.
- The cell wall also contains sugar molecules, techoic acid, lipoproteins and lipopolysaccharides. These are linked to peptidoglycan.

Cell walls of Archaeobacteria are different from Eubacteria. They do not contain peptidoglycan. Their cell walls are composed of proteins, glycoproteins and poly saccharides.

Cell Walls of Other Bacterial Groups: Many bacterial groups have no cell wall structure which is characteristic of gram positi. . or gram negative bacteria.

No Cell Wall in Some Bacteria: Some bacteria has no cell wall (like Mycoplasmas).

4. Cell Membrane

(i) **Location:** Beneath the cell wall is the cell membrane or plasma membrane.

(ii) **Nature:** It is thin, delicate, flexible and completely surrounds the cytoplasm. Any damage to results in the death of organism.

(iii) **Chemical Composition:** Bacterial membrane differs from eukaryotic membrane because it does not contain sterol (such as cholesterol).

(iv) **Functions:** Cell membrane regulates the transport of proteins, nutrients, sugar and electrons or the metabolites.

It also contains enzymes for respiratory metabolism.

5. Cytoplasmic Matrix

(i) **Definition:** The cytoplasmic matrix is' the substance present between the plasma membrane and the nucleoid.

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The plasma membrane and everything present within is known as protoplast.

(ii) **Properties of Cytoplasmic Matrix:** It is a major part of protoplast. It has gel like consistency.

Small molecules can move through it rapidly.

Large separate structures such as chromatin/nuclear body, ribosomes, mesosome granules and nucleoid are present in this matrix.

The cytoplasm of prokaryotic cell has no membrane bound organelles and cytoskeleto: (microtubules)

6. Nucleoid

(i) **Definition:** The DNA of bacteria is a single circular and double stranded molecule. It aggregates as an irregular shaped dense material called as nucleoid.

Other names for nucleoid are nuclear body, chromatin body and nuclear region. In bacteria chromosomes and nuclear membrane absent

(ii) **Location:** Nucleoid is present near the center of cell.

(iii) **Visible in the Light Microscope:** It is visible in the light microscope after staining with Feulgen stain

(iv) **Size:** It is very long molecule of DNA which is tightly folded so as to fit in the cell component. The closed circle chromosome (DNA) of Escherichia coli is about 1.4000 11 m.

(v) **Haploid Organisms:** Because of the presence of a single chromosome, bacteria are haploid organisms.

7. Plasmid

- In addition to the single circular DNA molecule found in all bacteria, some species also contain one or more plasmids.
- A plasmid is a small, self-replicating circle of extra DNA. It possesses only a few genes, which generally give extra survival advantage. They contain drug, heavy metals, disease and insect resistant genes.

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- Some give resistance to antibiotics. For example, some staphylococci contain a plasmid which includes a gene for the enzyme penicillinase. This breaks down penicillin, thus making the bacteria resistant to penicillin.

- Other plasmid genes are known which give resistance to disinfectants. cause disease or responsible for the fermentation of milk to cheese by lactic acid bacteria

In the modem genetic engineering techniques plasmids are important vectors. Genes are inserted in them to get complex chemicals as food, hydrocarbons, with applications in clearing oil spills and producing protein from petroleum.

8. Ribosomes

(i) **Location:** They are mostly free in the cytoplasm. Sometimes they are loosely attached to the plasma membranes.

(ii) **Size:** They are smaller (70S) than eukaryotic (80S) ribosome.

(iii) **Number of Ribosomes:** There are thousands of ribosomes in each healthy growing cell.

(iv) **Chemical Composition:** Ribosomes arc composed of RNA and proteins.

(v) **Function:** They are protein factories.

9. Mesosome

(i) **Definition:**The cell membrane, invaginates into the cytoplasm forming a structure called asmesossomes.

(ii) **Shapes of Mesosomes:** Mesossomes are in the form of vesicles, tubules or lamellae.

(iii) **Function:**Mesosomes are involved in DNA replication. They play a role in cell division.

Some mesosomes are involved in the export of exo-cellular enzyme.

Respiratory enzymes-arc also present on the mesossomes.

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10. Granules and Storage Bodies:

(i) **Storage:** Bacteria live in competitive environment and the nutrients become short. Therefore, the store extra nutrients when possible

(ii) **Storage Materials:** Storage materials may be glycogen. sulphur, fat and phosphate.

- ❖ Waste materials are generally exerted in the form of alcohol, lactic acid and acetic acid.

11. Spores:

Some bacteria, mainly of the genera Clostridium and Bacillus form endospores (spore produced inside cells). They are thick walled. Long lived and extremely resistant particularly to heat drought and shortwave radiations. Their position in the cell, variable and is of importance in recognition and classification.

Certain Species Bacteria Produce Spores:

(i) **Formation / Production:** Spores are metabolically dormant bodies and are produced at a later stage of cell growth.

(ii) **Types of Spores:** Spores are of two types:

(a) Exospores: These are formed external to the vegetative cells.

(b) Endospores: These are formed within the vegetative cells.

(iii) **Properties / Functions:** Spores are resistant to adverse physical environmental conditions. For example light high temperature, desiccation, pH and chemical agents,

Under favorable conditions they germinate and form vegetative cells.

12. Cysts

(i) **Definition:** Cysts are dormant, thick-walled, desiccation resistant forms. However they are not heat resistant.

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(ii) **Development:** They are developed during differentiation of vegetative cells.

(iv) **Germination:** These can germinate under suitable conditions.

NUTRITION OF BACTERIA

- Why Nutrition / Energy Required?
- Like other organisms bacteria need nutrition (energy) for their growth, maintenance and reproduction.

CLASSIFICATION OF BACTERIA ON THE BASIS OF NUTRITION:

- ❖ On the basis of nutrition bacteria are of two types which are heterotrophic and autotrophic.

1. Heterotrophic

They cannot synthesize their organic compounds from simple inorganic substances. Most bacteria are heterotrophic. They live either as the saprophytes or as the parasites.

(i) **Saprophytic Bacteria:** They get their food from dead organic matter. Soil is full of organic compounds in the form of humus.

Humus is the material resulting from the partial decay of plants and animals.

Many bacteria in the soil have every extensive enzyme system that break down the complex substances of humus to simpler compounds.

The bacteria absorb and use these simpler substances as a source of energy.

(ii) **Parasitic Bacterial:** These are fully dependent on their host for their nutrition.

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2. Autorophic bacterial

They can synthesize organic compounds from inorganic substances. Some kinds of bacteria are auotrophic. These bacteria are divided into two groups:

(i) **Photosynthetic Autotrophs:**

- These bacteria synthesize their food by the process of photosynthesis.
- The chlorophyll in them is different from that of green plants.
- Bacterial chlorophyll is dispersed in the cytoplasm (while in most green plants, the chlorophyll is present in the chloroplasts).
- During photosynthesis these bacteria use hydrogen sulphide (H_2S) instead of water as a hydrogen source and release sulphur instead of oxygen.
- The overall reaction of photosynthesis in photosynthetic bacteria is:

$$CO_2 + H_2 2S \xrightarrow[\text{Chlrophyll}]{\text{Light}} (CH_2O) + H_2O + 2S$$

Examples:

Green sulphur bacteria, purple sulphur bacteria and purple non-sulphur bacteria are photosynthetic bacteria.

(ii) Chemosynthetic Autotrophs:

These bacteria can, oxidize inorganic compounds like ammonia, nitrate. nitrite, sulphur or ferrous iron. As a result the energy is released which is used for their synthetic reactions, Nitrifying bacteria are chemosynthetic.

RESPIRATION IN BACTERIA

On the basis of mode of respiration bacteria are divided into following groups:

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1. **Aerobic Bacteria:**

   These are able to grow in the presence of oxygen. Pseudomonas is an aerobic bacterium.

2. **Anaerobic Bacteria:**

   These can grow in the absence of oxygen. Spirochete is anaerobic bacterium.

3. **Facultative Bacteria:**

   These bacteria can grow either in the presence or absence of oxygen. E. coli IS a facultative anaerobic bacterium.

4. **Microaerophilic:**

   Some bacteria require a low concentration of oxygen for growth and are known as microerophilic. Example is Campylobacter.

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GROWTH AND REPRODUCTION IN BACTERIA

Bacterial Growth:

The increase in number of bacterial cells is called as bacterial growth. This increase in number occurs by asexual reproduction.

Asexual Reproduction:

In bacteria asexual reproduction occurs by means of binary fission.

(i) **Binary Fission:** The division of a prokaryotic cell into two identical daughter cells is called IS binary fission. Following processes occur in binary fission:

- Parent cell enlarges
- Its chromosome duplicates

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- Plasma membrane pinches inward at the center of the cell
- When nuclear material has been equally distributed, the cell wall grows inward to separate cell into two.

Repeating the Process:

- ❖ This sequence is repeated at intervals by each new daughter cell. As a result the population of cells increases. Once the division is complete, bacteria grow and develop their specific features.

Generation Time:

- ❖ The time interval until the completion of next division is known as generation time. In the fastest growing bacteria such divisions may occur as often as every 20 minutes.

Bacterial Growth Curve:

Four different phases are known in bacterial growth curve.

(i) **Lag Phase**: It is phase of no growth. Bacteria prepare themselves for division.

(ii) **Log Phase**: It is phase of rapid growth. Bacteria divide at exponential rate.

(iii) **Stationary Phase**: Bacterial death rate is equal to the bacterial rate of reproduction and multiplication.

(iv) **Death/Decline Phase**: Bacteria start dying. Death rate is more than reproduction rate.

Sexual Reproduction:

- In 1946 it was discovered that bacteria can take part in a primitive form of sexual rc production. The usual process of sexual reproduction and mitosis is absent in bacteria.
- Gametes are not involved, but the exchange of genetic material does take place and is called genetic recombination. It is generally by conjugation.

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- Conjugation involves transfer of DNA between cells in direct contact. One cell acts as the donor (male) and the other as the recipient (female).
- The ability to serve as a donor is determined by genes in a special type of plasmid called the sex factor, or F factor (F for fertility). This forms the protein of a special type of pilus the F pilus or sex pilus. This enables cells to come into contact. The pilus is hollow andthe DNA passes through the pilus from the donor (F^+) to the recipient (F).

Advantages of Sexual Reproduction (Conjugation):

- ❖ Due to conjugation new genetic combinations are produced. As a result these bacteria can survive in many different conditions.
- ❖ Mutilism (or symbiosis) is the name given to any form of close relationship between two living organisms in which both partners benefit.
- ❖ Examples of bacterial mutualists are **Rhizobium,** a nitrogen-fixer living in the root nodules of legumes such as pea and clover, and **Escherichia** coli, which inhabits the gut of humans and probably contributes vitamins of the Band K groups.

Importance Of Bacteria

We will discuss importance of bacteria under following headings:

1. Ecological Importance:

Bacteria are ecologically very important. This is because of the following reasons:

(i) Highly Adaptable:

They are highly adaptabie and found almost everywhere.

(ii) Decomposition:

They decompose organic matter. In this way they prevent the accumulation of dead material and metabolic wastes.

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(iii) Recycling of Elements:

They play important role in the completion of nitrogen, phosphorus, sulfur and carbcycles.

2. Economic Importance

Bacteria are economically very important. Their beneficial and harmful effects .ire as follows:

(i) **Beneficial Effects:**

(a) Food Production: They are used in food production.

(b) Vaccine and Antibiotics: Bacteria are involved in the production of antibiotics and vaccines,

(c) Drugs: They are used in the formation of many different kinds of drugs.

(d) Biotechnology: They are used in biotechnology.

(ii) **Harmful Effects:**

(a) Spoilage of Food and Vegetables: Bacteria are also responsible for spoilage of food and vegetables.

(b) Plant Pathogens: Many plant pathogens adversely affect the agriculture.

(c) Animal/Human Pathogens: Bacteria are very common pathogens of man and other animals. About 200 species of bacteria cause diseases in man.

Control Of Bacteria

Microorganisms can be controlled by various methods.

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1. Physical Methods

Many physical methods are applied to prevent bacteria. For example steam, dry heat, gas, filtration and radiation.

The process in which we use physical agents to control bacteria/microorganism is known as sterilization process. Sterilization is destruction of all life forms.

(i) **High Temperature Treatment:** High temperature is used in microbiological labs for control of microbes. Both d y heat and moist heat are used.

- **Moist Heat:** Moist heat causes coagulation of proteins and kills the microbes.
- Dry Heat: Dry heat causes oxidation of different chemicals of microbes end kills them.

(ii) **Radiations:** Certain electromagnetic radiations below 300 nrn can effectively kill the microorganisms Gamma rays are commonly used for sterilization process.

(iii) **Membrane Filters:** Heat sensitive compounds like antibiotics series, hormones etc are sterilized by membrane filters.

2. Chemical Methods

Chemical methods for control of bacteria include antiseptics, disinfectants are chemotherapeutic agents.

(i) Antiseptics: These are chemical substances used on living tissues to kill and inhibit the growth microorganism.

(ii) Disinfectants: These chemical agents are used to inhibit the growth of vegetative cells on the nonliving materials.

These include oxidizing and reducing agents. For example halogens, phenols, hydrogen peroxide, Potassium permagnate, alcohol and formaldehyde etc.

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(iii) **Chemotherapeutic:** Chemotherapeutic agents and antibiotics work with natural defense and stop the growth of bacteria and other microbes. They destroy or inhibit the growth of micro organisms living tissues.

These are Sulfonamides, tetracycline, penicillin, etc.

Some other processes that kill / inhibit the microbial population are:

(a) **Microbicidal Effect:** Microbicidal effect is one that kills the microbes immediately.

(b) **Microbistatlc:** Microbistatic inhibits the reproductive capacities of the cells and maintain the microbial population at constant size.

➢ **MODE OF ACTION:**

- Mode of action, of different physical and chemical agents, of control vary.
- Damage occurs due to malfunctions in cell wall, cell membranes, cytoplasm, enzymes or nucleic add.

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Use And Misuse Of Antibiotics

1. **Antibiotics:**(Greek word Anti, against, and Bios, life)

Antibiotics are the chemotherapeutic chemical substances used in treatment of infectious diseases.

2. **Origin:** They are synthesized and secreted by bacteria, actinomycetes, fungi and in the laboratory however, their origins are living cells.

3. **Selection of Antibiotics:** To select the antibiotic, we must know:

Its mode of action and Possible adverse (side) effects

4. **Use of Antibiotics:** Use antibiotics as prescribed by the physicians

Take dose at regular intervals and complete the treatment as advised by the doctor.

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5. **Adverse Effects of Antibiotics:** The misuse of antibiotics results in the following adverse effects:

   (i) Drug Resistance: The great use 01 antibiotics, is followed by the problems of drug resistance in microorganisms. Due to this, resistance against disease treatments is increasing.

   (ii) Interact with Human Metabolism: Misused antibiotics can interact with the human metabolism and may cause death.

   (iii) Allergic Reactions: Misuse of antibiotic like penicillin can cause allergic reactions.

   (iv) Deafness: Streptomycin can affect auditory nerve. The result is deafness.

   Discoloration of Teeth: Tertacycline and its related compounds cause permanent discoloration of the teeth in the young children.

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Additional / Related Readings

1. Kingdom Prokaryotae (prokaryotic cells) includes Bacteria and cyanobacteria.
2. Microbiologists place bacteria in two major groups: EUBACTERIA (In Greek it means "true bacteria") and Archaeobacteria (In Greek it means "ancient bacteria".
3. The discovery of small organisms (like bacteria) was linked with the invented in of microscope.
4. ANTONE VAN LEEUWENHOEK was a Dutch Scientist and in 1673 he reported the microbes (such as bacteria and protozoa) for the first time. He called these small creatures as "animalcules".
5. Louis Pasteur developed the vaccines for diseases anthrax, fowl cholera and rabies.
6. Louis Pasteur proved that microorganism could cause disease. He also developed pasteurization process and fermentation.

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7. Robert Koch isolated rod-shaped bacteria with squarish ends (bacilli) from the blood or sheep that was died of anthrax.

8. Robert Koch formulated the germ theory of disease which has four postulates.

9. Koch and his colleagues invented many techniques for: inoculation, isolation and media preparation, maintenance of pure cultures and preparation of specimens for microscopic studies.

10. Some bacteria are present in specific environments. For example: hot springs, alkaline/acidic soil, highly saline environments, in highly polluted soils and waters etc.

11. The size of bacteria is from 0.1 to 600 µm.

l2. The procedures used to eliminate or reduce infection is called antisepsis

13. The cyanobacteria are the largest and the most diverse group of photosynthetic bacteria previously called blue green algae.

l4. Cyanobacteria are true' prokaryotes. They range in diameter from 1-10 urn. They have Gram-negative type cell wall.

15. Cyanobacteria may be unicellular, colonial or filamentous

16. Filaments cyanobacteria consisting of trichomes surrounded by mucilaginous sheath

17. In cyanobacteria flagella are absent. They use gas vesicles to move in the water.

18. A trichome is a chain of cells within the filament. Due to gas vesicles many filamentous species have gliding motility.

19. For photosynthesis the cyanobacteria have chlorophyll a and photosystem II.

20. Bacteria have sulfogenic photosynthesis while cyanobacteria have oxygenic photosynthesis.

21. In Cyanobacteria, Photosynthetic pigments and electron transport chain is in thyiakoid membranes linked with particles called phycobilisomes.

22. In Cyanobacteria, CO_2 is assimilated through the Calvin cycle.

23. Phycocyanin pigment (blue) is their predominant phycobilin, Cyanobacteria use phycobilins as accessory pigments.

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24. Reserve food material in cyanobacteria is glycogen.

25. Cyanobacteria reproduce by binary fission and fragmentation, Hormogonia, akinetes and heterocysts may also form in it.

26. Cyanobacteria: Formally called blue-green algae, single rod-shaped or spherical prokaryotic cells that occur in clusters or in long filamentous chains and' carry out photosynthesis by means of chlorophyll a, carotenoids, and red and blue pigments.

27. Cyanobacteria have heterocysts, which are helpful in the fixation of atmospheric nitrogen.

28. Super blue green algae is a single celled organism that produces its own food through photosynthesis. It serves as a "complete whole food" which contains 60 proteins with all essential amino acids.

29. Oscillatoria and few other cyanobacteria can be used as pollution indicator.

30. Many species of cyanobacteria form water blooms.

31. Nostoc is common in terrestrial and subaerial environment.

Note: Gas vesicles are not true membranous organelles in the cyanobacteria.

32. Nostoc forms a jelly like mass in which many filaments are embedded.

33. Trichome breaks near heterocyst to form fragments called hormogonia.

34. In cyanobacteria there is no sexual reproduction. However asexual reproduction is present.

35. Pieces of trichome or filament are Hormogonia.

36. Akinetes are thick walled, enlarged vegetative cells which accumulate food and become resting cells.

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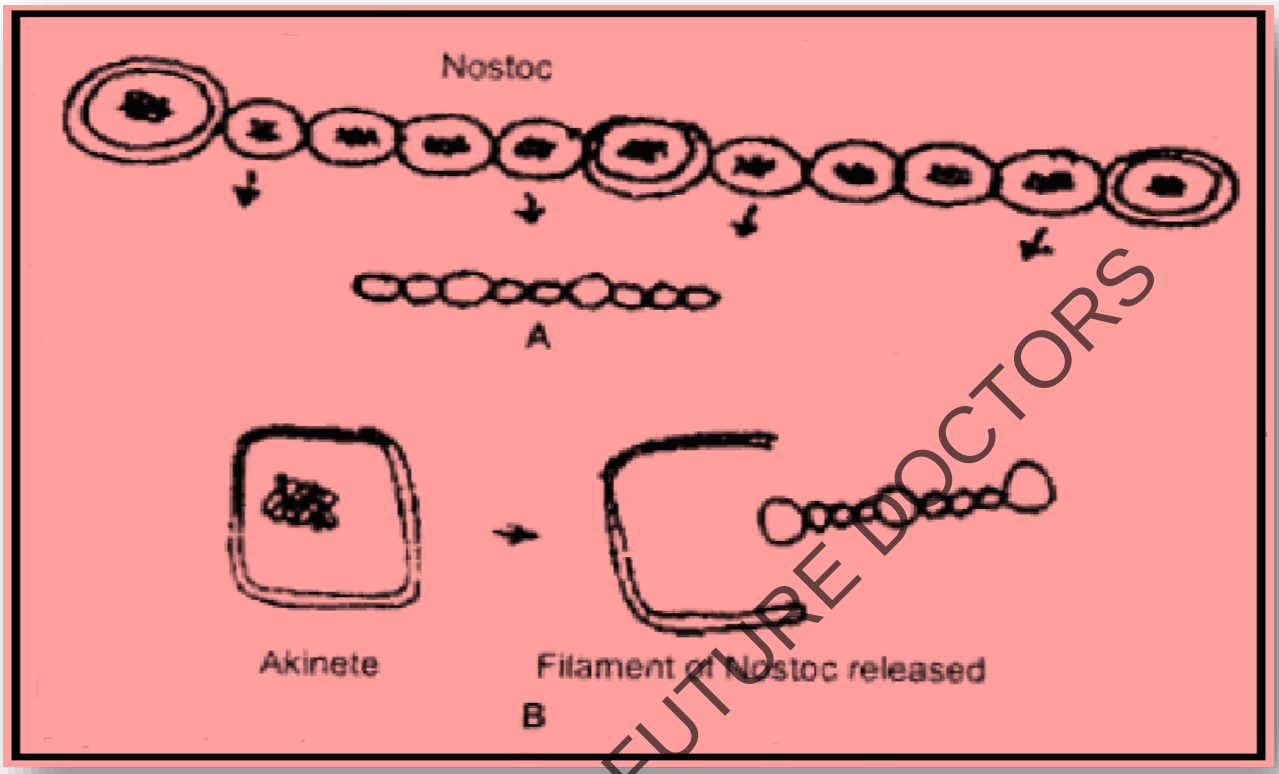

Fig. Reproduction in Nostoc
(a) Hormogonia (b) Akinetcs

37. **Binary fission:** The division of prokaryotic cells into two identical daughter cells.

38. **Chemoautotroph:** An organism deriving energy from the oxidation of inorganic compounds

39. **Eubcateria:** Literally, "true bacteria"; by far the most abundant group of prokaryotes

40. Gram negative bacteria: Bacteria, such as E.Coli, whose cell walls are surrounded by a lipid bilayer and hence do not take up iodine dye (crystal violet) during staining.

41. **Gram positive bacteria:** Bacteria having a peptidoglycan cell wall, which takes up crystal violet dye and hence appears to stain purple under the light microscope.

42. **Heterotroph:** An organism that obtains energy for cellular processes by taking in food consisting of whole autotrophs or other heterutrophs, their parts, or their waste products

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43. **Humus:** One of four main constituents of soil, humus consists of decomposing organic, materials that release nutrients and prevent soil from compacting.

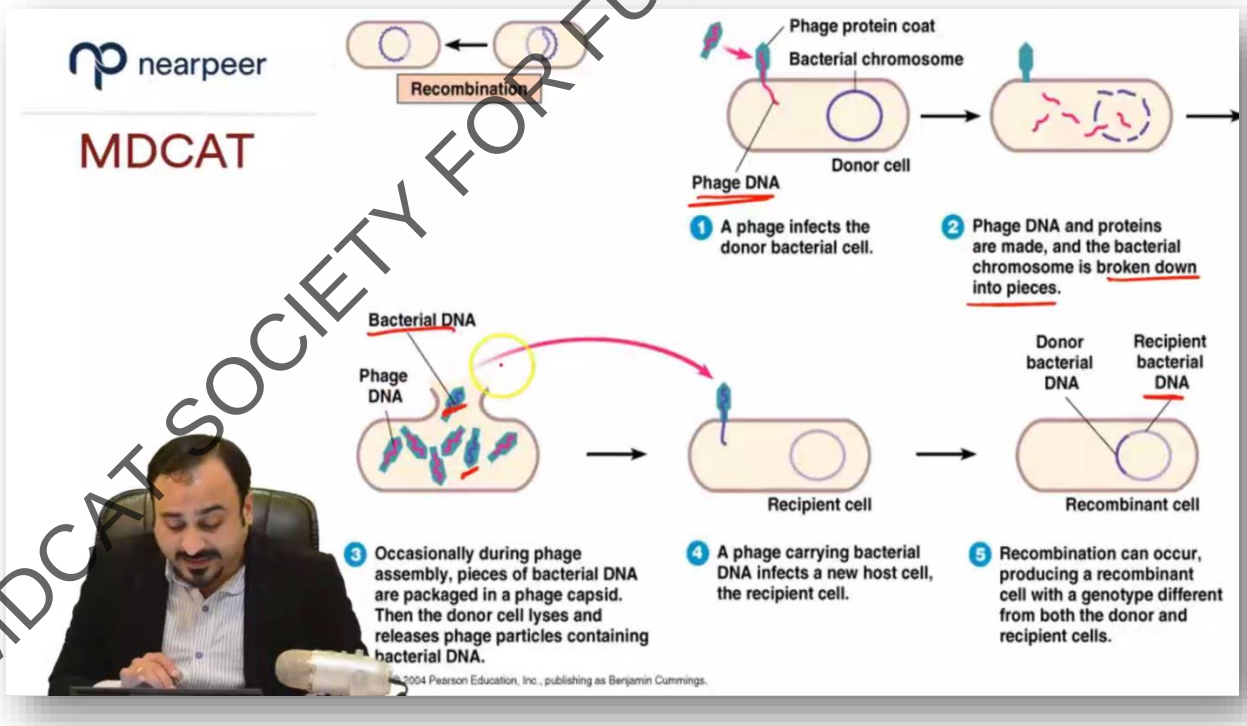
44. **Nitrogen fixation:** The conversion in plants of atmosphere N_2 to a usable form, NH^4(ammonium ion)

45. **Nucleoid:** A dense, unbounded area within a prokaryotic cell that encompasses the eel. single chromosome and serves much like a nucleus.

46. **Obligate aerobe:** An organism, generally a bacterium, which must have oxygen form etabolic processes.

47. **Phycobilin:** A pigment in red algae that gives the algae their color and enables them capture green and blue wavelength of light in, deep water.

48. **Obligate aerobe:** An organism, generally a bacterium, which must have oxygen form etabolic processes.



Watch Video Number 13 for better visualized understanding of this concept at **www.nearpeer.org**

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QUESTIONS FOR PRACTISE

1. First phase in the growth curve is:

(a) lag phase (b) log phase

(c) stationary phase (d) decline phase

2. Which one of the following is the most resistant stage found in bacteria?

(a) cyst (b) fission stage

(c) endospore (d) capsulated stage

3. In bacteria, surface appendages to attach one another or to host organisms are:

(a) flagella (b) pili

(c) hapteron (d) fimbriae

4. In bacteria, the enzymes for oxidation of metabolites are present in:

(a) pili (b) oxysomes

(c) mesosomes (d) thylakoids

5. Accessory genes of bacteria are present in:

(a) plasmids (b) nucleoid

(c) RNA (d) plasmids and nucleoids

6. Bacterial flagella are made up of:

(a) flagellin (b) tubulin

(c) actin (d) myoglobin

7. In bacteria, aerobic respiration is supported by:

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(a) cell wall and capsule (b) cell membrane and mesosomes

(c) cell wall and membrane (d) cell wall and mesosome

8. A plasmid integrated into bacterial DNA is called:

(a) episome (b) provirus

(c) prophage (d) induction

9. In bacteria cell membrane invaginates into the cytoplasm forming a structurecalled:

(a) mesosome (b) ribosome

(c) lysosome (d) glyoxysome

10. If a bacterial cell divides in every 20 minutes, how much time it will take in the formation of bacteria?

(a) 20 minute (b) 60 minute

(c) 80 minute (d) 40 minutes

11. Which of the following archaeobacteria?

(a) methanogenic (b) pseudomonas

(c) green sulfur (d) purple non sulfur

12. Bacteria differ from viruses in- having:

(a) cytoplasm (b) DNA

(c) protein (d) infectious nature

13. An example of respiratory and digestive disease:

(a) tuberculosis (b) cholera

(c) jaundice (d) dysentery

14. Nitrogen fixation in cynobacteria is a function of:

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(a) heterotrichous (b) heterocyst

(c) heterospore (d) akinite

15. Cynobacteria resembles with plants in having:

(a) chlorophyll a and b (b) chlorophyll a and PSI

(c) chlorophyll a and PSII (d) only PSII

16. Blue green algae are so called in having:

(a) chlorophyll a and phycocyanin (b) chlorophyll a and chlorophyll b

(c) chlorophyll and phycoerythrin (d) phycoerythrin and phycocyanin

17. The simplest of the oxygen producing photosynthetic organisms are:

(a) bacteria (b) cyanobacteria

(c) algae (d) fungi

18. Blue green algae can even grow in hot springs with temperature upto:

(a) 80^{o} F (b) 25^{o} C

(c) 85^{o} C (d) 80^{o} C

19. Cell walls of cyanobacteria is:

(a) gram – ve (b) gram + ve

(c) gram – ve and gram + ve (d) like the cell wall of archaeobacteria

20. In blue green algae mostly nitrogen fixation occurs in specialized cells called:

(a) akinetes (b) heterocysts

(c) vegetative cells (d) all trichome cells

21. Blue green algae such as nostoc and anabaena are purposely cultivated in ricepaddies because they are involved in:

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(a) N-fixation (b) soil mixing

(c) soil softness (d) soil smoothness

22. The individual chain of cells in a filament of nostoc is called a:

(a) small segment (b) hormogonium

(c) small filament (d) trichome

23. A bacterium with tuft of flagella at two poles is:

(a) atrichous (b) amphitrichous

(c) monotrichous (d) lophotrichous

24. Cells of the trichome break at the point next to heterocyst and each piece is:

(a) fragment (b) hormogonium

(c) segment (d) peritoneum

25. In gram negative bacteria, lipids are:

(a) 10 (b) 11

(c) 12 (d) 11 – 12

26. The bacterium E.coli is:

(a) facultative anaerobic (b) aerobic

(c) microaerophilic (d) anaerobic

27. Which one is the phase of rapid growth in bacteria?

(a) log (b) lag

(c) stationary (d) decline

28. In bacteria waste materials are:

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(a) alcohol (b) lactic acid

(c) acetic acid (d) alcohol, lactic acid and acetic acid

29. In bacteria the dormant, thick-walled, desiccation resistant forms and develop during differentiation of vegetative cells which can germinate under suitable condition are:

(a) exospores (b) cysts

(c) endospores (d) zoospores

30. The process in which we use physical agents to control bacteria/microorganism is known as:

(a) sterilization (b) immunization

(c) vaccination (d) pasteurization

31. The destruction of all life forms is:

(a) vaccination (b) immunization

(c) sterilization (d) pasteurization

32. The accessory pigments of cyanobacteria are:

(a) phycobilins (b) chlorophyll a

(c) chlorophyll (d) chromatophores

33. The cbemotberapeutic chemical substances which are used in the treatment ofinfectious diseases are:

(a) antibodies (b) antibiotics

(c) helper T-lymphocyte (d) killer T-lymphocyte

34. Trichomes of nostoc filament mostly break near:

(a) heterocyst (b) hormogonium

(c) cyst (d) mucilage

35. Which one is a cyanobacterium?

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(a) amoeba (b) Escherichia

(c) anabaena (d) staphylococcus

36. Which effect is one that kills the microbes immediately?

(a) microbicidal (b) filtration

(c) pasteurization (d) immunization

37. Asexual reproduction in bacteria occur by:

(a) conjugation (b) multiple fission

(c) binary fission (d) transformation

38. In bacteria chlorophyll is present in:

(a) ribosomes (b) plasmids

(c) mesosomes (d) cytoplasm

39. In gram positive bacteria, overall thickness of cell wall is:

(a) 20 – 80 nm (b) 20 – 60 nm

(c) 8 – 11 nm (d) 1 – 4 nm

40. The bacteria which exist in grape like cluster are called:

(a) staphylococci (b) coccobacillus

(c) streptobacillus (d) pleomorphic

41. The first organism that appeared on the earth is believed to be related to:

(a) eubacteria (b) archeobacteria

(c) cyanobacteria (d) viruses

42. In which activity louis pasteur was directly involved:

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(a) vaccine for anthrax (b) pasteurization

(c) fennentation (d) all of these

43. In which activity Robert Koch was not involved:

(a) preparation of specimen for microscopic examination

(b) discovery of bacteria that caused anthrax

(c) development of vaccine for anthrax and cholera

(d) formulation of germ theory of disease

44. Where are bacteria present?

(a) highly saline environment like dead sea (b) oil deposits

(c) hot springs (d) all of these

45. Which structure is not found in all bacteria?

(a) cell membrane (b) cell wall

(c) nucleoid (d) ribosome

46. Some members of genus mycoplasma have size range about:

(a) 100 – 200 µm (b) 1.1 – 1.5 µm

(c) 2.0 – 6.0 µm (d) 0.75 – 1.25 µm

47. Some bacteria that can exist in variety of shapes are called:

(a) pleomorphic (b) hetromorphic

(c) morphovariants (d) spirobacillus or coccobacillus

48. Cocci bacteria are found in different arrangements, which are based on:

a) no. of cells found in a particular arrangement

(b) plane of cell division

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(c) shape of the cell

(d) both a and b

49. Which one is the example of cocci bacteria?

(a) pseudomonas (b) escherichia coli

(c) hyphomicrobium (d) none of them

50. Cocci bacteria are generally:

(a) peritrichous (b) amphitrichous

(c) lophotrichous (d) atrichous

51. Bacteria fully dependent on their host:

(a) parasitic (b) photosynthetic

(c) chemosynthetic (d) heterotrophic

52. Grampositivebacteria contain less of _____ as compared to gram negative.

(a) peptidoglycan (b) lipoid materials

(c) permeability (d) techoic acid

53. Slime provides greater pathogenicity to bacteria by:

(a) attaching them at target site

(b) protecting them from the effect of antibiotics

(c) protecting them against phagocytosis

(d) all of the above

54. Bacterial cell membrane differs from eukaryotic cell membrane by:

(a) lacking cholesterol

(b) containing enzyme for respiratory metabolism

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(c) forming infolding like mesosome

(d) all of the above

55. Rod shaped bacteria are:

(a) cocci (b) bacilli

(c) spirilla (d) vibrius

56. Which of the following is present in both gram positive and gram negative walls?

(a) an outer membrane (b) peptidoglycan

(c) teichoic acid (d) lipopolysaccharides

57. In 1880, Louis Pasteur isolated the bacteria responsible for:

(a) small pox (b) chicken pox

(c) chicken cholera (d) anthrax

58. Function of bacterial endospore is:

(a) reproduction (b) protein synthesis

(c) survival (d) storage

59. Which of the following bacteria is a bacillus?

(a) pneumococcus (b) pseudomonas

(c) vibrio cholera (d) hyphomicrobium

60. An example of chemotherapeutic agents is:

(a) formaldehyde (b) chloramphenicol

(c) phenol (d) alcohol

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UNIT NO. 3 (KINGDOM PROKARYOTE) MONERA

1	A	2	C	3	B	4	C	5	A	6	A	7	B	8	C	9	A	10	B
11	A	12.	A	13	A	14	B	15	C	16	A	17	B	18	C	19	A	20	B
21	A	22	D	23	B	24	B	25	D	26	A	27	A	28	D	29	B	30	A
31	C	32	A	33	B	34.	A	35	C	36	A	37	C	38	D	39	A	40	A
41	B	42	D	43	C	44	D	45	B	46	A	47	A	48	D	49	D	50	D
51	A	52	B	53	C	54	A	55	B	56.	B	57	C	58	C	59	B	60	B

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THE KINGDOM PROTISTA (PROTOCTISTA)

KEY POINTS

1. In 1861, John Hogg proposed the kingdom Protoctista for microscopic organisms.
2. In 1866, Ernst Haeckel included bacteria and Euglena like microorganisms in the Kingdom Protista. However he separated blue green algae and bacteria (prokaryote, from nucleated protists and placed them in a separate group called Monera, within the kingdom Protista.
3. In 1938, Herbert Copeland elevated the prokaryotes to kingdom position and separated them from Protista.
4. In 1969, Robert Whittaker proposed five kingdom systems; in kingdom Protista he included only unicellular eukaryotes. However, nowadays this kingdom also includes colonial and simple multicellular eukaryotes.
5. The Kingdom Protista is defined by exclusion (keeping out). It means that all members have characters that exclude them from the other four kingdoms.
6. The Kingdom Protista con-sists of primarily aquatic eukaryotic organisms.
7. All protists are eukaryotic and have evolved from prokaryotes. The other eukaryotickingdoms, Plantae, Fungi and Animalia evolved from protists in various ways.
8. Theprotists are unicellular, colonial or simple multicellular organisms.
9. All protists are eukaryotic. It is unifying feature of protists.
10. Unlike plants and animals protists do not develop from a blastula or an embryo.
11. On the basis of diversity, the protists are regarded as polyphyletic group of organisms. Polyphyletic means that they do not have a single common ancestor.
12. Margulis and Schwartz have divided this kingdom (Protista) into 27 phyla because it is a crowd of different organisms.

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13. Protists are three groups Animal like protists (Protozoz), plant like protists (Algae) fungi like protists(slime molds and water molds)

14. All protozoans are unicellular. Most of them ingest their food by endocytosis.

Table: Some Groups of Protozoa

Common Name	From	Locomotion	Examples
Zooflagellates	Unicellular, some colonial	One or more Flagella	Trypanosoma, Euglena
Amoebas	Unicellular, no definite shape	Pseudopods	Amoeba, Entamoeba
Actinopods	Unicellular	Pseudopods	Radiolarians
Foraminifera	Unicellular	Pseudopods	Forams
Apicompexans	Unicellular	None	Plasmodiuim
Ciliates	Unicellular	Cilia	Paramecium, Vorticella, Stentor

15. The intestinal parasite, Entamoeba histolytica. It causes amoebic dysentery in humans

16. Pseudopodia form cytoplasmic projections

17. In amoebas reproduction is by binary fission or multiple fission

18. During unfavourable conditions cysts are formed in Amoebas

19. The giant amoeba Pelomyxa palustris may be the most primitive eukaryote.

20. The giant amoebas live in mud at the bottom of freshwater ponds. They have methanogenic bacteria. These bacteria degrade organic molecules into methane

21. Zooflagellates may be free-living, symbionts or parasites.

22. Zooflagellates are mostly unicellular but a few colonial forms are also present,

23. Trichonymphas are complex, specialized flagellates with many (hundreds of) flagella which live as symbionts in the guts of termites and help in the digestion of dry wood.

24. Trypanosoma is a parasitic flagellate in human causing African sleeping sickness. It is transmitted by the bite of infected tsetse fly

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25. Choanoflagellates are sessile marine or freshwater flagellates. These are attached by a stalk and their single flagellum is surrounded by a delicate collar. They closely resemble the collar cells in sponges.

26. Ciliates are unicellular organisms with a flexible outer covering called a pellicle. Itgives them a definite but changeable shape.

27. In Paramecium, the surface of the cell is covered with several thousand cilia.

28. Stentor is sessile ciliates

29. Contractile vacuoles perform the function of water regulation in freshwater ciliates.

30. Ciliates differ from the other protozoans in having two kinds of nuclei. One or moresmall diploid micronuclei involved in sexual process and a large, polyploidy macronucleus that controls cell metabolism and growth.

31. Most ciliates reproduce sexually by conjugation

32. Foraminiferans and actinopods are marine protozoans

33. Tests of foraminifera are made of calcium whereas those of actinopods are made of silica.

34. The shells or tests contain pores through which cytoplosmic projections can be extended.Dead foraminiferans sink to the bottom of the ocean where their shells form a grey mud that is gradually transformed into chalk.

35. Apicomplexans are a large group of parasitic protozoans some of which causeserious diseases such as malaria in humans.

36. Apicomplexans have no specific structures for locomotion but move by flexing.

Note: The saliva of female Anopheles mosquito contains a chemical that prevents the coagulation of the blood.

37. Chill, followed by high fever are the symptoms of malaria. These are due to toxic substances that are released and affect other organs of the body.

38. Algae are aquatic, eukaryotic photosynthetic thallophytes.

39. Algae carry out 50 to 60 of all the photosynthesis on the earth (Most of the rest byplants).

40. The sex organs in algae are unicellular (the sex organs in plants are multicellular).

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41. In algae the zygote is not protected by the parent body. However a plant zygote grows into a multicellular embryo that is protected by parental tissue.

42. Algae may be unicellular, colonial, filamentous / multicellular. Filamentous may have cross walls or coenocytes.

43. Seaweeds have leaf-like extensions.

44. The body of algae is not differentiated into true roots, stems and leaves. The xylemand phloem are also absent, such a body is called a thallus

45. Classification of algae into phyla is mainly based on pigment composition.

46. There are great variations in algal life cycles.

47. All algae except Rhodophyta (red algae) have motile flagellated cells in at least one stage of life cycle.

Table: Classification of the Photosynthetic Prtoctista (Algae)

No.	Phylum	Common Name	Form	Locomotion	Pigments	Examples
(i)	Euglenophyta	Euglenoids	Unicellular	Two flagella, one long one short	Chi.a, Chi.b carotenoids	Englena
(ii)	Phyrrophyta	Dinoflagellates	Unicellular	Two flagella	Chi.a, Chi.c carotenoids including fueoxen-thin	Gonyaulax, Ceratium
(iii)	Chrysophyta	Diatoms	Usually Unicellular	Usually none	Chi.a, Chi.c carotenoids including fueoxen-thin	Diatoms, Frequilaria, Pinnularia
(iv)	Phaeophyta	Brown Algae	Multicellular	Two flagella, on reproductive cells	Chi.a, c carotenoids including fueoxen-thin	Fucus, Macrocystis
(v)	Rhodophyta	Red Algae	Multicellular or Unicellular	None	Chi.a, c carotenoids phycoerythrin	Chondrus, Polysiphonia
(vi)	Chlorophyta	Green Algae	Unicellular, colonial, Multicellular	Most have flagella	Chi.a, Chi.b carotenoids	Chlirella, Ulca, Acetabularia Spirogyra

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48. On the basis of molecular data, Euglenoids are thought to be closely related to zooflagellates.

49. Chlorophyll a, b carotene and xanthophylls (carotenoids) present in Euglenoids. green algae and Green land plants.

50. **Some** species of Euglenoids are always colourless and heterotrophic.

51. **Most** dinoflagellates are unicellular.

52. Dinoflagellates are often covered with the shells of interlocking ceilulose plates impregnated with silicates.

53. Major group of producers are Diatomes; then Dinoflagellates.

54. **Dinoflagellates have rarely population explosions or blooms. These blooms colour the water orange, red or brown and are called as red tides.**

55. The cell wall of each diatom consists of two shells that overlap where they fit together like a petri dish. This cell wall is composed of Silicon.

56. The giants of protista are included in Brown algae (e.g., Kelps).

57. Brown algae are common in cooler marine waters, especia.ly along rocky coastlines inthe intertidal zone (e.g. Laminaria).

58. All brown algae are multicellular.

59. Brown algae range from a few centimeters to approximately 75 meters in length.

60. The largest brown algae, called the kelps, are tough and leathery in appearance

61. The kelps have leaflike blades, stemlike stripes and rootlike holdfast.

62. Red algae also has hold fast.

63. Some red algae have calcium carbonate in their cell walls from the ocean. These types lake part in building coral reefs, along with coral animal

64. Green algae and green land plants have monophyletic lineage. This is indicated byP.N.A sequencing.

65. Most green algae possess cell walls with cellulose.

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66. Green algae have pigments, energy reserve products, and cell walls that are identical to those of plants.

67. Green algae and green land plants have starch as reserve food.

68. Chlorella is a unicellular non-motile green alga.

69. Marine algae are source of many useful substances like algin, agar, carrageenan, and antiseptics. Iodine is also obtained from algae

70. Some protists resemble fungi because they are not photosynthetic and the body formed of Hyphae.

71. Fungus like protists are not fungi because the fungus like protists have centriole and cellulose. Fungi have chitin and no centriole.

72. Two major groups of fungus-like protists are: Slime molds (Myxomycota) and water molds (oomycotes).

Note: Cellular slime molds belong to the division Acrasiomycota while the true slime molds belong to the division Myxomycota.

73. The feeding stage of a slime mold is a plasmodium. It is a multinucleate mass of cytoplasm that can grow to 30 cm (1 ft) in diameter. It ingests bacteria, yeasts, spores and decaying organic matt.

74. During unfavourable condition, slime mold forms resistant haploid spores. These spores are formed by meiosis in the stalked structures called sporangia.

75. When conditions becomefavourable again, spores germinate into biflagellated or amoeboid reproductive or swarm cells. The reproductive or swarm cell; unite to form diploid zygote. Zygote produces multinucleate plasmodium. Each nucleus is diploid.

76. The plasmodial slime mold, **Physarum polycephalum,** is used to stud) growth and differentiation, cytoplasmic streaming and the function of cytoskeleton.

77. The hyphae of water molds are aseptate

Note: Late Blight of potato is also called wild fire.

78. Phytophthora infestans causes a disease called late blight of potatoes.

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79. Because of many rainy, cool summers in Ireland in the 1840's, the water mold multiplied freely. It caused a disease called late blight of potatoes.

80. Foraminiferan: A marine protozoan that secretes a calcium-containing shell.

81. Plasmodium stage of slime mold: A coenocytic mass of cytoplasm, either branched or solid, that forms the multinucleate body of a true slime mold.

QUESTIONS FOR PRACTISE

1. John Hogg proposed the kingdom Protoctista for microscopic organisms in:

(a) 1881 (b) 1961

(c) 1861 (d) 1981

2. Who elevated the prokaryotes to kingdom status, thus separating them from Protista in 1938?

(a) Herbert Copeland (b) Ernst Haeckel

(c) John Hogg (d) Robert Whittaker

3. Members of which group are unicellular in which most ingest their food byendocytosis?

(a) bacteria (b) dinoflagellates

(c) protozoans (d) diatomes

4. The giant amoeba which may be the most primitive of all eukaryote like forms is the:

(a) pelomyxa palustris (b) entamoeba

(c) trypanosoma (d) vorticella

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5. Number of Flagella in Trichonympha are:

(a) hundreds of (b) dozens of

(c) few (d) none of these

6. Trypanosoma is a human parasite causing African sleeping sickness which is transmitted by:

(a) tsetse fly (b) house fly

(c) fruit fly (d) dragon fly

7. Tests of Foraminifera are made of:

(a) calcium (b) sulphur

(c) phosphorus (d) iodine

8. Which group has all parasitic protozoa?

(a) foraminifera (b) apicomplexans

(c) amoebas (d) actinopods

9. Which group has special evolutionary significance because it resemble with plants and green algae in having similar pigments and, on the other hand, are also related to zoo flagellates?

(a) euglenoids (b) dinoflagellates

(c) diatoms (d) zoo flagellates

10. Which group has silica shells with extremely beautiful symmetrical patterns?

(a) diatoms (b) euglenoids

(c) dinoflagellates (d) actinopods

11. Which group of algae includes the giants of the protist kingdom?

(a) brown (b) golden

(c) green (d) red

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12. The plasmodial slime mold is the:

(a) trichonympha (b) entamoeba

(c) physarum polycephalum (d) phytophathora infestans

13. Apicomplexans are a large group of:

(a) free living protozoa (b) parasitic protozoa

(c) saprophytic fungi (d) parasitic fungi

14. The major groups of eukaryotic organisms in the kingdom protista are:

(a) 3 (b) 4

(c) 5 (d) 2

15. Who proposedthe kingdom protista for microscopic organisms?

(a) Wittaker (b) Hogg

(c) Copeland (d) Heackeld

16. Margulis and Schwartz have listed the No. of phyla of protista as:

(a) 23 (b) 25

(c) 27 (d) 29

17. The cell wall consists of two over lapping shell in:

(a) euglenoids (b) diatoms

(c) dinoflagellates (d) brown algae

18. Polysiphonia is a representative of:

(a) green algae (b) brown algae

(c) red algae (d) diatoms

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19. ChI a and Chi b are found:

(a) brown algae, golden algae and diatoms

(b) green algae, golden algae and euglenoids

(c) green algae, euglenoids and green plants

(d) red algae, euglenoids, and brown algae

20. Reproductive swarm cells are present in:

(a) rhodophyta (b) oomycotes

(c) chlorophyta (d) myxomycota

21. Late blight of potatoes is caused by:

(a) phytophthora infestans (b) physarum polycephalum

(c) puccinia (d) ustilago

22. Common photosynthetic pigment in all algae is:

(a) carotene and xanthophylls

(b) chlorophyll a and chlorophyll b

(c) chlorophyll a and carotene

(d) chlorophyll a, chlorophyll band carotenoids

23. Life cycle in Algae:

(a) one type (b) two types

(c) three types (d) many types

24. Fucus is:

(a) fungus (b) alga

(c) plant (d) lichen

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25. Which one is a representative of Brown algae?

(a) laminaria (b) diatom

(c) chlorella (d) polysiphonia

26. Ciliates are unicellular organisnls with a flexible outer covering called:

(a) membrane (b) wall

(c) capsule (d) pellicle

27. Classification of algae entophyte ia is largely based on their:

(a) morphology (b) location

(c) pigment composition (d) cytology

28. Which are involved in population explosion?

(a) euglenoids (b) zooflagellates

(c) dinoflagellates (d) diatomes

29. Of all the photosynthesis on the earth, Algae carry out probably:

(a) 50 to 90 (b) 50 to 80

(c) 50 to 60 (d) 60 to 80

30. Rndocytosis occurs in:

(a) some protozoans (b) all protozoans

(c) most of protozoans (d) fungi

31. Fungus like protists have:

(a) centriole and cellulose (b) cellulose and chitin

(c) chitin and lignin (d) chitin

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32. In protista, the organisms are:

(a) unicellular (b) colonial

(c) simple multi-cellular (d) all of these

33. Most abundant living and fossil organism:

(a) protozoans (b) dinoflagellates

(c) diatoms (d) euglenoids

34. No flagellate protozoans move by:

(a) cilia (b) pseudopodia

(c) flexing (d) all of these

35. Acetabularja belongs to the Phylum:

(a) rhodophyta (b) chrysophyta

(c) euglenophyta (d) chlorophyta

36. How many ciliate protozoans have two types of Nuclei?

(a) few (b) most

(c) all (d) one

37. Reproductive organs of fungi and Algae are:

(a) unicellular (b) colonial

(c) multi-cellular (d) may be unicellular or multi-cellular

38. Black bread mold, csembles liverworts in that both develop:

(a) myceliupe (b) hyphae

(c) archegonia (d) spores

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39. The cell wall of Chlorella contains:

(a) chitin (b) murein

(c) cellulose (d) silicon

40. The sexual reproduction in which one gamete is motile other is non-motile is called:

(a) isogamy (b) anisogamy

(c) oogamy (d) heterospory

41. Algae differ from mosses in having:

(a) aquatic habit (b) thalloid plast body

(c) unicellular sex organs (d) alternation of generations

42. Which one is a representative of Chrysophyta?

(a) laminaria (b) diatoma

(c) chlorella (d) polysiphonia

43. Spore forming parasitic protozoans that normally complete life cycle in two hos are grouped in:

(a) diatoms (b) actinopods

(c) foraminiferans (d) apicomplexans

44. Which of the following is a filamentous alga?

(a) spirogyra (b) ulva

(c) chlorella (d) acetabularia

45. The feeding stage of slime mold is:

(a) microscopic

(b) macroscopic

(c) mostly microscopic and sometimes macroscopic

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(d) changeable rapidly and reversibly

46. All the members and stages are non-motile in:

(a) green algae (b) red algae

(c) brown algae (d) dinoglagellates

47. Fucoxanthin is not present in:

(a) red algae (b) euglenoids

(c) green algae (d) all of these

48. Pigment present only in red algae is:

(a) phycocyanin (b) phycoerythrin

(c) fucoxanthin (d) none of these

49. The only group of algae in which chlorophyll b is present:

(a) chlorophyta (b) rhodophy

(c) pyrrophyata (d) phaeophyta

50. A Dinoflagellate has:

(a) cellulose plates in the shell (b) ca plates in the shell

(c) si plates in the shell (d) chitin plates in the shell

51. Which one belongs to oomyota?

(a) egg fungi (b) club fungi

(c) sac fungi (d) cup fungi

52. Phycomycete is:

(a) mold (b) green algae

(c) yeast (d) bacterium

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53. Following are characteristics of Apicomplexans except:

(a) spore like cyst stage in life cycle (b) all are external parasites

(c) have no locomotary organs (d) cause many serious diseases

54. The sporozoites in human liver stay for:

(a) 5 – 15 days (b) 15 – 25 days

(c) 1 – 5 days (d) 25 – 30 days

55. Which one represents zygote in the life cycle of Plasmodium?

(a) sporozoite (b) merozoite

(c) ookinete (d) gametocyte

56. Most of oomycotes live in:

(a) water (b) soil

(c) air (d) host

57. Of the following which one is the largest protozoan?

(a) amoeba (b) euglena

(c) paramecium (d) entamoeba

58. No. of Algal species are about:

(a) 2500 (b) 25000

(c) 1500 (d) 15000

59. Which one is absent in algae?

(a) embryo (b) cambium

(c) vascular tissue (d) all of these

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60. Entamoeba histolytica causes amoebic dysentery because this parasite feeds on the cells that live in human:

(a) stomach (b) duodenum

(c) colon (d) rectum

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UNIT NO. 3 (KINGDOM PROTISTA) PROTOCTISTA

1	C	2	A	3	C	4	A	5	A	6	A	7	A	8	B	9	A	10	A
11	A	12.	C	13	B	14	B	15	B	16	C	17	B	18	C	19	C	20	D
21	A	22	C	23	D	24	B	25	A	26	D	27	C	28	C	29	C	30	C
31	A	32	D	33	C	34.	D	35	D	36	C	37	A	38	D	39	C	40	C
41	C	42	B	43	D	44	A	45	B	46	B	47	D	48	B	49	A	50	A
51	A	52	A	53	B	54	A	55	C	56.	A	57	A	58	B	59	D	60	C

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FUNGI

IMPORTANCE OF FUNGI

- Fungi are ecologically as well as economically very important

ECOLOGICAL IMPORTANCE

- Fungi have great ecological importance as decomposers symbionts and bioremediators.

1. **Decomposers:**

- Fungi, along withsaprobic bacteria, play a vital role in the recycling of inorganic nutrients in the ecosystem. Without decomposition all the essential nutrients would soon become locked up in the form of dead animals, plants and the wastes of animals and plants. Therefore the essential nutrients would he unavailable to the organisms. As a result the life would cease.

2. **Symboints:**

(i) **Mycorrhizae:** Mycorrhizal fungi improve the growth of plants with which they are associated. About 95% of all kinds of vascular plants have this association.

(ii) **Lichens:** Lichens growing on the rocks break them, setting a stage for other organisms during the course of ecological succession.

(iii) **Bio-indicators:** Lichens are very good bio-indicators of air quality as they are very sensitive to pollution.

(iv) **Bioremediation:** Some fungi are also used for bioremediation (degrading/removing environmental poisons/pollutants by organisms).

COMMERCIAL IMPORTANCE

Fungi cause economic gains as well as losses. Economic gains due to fungi.

1. **Edible Fungi:** Certain fungi are edible, about 200 species of mushrooms (e.g. Agaricussp) morels (e.g. Morchella esculenta), truffles (underground fruiting bodies of some

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Ascomycetes, e.g. Tuber sp that people find with the help of trained dogs or pigs) are common edible fungi.

Reindeer Moss (lichen, not a moss) is used as food for reindeers and some other large animals in arctic/subarctic/ boreal regions. There are some poisonous mushrooms called the toadstools such as death cap/death angle (Amanila) and jack-O' lantern mushroom.

2. **Fermenting Agent:** Certain fungi are used in food industry because of their fermenting ability. Yeasts (Saccharornyces cerevisiae) are used in the production of bread and liquor.

Penicillium species are used for giving flavour, aroma and characteristic colour to some cheese. Some species of Aspergillus are used in fermenting producing soya sauce and soya paste from the soya bean.

Citric acid is also obtained from some Aspergillus species.

3. **Antibiotics and Drugs:**

(i) Some fungi are source of antibiotics and some other drugs. Penicillin, first antibiotic discovered (by A. Fleming-I 928) is obtained from Penicilliumnutatum.

(ii) Lovastatin is used for lowering the blood cholesterol.

(iii) Cyclosporine obtained from a soil fungus is used in organ transplantation for preventing transplant rejection.

(iv) Ergotine is used to relieve one kind of headache ingrained.

(v) Griseofulvin is used to inhibit fungal growth.

(vi) Dyes: Some natural dyes obtained from lichens are used in textile industry.

(vii) Pink bread mold (Neurospora) has also been used for genetic research:

USE OF YEASTS IN BIOLOGICAL RESEARCH

Yeasts are unicellular microscopic fungi, derived from all the three different groups of fungi but mostly ascomycetes.

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Asexual Reproduction:

Yeasts reproduce mostly asexual by budding sexual reproduction. Yeasts reproduce sexually by forming asci/ascòspores or basidia/basidiospores.

Importance of Yeasts:

(i) Yeasts are used in genetic/molecular biological research because of their rapid generation
and rapidly increasing pool of genetic and biochemical information.

(ii) Yeasts were the first eukaryotes to be used by genetic engineers. In 1983 a functional artificial chromosome was made in Saccharomyces cerevisiae. The same yeast was the first eukaryote whose genomic sequence was completely studied in 1 996.

(iii) Yeasts are also being investigated for production of some hormones.

(iv) Yeasts (Saccharomyces cerevisiae) ferment carbohydrate (gluco) to ethanol and carbon dioxide. They are of great economic importance due to their fermenting ability and are used in the production of bread and liquor.

ECONOMIC LOSSES DUE TO FUNGI

- Fungi are responsible for plant diseases, animal diseases and food spoilage.

PLANT DISEASES:

Fungi arc responsible for many serious plant diseases because they produce several enzymes that can breakdown cellulose lignin and cutin. All plants are affected by them. Some of the plant diseases are as follows:

1. **Rusts and Smuts:** Due to Rust & Smut many people were died of starvation or were migrated to other countries.

2. **Other Diseases:** Powdery mildews (on grapes, rose and wheat etc.) ergot of rye, red rot of sugar cane. Potato wilt, cotton root rot, apple scab and brown rot of peaches, plums, apricots and cherries are some other common plant diseases caused by fungi.

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3. **Wound-Rotting Fungi**: Wood rotting fungi destroy not only living trees hut also structural timber. Bracket/shelf fungi cause lot of damage to the stored cut lumber as well as stands of timber of living trees.

ANIMAL DISEASES:

Fungi also cause certain animal diseases. Some are as follows:

1. **Ringworms and Athlete's Foot:** Ringworm and athletes foot are superficial fungal infections caused by certain imperfect fungi.

2. **Candidiasis or Candidosis:** Candida albicans (yeast) causes oral and vaginal thrush (candidiasis or candidosis).

3. **Histoplasmosis**: Histoplasmosis is a serious infection of lungs caused by inhaling spores of a fungus which is common in soil contaminated with bird's feces, if infection spreads into blood stream and then to other organs (which is very occasional)it can he serious and even fatal.

4. **Aspergillosis:** Aspergilius fumigatus causes aspergillosis, hut only in persons with defective immune system such as AIDS and may cause death.

5. **Aflatoxins:** Some strains of Aspergillus flavus produce carcinogenic (cancer-causing) mycotoxins (toxins produced by fungi) called aflatoxins.

   Aspergillus contaminates improperly stored grains such as peanuts and com etc and they have aflatoxin. Eggs and meat may also have small traces of aflatoxins

   Note: Any moldy human food or animal forage product should he discarded.

6. **Ergotism:** Ergotism is caused by eating bread made from purple ergot-contaminated rye flour.

   The poisonous material in the ergot causes nervous spasm convulsion, Psychotic delusion and gangrene.

   Food Spoilage: Saprobic fungi arc not only useful recyclers but also cause vast damage to the food, wood, fiber and leather by decomposing them. About 15 – 50 % of world fruit is lost each year due to fungal attack.

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Growth on Shower Curtains: A pink yeast (Rhodotorula) flows on shower curtains and other moist surfaces.

LIFE CYCLE OF RHIZOPUS

1. **Habitat:** These fungi are saprobic or parasitic. They are found on a wide variety of organic substrates, including mature fruits and vegetables, feces, jellies, syrups, leather, bread and tobacco. Some Rhizopus species are agents of human zygomycosis (fungal infection) and can be fatal. Rhizopus reproduces by vegetative, asexual and sexual methods spores. The asexual spores an: produced inside the sporangium and gene, really identical to their parent.

   - In Rhizopus the sporangia are supported by a large columella and the sporangiophores arise among distinctive rhizoids. Dark zygospores are produced after two compatible mycelia fuse during sexual reproduction producing colonies that may be genetically different from their parents.

2. **Hyphae:** The hyphae are unseptate, coenocytic and loosely arranged.

3. **Asexual Reproduction:** It is spore information which are produce in the sporangia.

4. **Sexual Reproduction:** Sexual reproduction involves plasmogamy, karyogamy and meiosis, during, sexual reproduction. Zygotc is formed directly by the fusion or hyphae called gametangia/gametes (conjugation). Karyogamy immediately follows plasmogamy.

5. **Meiosis:** The zygospore germinates under favourable conditions. Meiosis takes place when the zygospore germinates and haploid spores are produced.

   The zygote forms temporary, dormant, thick walled resistant structure called zygospore. Therefore the name of this group is Zygomycetes.

6. **Formation of New Mycelium:** Spores on germination produce new mycelium.

   Examples: Rhizopus is very common example. It grows on the moist bread and fruit etc. and spoils them.

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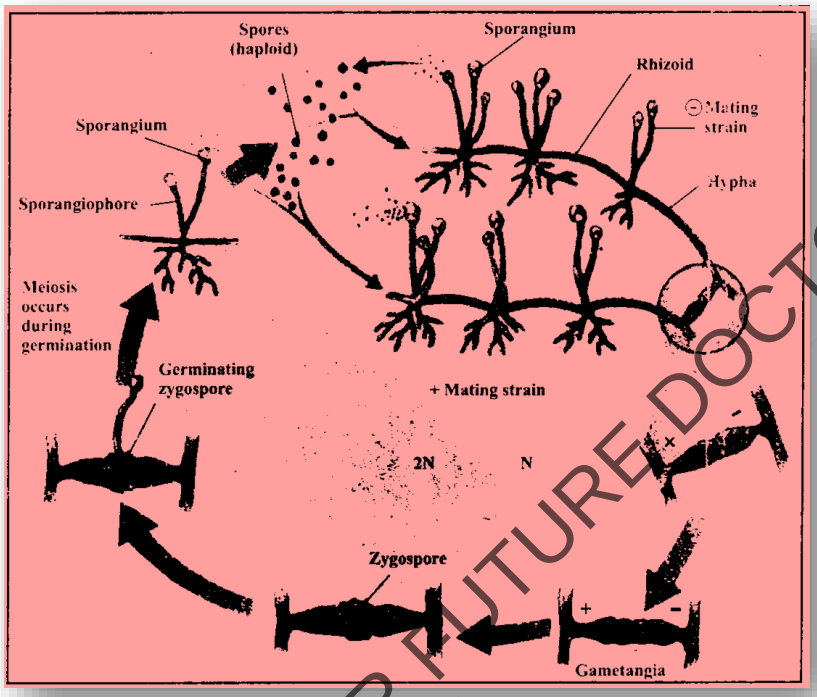

Fig: Life Cycle of Rhizopus
(Black bread mold a zygomycete, Zygote formed by fusion of gametangia/gametes directly develops into a reusing zygospore)

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ADDITIONAL RELATED READINGS

1. Fungi include eukaryotic, multi-cellular, heterotrophic organisms that have absorptive method of nutrition.
2. Study of fungi is called mycology and the scientists who study fungi are called mycologists.
3. More than 100,000 species are included in the kingdom fungi.
4. The ecological role of fungi as decomposers is like bacteria.

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5. Most fungi are decomposers that live on organic material. Here they secrete digestive enzymes and absorb small organic molecules which are produced by digestion.

6. Plant like characters of fungi are cell wall, no centrioles and non-motile.

7. Animal like characters of fungi are heterotrophic, glycogen as reserve food material and no cellular in their cell wall and contain chitin. Chitin is present in the exoskeleton of arthropods.

8. Fungi are different from animals because of cell wall, absorptive heterotrophs, non-motile, nuclear mitosis, specific DNA.

9. During nuclear mitosis the nuclear envelope does not break.

10. Fungi can tolerate a wide range of pH (i,e. 2 – 9) and temperature (– 5 to 50^{o} C or more).

11. Some fungi are unicellular such as yeasts.

12. The body of a fungus is known as mycelium. The mycelium consists of hyphae.

13. Asetate hyphae are multinucleate coenocytic hyphae.

14. Yeasts are non-hyphae unicellular fungi.

15. Normally pores are present in the septa of hyphae.

    (**Example**: Penicillium)

16. Hyphae may be compactly arranged and organized to form complex reproductive structure such as mushrooms. Puff balls and morels etc. These reproductive structures are called as fruiting bodies.

17. A single mycoclium may produce upto one kilometer new hyphae in one day.

18. Armillaria is a pathogenic fungus which badly affects conifers.

19. All fungalopo nuclei are haploid except for dipoid zygot that forms during sexual reproduction.

20. Fungi store surplus food usually in the form of lipid proplets or glycogen in the mycelium.

21. Fungi are of different types according to their mode of nutrition. They may be saprotrophs (or saprobes), parasites, predators or mutualists.

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22. Most fungi are saprotrophs or saprobes. These are decomposers that obtain their food (energy, carbon and nitrogen) directly from dead organic mailer.

23. When a spore germinates normally Rhizoid, are formed first, then sored and finally sporangiophores.

24. Rhizoids are for fixation, secretion of enzymes and absorption of food.

25. The saprobes (saprotrophic fungi) generally decompose the cellulose and legion which arc the main components of plant cell walls. Most bacteria cannot break these two materials.

26. Saprophytic fungi along with bacteria arc the major decomposers of the biosphere They help in the recycling of dements (C. N, P. O. H etc.) used by living things

27. Some fungi are parasites. They absorb nutrients directly from the living host cytoplasm with the help of special hyphal tips called haustoria.

28. Obligate parasites can grow only on living host and cannot grow on growth culture medium. Various mildews and most rust species arc obligate parasites

29. Facultative parasites can grow as parasite on their host as well as on the an artificial group media

30. Some fungi are active predators. They are animal trapping fungi which can capture animals and use them as food.

31. The oyster mushroom (Pleurotus ostreatus) is a predatory (carnivorous) fungus, It fulfills its nitrogen requirements from the Nematode, It fulfills its glucose requirements by breaking the wood,

32. Some species of Arthrobotrys trap the soil nematodes by forming constricting ring.

33. The association in which there is the benefit to the both partners is called as mutualistic symbiotic association.

34. Fungi form two important mutualistic symbiotic associations. These are lichen- and mycorrhizae.

35. Lichens are mutualistic and have symbiotic associations between certain fungi and certain photoautotrophs.

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36. The fungi are mostly ascomycetes and imperfect fungi and few Basidiomycetes (about 20 out of 15000 species of lichens). The photoautotrophs are either green algae or a cyanobacterium, or sometimes both.

37. Most of the visible part of lichen is fungus and algal part is present within the hyphae.

38. Fungus protects the alga from strong light and desiccation and gets food from the alga.

39. There are there growth forms of lichens:

    i) **Crustous Lichen:** These lichens grow tightly attached to the rocks or tree trunks etc. example is leacanur

    ii) **Foliose Lichens:** They are leaf like. Example is Parmelia

    iii) **Fruticose Lichens:** They are branching, example is Ramalina

40. Mycorrhizae are mutualistic associations between certain fungi and the roots of vascular plants. There are two main types of mycorrhizae, Endomycorrhizae and ectomycorrhizae.

41. Ecctomycorrhizae is mostly formed with pines and firs.

42. About 95 % of all kinds of vascular form mycorrhizal associations.

43. In mycorrhizal association fungi supplies inorganic (mineral and water etc.) to the plant and the plant supplies organic carbon to the fungi hyphae.

44. Most fungi reproduce asexually as well as sexually, however imperfect fungi has no sexual reproduction.

45. Asexual reproduction (in fungi) takes place by spores, conidia, fragmentation and budding.

46. Spores are a common way of reproduction in fungi.

47. Spores may be produced by sexual or asexual process. However they are haploid and non-motile.

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48. Spores are produced inside the reproductive structures called sporangia. The sporangia cut off from the hypae by complete septa.

49. Conidia are non-motile, asexual spores produced in chains or cluster at the end of modified huphae called conidiospores.

50. The mycelium of some hyphal fungi breaks into fragments and each fragment gives rise to a new mycelium.

51. Budding is an asexual asymmetric division in which tiny outgrowth of bud is produced which may separate and grow.

52. In fungi the processes of sexual reproduction s highly variable but two things are common that are fusion of halpoid niclei and meiosis.

53. During sexual production, the hyphae of the two genetically different but matched mating types come together/ now first of all their cytoplasm fuse and then nuclear fusion occurs. The fusion of cytoplasm is called as plasmogamy while the fusion of nuclei is called askaryogamy.

54. Out of the three main groups of fungi, in two groups (Basidiomycetes and ascomycetes) karyogamy does not take place immediately after plasmogamy. However the two haloid nuclei from the two individuals (which are generally different) may coexist and divide in the same hyphae for most of the life of the fungus.

55. A fungal hyphae. Cell having 2 nuclei of different genetic types is called as dikaytic (also heterokaryotic) hyphae/cell.

56. When meiosis occurs in the zygote, different groups of fungi produce types of haloid sexual spores (such as basidiospores and ascospores). These spores and may be produced by their typical structure / fruiting bodies such as basidiocarps and asci/assicarps.

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Table: Classification of Fungi

Phylum (Group)	Typical Examples	Sexual Reproduction	Asexual Reproduction	Hyphae
Zygomycota (Zygomycetes)	Rhizopus (Black bread mold) Pilobolus (spitting fungus)	Zygospores	Non-motile spores form in sporangia	Non-septate, multinucleate
Ascomycota (Ascomycetes of sac fungi)	Yeasts, Morels, truggles, Powdery mildway, molds	Ascospores inside saclike asci	Conidia cut off from tips of conidiophores	Septate, lengthy dikaryotic phase
Basidiomycota (Basidiomycetes or club fungi)	Mushrooms, rusts, Smuts, puff balls, bracket fungi	Basidiodpores borne on club shaped basidia	Uncommon	Sptate, lengthy dikaryotic phase
Deuteromycoa (Deuteromycetes / imperfect fungi)	Aspergillus, Penicillium, alternaria	Sexual phase has not been observed	Conidia	Varied

57. Ascomycota is the largest group of fungi, including over 60000 species, (about 50 % occur in lichens and some such is morels are mycorrhizal.

58. Hyphae of Ascomycota and basidiomycota are septate.

59. Ascomycota / basidiomycota have lengthy dikayotic phase that forms ascocarps / absidiocarps respectively.

60. In Ascomycota / basidiomycota karyogamy does not immediately follow plasmogamy. However karyogamy is immediately followed by meiosis.

61. The ascospores are haloid sexual spores.

62. Commonly 8 ascospores are produced inside each ascus.

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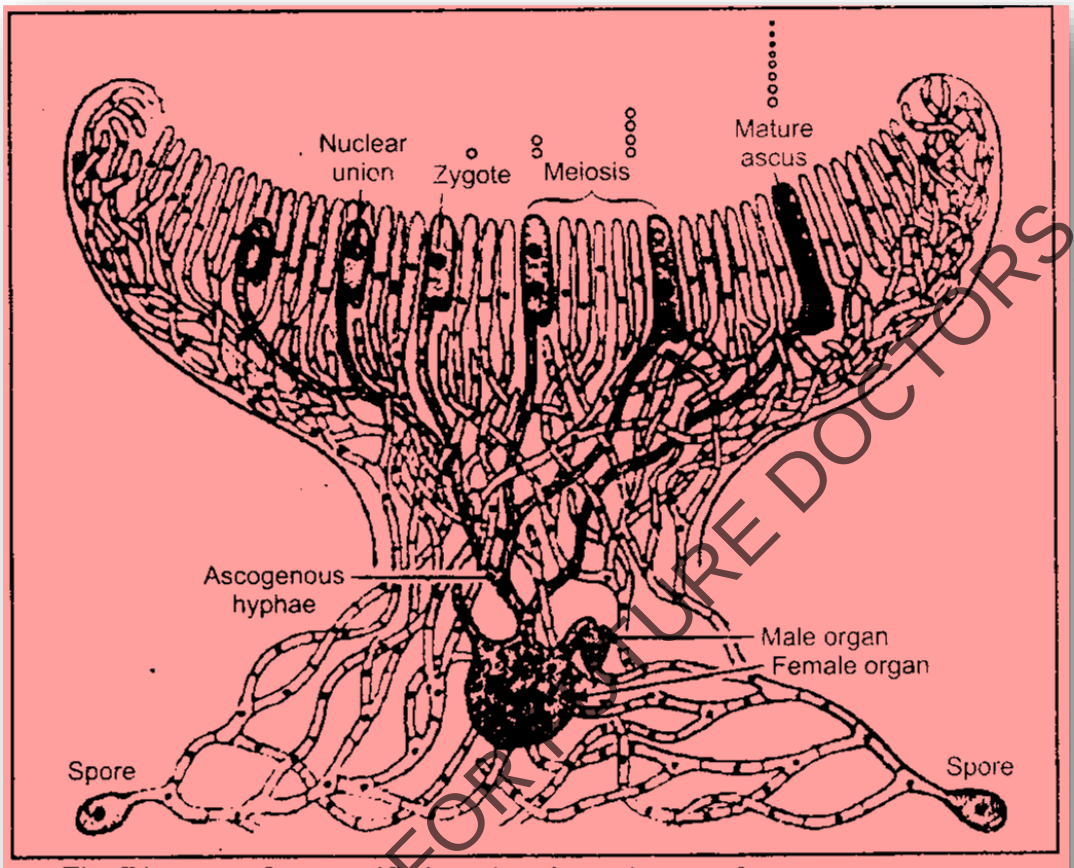

Fig. Diagram of a magnified section through a cup fungus (Ascomycota)

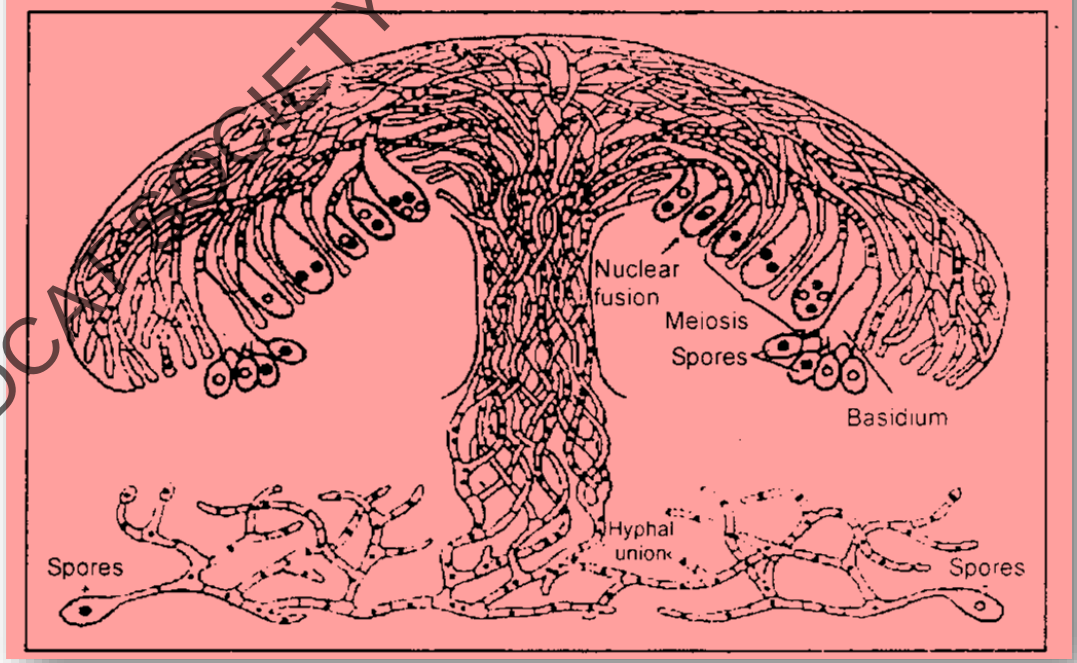

Fig: Section through a mushroom (Basidiomycota)

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63. Edible mushrooms, plant pathogens such as rusts ad smuts, puffballs and bracket / shelf fungi belongs to basidiomycota.

64. Puccinia species are most common rust fungi while Ustilago species are most common smut fungi.

65. The Spores (teliospores) of Ustilago tritici (loose smut of wheat) an: produced on the wheat ears.

66. Duteromycota, Deuteromycetes / Imperfect fungi is heterogenous group includes all such fungi in which sexual phase has not been observed.

67. Most of the members of Deuteromycota are related to Ascomycota. However some an: related to other two phyla (Zygomycota and Basidiomycota).

68. In parasexuality (in Deuteromycota) the portions of chromosomes of two nuclei lying in the same hypha are exchanged.

69. Penicillium sp (blue, green, mold) produces asexually by means of naked spores called conidios.

70. In Penicillium conidio are produced in chains at the tips of special hyphae called conidiophores which are branched and brush-like.

71. Fixation (by Rhizoids) is the structural adaptation of Fungi to live on Land.

72. Cytoplasmic flow throughout the hyphae is responsible for their rapid growth and spread.

73. Hyphal cell wall is thick and is formed of chitin. It is more resistant to decay than are cellulose and lignin found in the plant cell wall

74. Sporangia and conidia are produced on the elevated sporangiophorcs and conidiophores; As a result the spores and conidia are dispersed to a long distance by the wind.

75. The spores and conidia are thick walled and are non-flagellated. They do not require water for sexual reproduction.

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76. Many fungi are more tolerant (than are bacteria) to damage in hyperosmotic surroundings.

77. Many fungi can tolerate temperature extremes from – 5° C to 50° C or more. Therefore molds (e.g. Penicillium) can grow on oranges and jelly kept in a refrigerator, while generally bacteria cannot.

QUESTIONS FOR PRACTISE

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1. Which of the following statement is TRUE about fungi?

(a) flagellated cells are absent (b) they are autotroph

(c) they cannot digest lignin (d) growth and spread of hypohae is slow

2. Which of the following NOT edible?

(a) morchella esculenta (b) Jack - O - lantern mushroom

(c) reindeer moss (d) agaricus mushroom

3. Predatory mode of nutrition is found in:

(a) oyster mushrooms (b) penicillium

(c) aspergillus (d) agaricus mushroom

4. Fungi can absorb the food from substrate because they have:

(a) conidia (b) stolons

(c) sporangiophores (d) rhizoids

5. Non-septate multinucleate hyphae are found in:

(a) mushrooms (b) zygomycota

(c) ascomycota (d) basidiornycota

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6. Simple breaking of mycelium of some hyphal fungi is:

(a) budding (b) fragmentation

(c) trichome formation (d) hormogonium formation

7. Saprobes are also called as:

(a) parasites (b) mutualism

(c) saprotrophs (d) trichomes

8. What is true about an ascus?

(a) sexual reproductive part of hypha (b) asexual reproductive part of hypha

(c) contains four ascospores (d) ascocarps are present in ascus

9. In the yeast, spores are produced:

(a) exogenously

(b) endogenously

(c) always both exogeneously and endogenously

(d) sometimes endogenously and sometime exogenously

10. The fungal partner of lichens sometimes may belong to:

(a) myxomycetes (b) oomycetes

(c) basidiomycetes (d) ascomycetes

11. Lichens are bio-indicators of:

(a) water pollutions (b) air pollution

(c) noise pollution (d) soil pollution

12. Lichens have important role in:

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(a) succession (b) development

(c) evolution (d) development and evolution

13. Lichens reproduce by soredia each soredium has:

(a) algae (b) fungi

(c) cyanobacterias (d) Phototroph and Fungi

14. Nutrition in Fungi is:

(a) photosynthetic (b) chemosynthetic

(c) only parasitic (d) absorptive heterotrophs

15. Very fine asexual spores of Ascomycota are:

(a) conidia (b) ascospores

(c) zygospores (d) basidiospores

16. The Fungi cannot survive without:

(a) light (b) water

(c) food (d) water and food

17. Fungi differ from algae in having:

(a) cell wall of cellulose (b) cell wall of chitin

(c) cholorophyll and photosynthesis (d) starch as reserve food

18. Which of the following is a fungal disease of plants?

(a) tobacco mosaic disease (b) ergot of rye

(c) late blight of potato (d) citrus canker

19. In yeasts, meiosis occurs in:

(a) ascospores (b) basidial mother cell

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(c) ascus mother cells (d) both ascus and basidial mother cells

20. Fungi are classified on the basis of:

(a) structure of sporangium (b) method of spore formation

(c) mycelial characters (d) all of these

21. Sexual reproductive structure of Basidiomycota is:

(a) ascus (b) ascocarp

(c) basidium (d) basidium and basiodiocorp

22. Teliospores are:

(a) monokaryotic

(b) dikaryotic

(c) mono dikaryotic

(d) haploid in one phase and diploid in the other phase

23. Which one is the Deuteromycota?

(a) alternaria (b) fusarium

(c) helminthosporium (d) all of these

23. Parasexuality is a Kind of:

(a) meiosis (b) sexual reproduction

(c) asexual reproduction (d) genetic recombination

25. Ascomycota has:

(a) ascus (b) ascarp

(c) ascospores (d) all of these

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26. Degrading/removing environmental poisons/pollutants by organisms is:

(a) bioremediation (b) biomedication

(c) bioabsorption (d) biodegration

27. Cyclosporine is:

(a) fungus (b) fungal hyphae

(c) medicine (d) fungal spores

28. Rhodotorula is:

(a) pink yeast (b) commonly exploited yeast

(c) smut (d) rust

29. Fungi resemble plants because they:

(a) have cell wall (b) lack centriole

(c) are non-motile (d) all of these

30. Fungal cell walls contain chitin, which is also found in exoskeleton of:

(a) arthropods (b) mollusks

(c) echinoderms (d) chordates

31. Fungal are different from animals because they:

(a) have cell wall (b) are non-motile

(c) arc absorptive heterotrophs (d) all of these

32. In fungi, asexual reproduction takes place by:

(a) conidia (b) fragmentation

(c) budding (d) all of these

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33. Griscofulvin is obtained from fungi and is used to:

(a) relievemigraine (b) lower blood cholesterol

(c) inhibit fungal growth (d) prevent transplant rejection

34. Which is the largest group of fungi, including over 60,000 species?

(a) basidiomycota (b) zygornycota

(c) ascomycota (d) dcutcromycota

35. Conidia are non-motile, asexual spores which are cut off at the end of modified hyphae called:

(a) basidium (b) ascus

(c) sporangiophores (d) conidiophorcs

36. Parasitic fungi absorb nutrients directly from the living host cytoplasm with the help of special hyphal tips called:

(a) haustoria (b) rhizoids

(c) roots (d) gametangia

37. The fungus that ferment carbohydrate (glucose) to ethanol and carbon dioxide is:

(a) mushrooms (b) yeasts

(c) alternaria (d) penicillium

38. Mycophagous means:

(a) fungus eating (b) fungus growth

(c) life cycle of a fungus (d) Production of antibiotics from fungi

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UNIT NO. 3 (FUNGI)

1	A	2	B	3	A	4	D	5	B	6	B	7	C	8	A	9	D	10	C
11	B	12.	A	13	D	14	D	15	A	16	D	17	B	18	B	19	D	20	D
21	D	22	B	23	D	24	B	25	D	26	C	27	B	28	D	29	B	30	C
31	D	32	D	33	C	34.	B	35	D	36	D	37	C	38	A	39	A	40	A
41	B	42	C	43	C	44	B	45	D	46	D	47	D	48	A	49	C	50	A
51	D	52	A	53	D	54	D	55	C	56.	C	57	D	58	A	59	B	60	A

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KINGDOM ANIMALIA AND PLANTAE

MAJOR CONTENTS

Content:

→ Kingdom Animalia (Rhyla)
→ Kingdom Plantae
→ Additional/ Related Readings

Learning Outcomes:

(a) Porifera (with respect to their capacity to regenerate)
(b) Coelenterata (coral reefs as habitat for sea animals)
(c) Platyhelminthes (Harmful effects on human beings) with examples
(d) Aschelminthes (infection in humans) with examples
(e) Arthropoda (Economic importance of Arthropods and harmful impacts on Man)
(f) Define the following terms:
Coelomata, Acoelomata, Pseudocoele, Radiata, Bilateria, Diploblastic and Triploblastic organization
(g) Economic importance of families with reference to food and other usefulness:
Cassia
Solanaceae
Gramineae

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Watch video **4.1 and 4.2** for better understanding of entire unit at **www.nearpeer.org**

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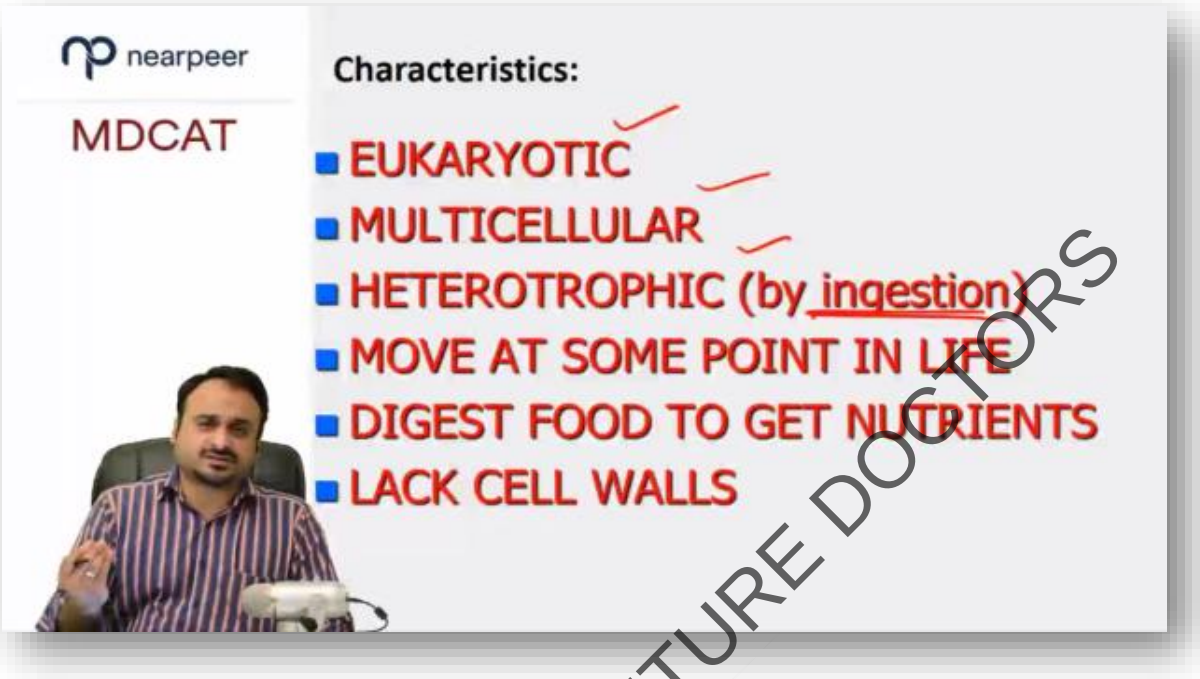

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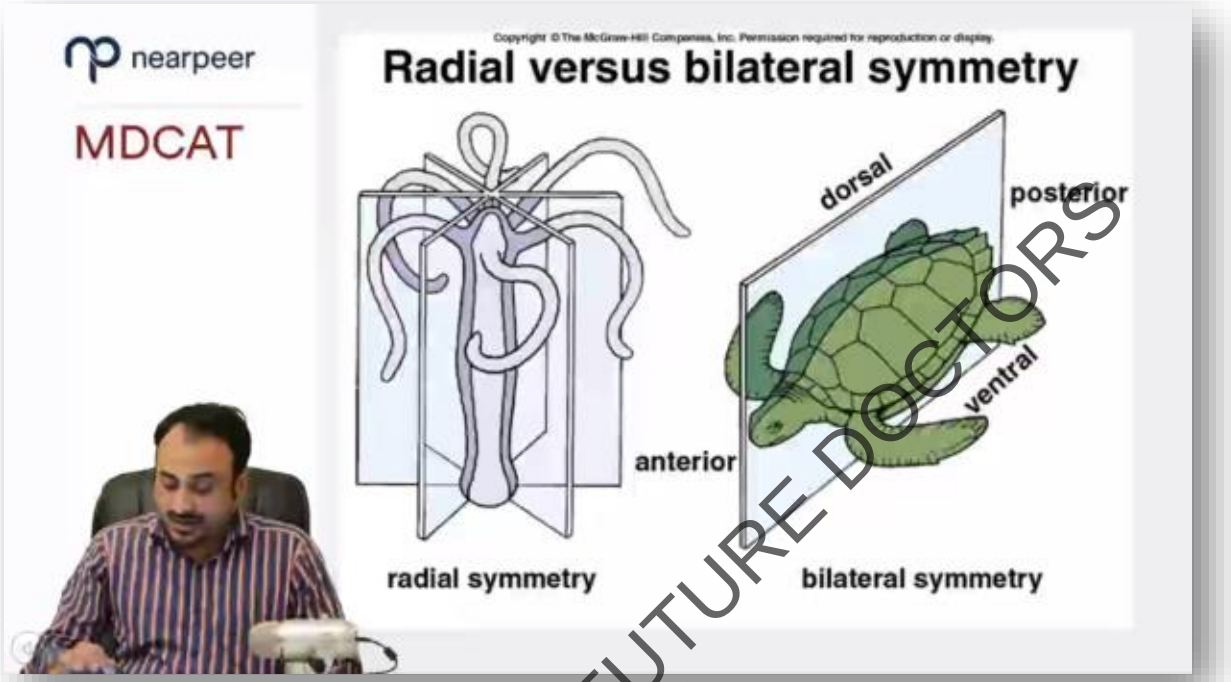

KINGDOM PLANTAE

IMPORTANCE OF FAMILY SOLANANCEAE:

- This family has about 90 genera and 2000 species. It is worldwide in distribution. Nasir (1985) has reported 14 genera and 52 species in Pakistan.
- Solanumtuberosum (potato), Nicotianatabacum (Tobacco), Lycopersicumesculentum (tomato), Capsicum frutescens (Red pepper).
- Members of this family provide drugs, and food, some are weedy, some are poisonous and others are ornamentals.
- The most important plant in the family is Solanumtuberosum (Potato-white or Irish Potato). In Ireland people are completely dependent on Potatoes.
- Lycopersicumesculentum (tomato) is a favorite home garden vegetable. It was one believed to be poisonous.

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- Solanummelangena (eggplant or brinjal) is also used as food.
- The fruit of Capsicum annum and Capsicum frutenscens which are rich in vitamin C and A, are used as condiment.
- Physalis (Ground-Cherry) produces an edible fruit enclosed in a bladder like persisten:

  calyx (the husk). Therefore it is called the husk tomato.
- The leaves of Nicotianatabacumare dried to form tobacco which is used in making cigarettes.
- Many members produce powerful alkaloids. For example Attropa belladonna produces atropine while Daturaproduces daturine.
- Many plants are cultivated in the gardens for their beautiful flowers.

  For example Petunia, Nicotiana, Cestrum and Solanum etc.

IMPORTANCE OF CAESALPINIACEAE (CASSIA FAMILY)

- This family has about 152 genera and 2300 species. There are 16 genera and 60 species in Pakistan.
- Tomarindusindica, Cassiafistula, Bauhinia verigata.
- The family is of great importance. Some plants are ornamental, some are medicinal. A few have food and other values.
- The leaves of Cassia alata are used to cure ringworm and skin diseases.
- Cassia senna and Cobovata are cultivated for the leaves which produce the drug Senna. It is the base for a laxative.
- Oil extracted from the seeds of Cynometeracauliflora is used externally for skin diseases.
- The acidic fruit Tamaindusindica are used in tanning.
- The barks of Bauhinia and Tamarindusindica are used in tanning.

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- The heartwood of Haematoxylon (Longwood) yield the dye Haematoxylin.

IMPORTANCE OF FAMILY POACEAE (GRAMINEAE) GRASS FAMILY

- Triticumvutg are (Wheat),Zea mays (Corn), Avena sativa (Oats), Oryzasativa (Rice), Bambusa (Bamboo), Saccharamofficinarum (Sugar Cane) etc. arc familiar plants.
- It has greater importance than any other family of flowering plants.
- Cereals and millets are main source of food for man. Food providing plants include:

  Triticumsp (Wheat), A vena sativa (Oats), Zea mays (CornMaize), Oryza sativa (Rice), Hordeumvulg are (Barley), Secalecereale (Rye), Penisetumtyphoideum, Sorghum vulgare etc.
- Most of the fodder crops which arc equaly important to domestic animals, also belong to this family. The dried stem and leaves of the cereal crops are used as fodder for the cattle.
- Sugar is obtained from the juice of Saccharumofficinarum (Sugar Cane).
- Many grasses are used in the lawns (e.g Agrostis, Poa, Festuca etc.)
- Bambusa (Bamboo) is used as building material for making huts, boats, carts, pipesetc.

  Its split stem are used to make mats, baskets, fans, hats, course umbrella etc. Young bamboos are used as food.
- Leaves ofbamboos are given to horses as a cure of cough and cold etc.
- Certain grasses yield aromatic oils e.g. Cymbopogoncitratus (lemon grass) which yield lemon grass oil is used in perfumes and soap industry and for making Infusions.
- Some species of the grasses are used in making papers.
- Ethyl alcohol and many other kinds of beverages are also prepared from cereals. For example, whisky from Rye, barley and corn, similarly rum from sugar cane molasses.

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- Fibers obtained from the leaves of Sacccharummunja are used in making ropes.

ADDITIONAL / RELATED READINGS

1. A system of classification which describes the natural relationships among living organisms and their mode of origin are called phylogenetic system of classification.
2. Kingdom plantae mainly includes cukaryotic, autotrophic, multicellular, non-motile organisms which develop from embryos.
3. Bryophytes a flowerless non-vascular homoxsporous Plants in which gametophyte is dominant while the sporophyte is attached to the gametophyte.
4. The bryophyte are also called the amphibians of the plants because they cannot live away from water and need water for reproduction.
5. The mature sporophyte of bryophytes generally consists of foot, seta and capsule.
6. Significance of alternation of generations is that it causes variation, adaptation and evolution.
7. Rhizoid, are long filamentous extensions of the cells of lower epidermis.

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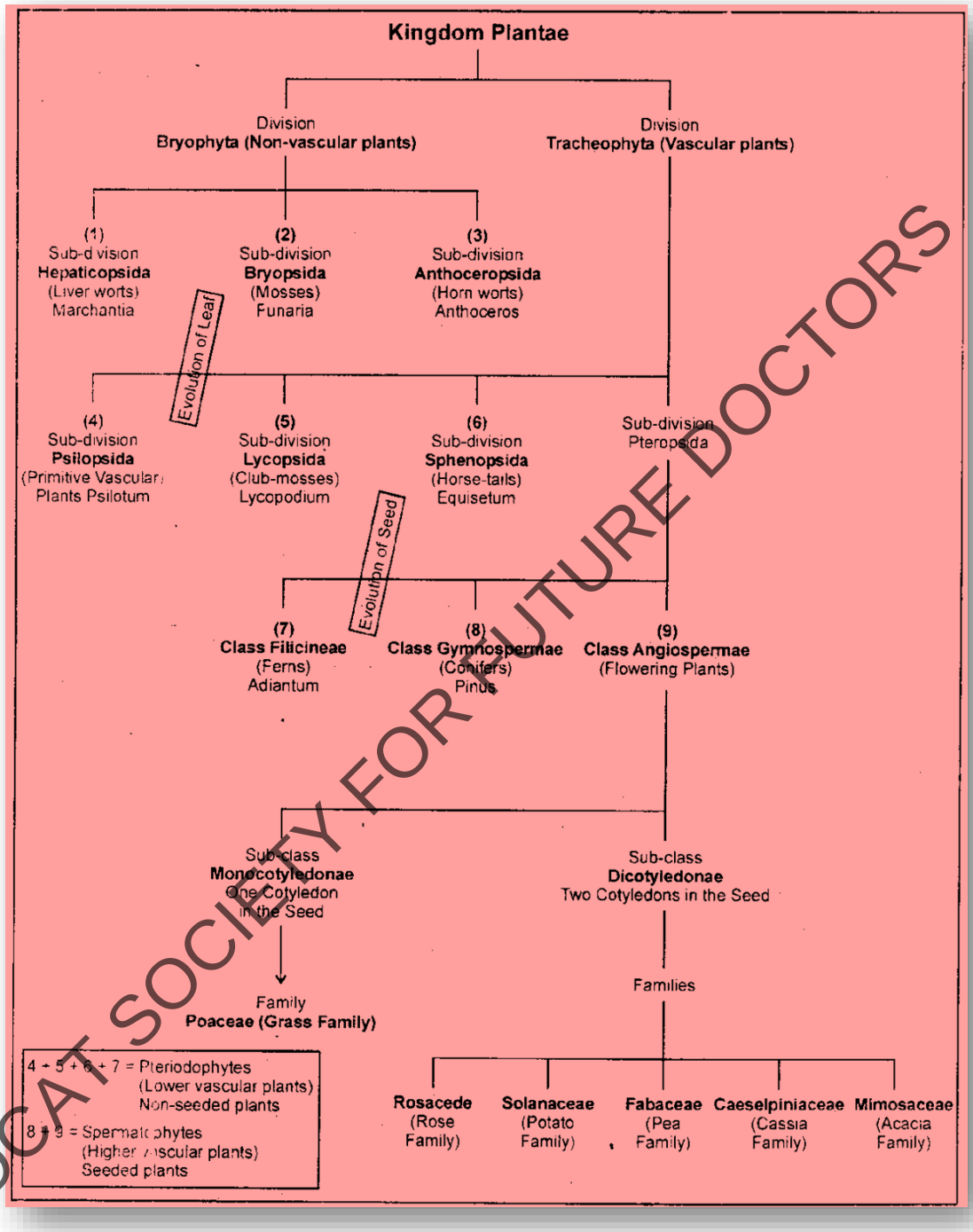

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Fig: Alternation of generations in plants

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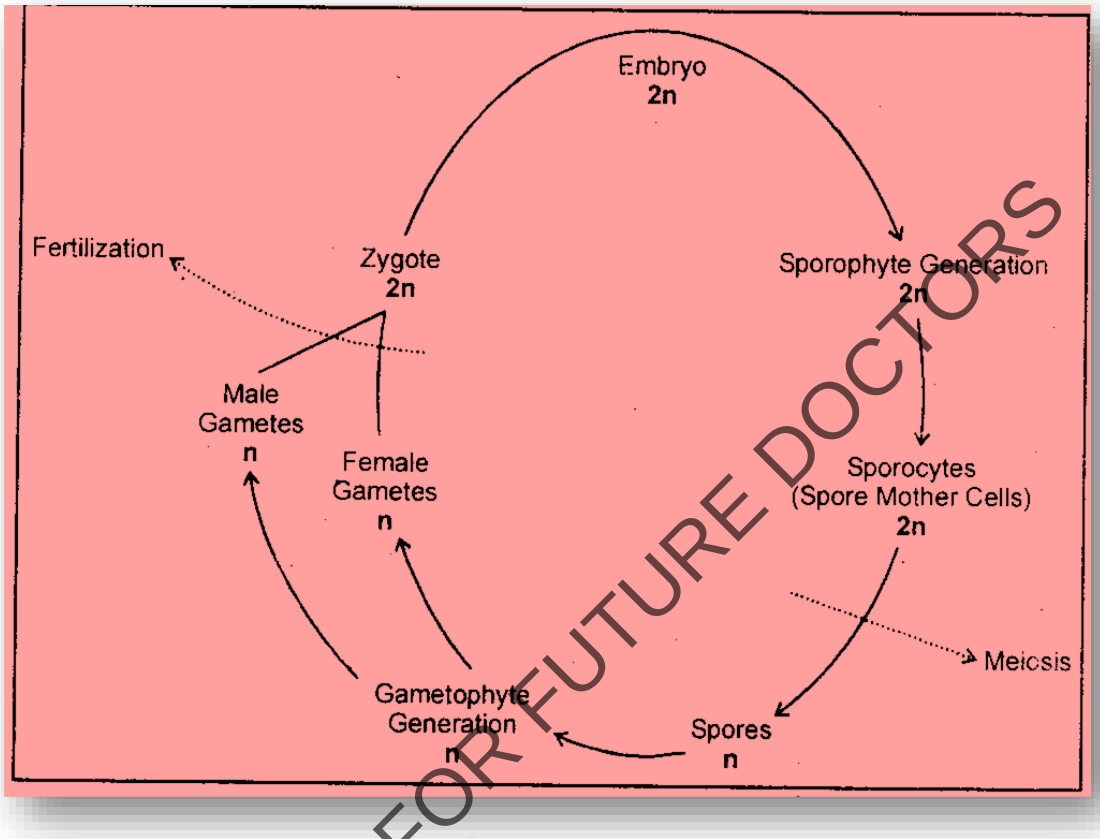

Fig. Alternation of generations in plants

8. Heterogamy (production of two kinds of gametes) is present in the bryophytes.
9. Bryophytes are divided into three subjdivisions which are Hepaticopsida (liverworts). Bryopsida (mosses) and Anthoceropsida (hornworts).
10. Liverworts include about 900 Species while mosses include about 1400 species.
11. In bryophytes plant body is gametophyte.
12. The mature sporophyte (in the bryophytes) consists of a foot, a seta and a capsule.
13. Paraphyses are sterile hair present in the cluster of antheridia and Archegonia of the gametophyte of Bryophytes.
14. In Marchantia Gemma cups are present which are involved in asexual reproduction.

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15. In mosses, each spore (unlike that of liverworts) develops into an alga like structure, the protonema.

16. The spore on germination develops into a gametophyte.

17. Tracheophytes are called vascular plants because of the presence of vascular tissues (i.e xylem and phloem).

18. Tracheids are water conducting cells of Xylem.

19. There is heteromorphic alternation of generations in all plants.

20. On the land there is heteromorphic alternation of generations.

21. Psilopsida is considered to be the earliest group of vascular plants. They are also called primitive vascular plants.

22. There are only two living genera of Psilopsida which are Psilotum and Tmesipeteris.

23. A leaf with a single undivided vein (vascular supply) is called microphyll.

24. Microphyll is present in Lycopsida and Sphenopsida.

25. Large leaves having divided veins and veinlets with an expanded leaf blade or lamina areknown as megaphylls.

26. Megaphylls are present in ferns and seed plants.

27. Three steps in the Evolution of Megaphyll are: Overtopping, Planation and Webbing.

28. The unequal development of various branches is called overtopping.

29. The process of evolution of leaf was very slow and gradual. It was completed in more than 15 – 20 million years.

30. Lycopsids are not mosses but are called club mosses/spike mosses because of their club/spike-shaped strobile and small leaves (though with vascular tissue) which are like mosses.

31. The gaemtophyte of Lycopsida is mainly underground.

32. In Sphenopsida the whole plant body is composed of a large number of joints. Therefore the plants of this group are also called as arthrophytes.

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33. Sub division Pteropsida is divided into three classes which are Filicineae, Gymnospermae and Angiospermae.

34. Fern leaves are called fronds.

35. When the frond is immature and young, it is coiled. This pattern of development is called circinate vernation.

Note: Fern Gametophyte is also called Prothallus, Prothallusis advanced than a thallus.

36. Dryopteris, Pteridium, Adiantum and Pterisetc are examples of Ferns.

37. In Adi.mtum the stipe (stalk) and rachis of leaf are black, smooth and shiny. Therefore itis called maiden hair fern.

38. In the Fronds a group of sporangia is called sorus.

39. The size of the prothalluis is about one-third of an inch (8 mm) at its longest diameter.

40. Fern prothallus is monoeciousi female and female sex organs are present on the under-surface of the same prothallus.

41. In the mature prothallus, archegonia occur near the notch and the antheridia are scattered among the rhizoids.

42. Each antheridiurn of the Fern prothallus produces many sperrnatozoids which are spirally coiled and multicilliated.

43. From Zygote Oospore, sporophyte generation develops.

44. A seed may be defined as a fertilized ovule or a seed is an integumentmega sporangium having an embryo.

45. All seed producing plants are called spermatophytes.

46. The evolution of seed was started about 390 million years ago. First complete seeds appeared about 365 million years ago during late Devonian times.

47. An ovule is integumented indehiscent mega sporangium.

48. Ovule + Sperm = Seed

49. The integuments become the seed coats after fertilization.

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50. Gymnosperms form about one-third of the world's forests.

51. The pine is a conifer (Gymnosperm) and the conifers are heterosporous.

52. Heterospory means production of two kinds of spores; the micro-pores and mega spores.

53 The microspore gives rise to the male gametophyte while the megaspores give rise to the female gametophyte.

54. The male and female pine cones are produced on the same plant.

55. A microspore of seed plants that contains the male gametophyte including the gametes is called a Pollen grain (Plural = Pollen).

56. In Gymnosperms and Angiosperms the female gametophyte is also called an embryosac.

57. In the life cycle of Pinus, the dominant diploid sporophytic generation alternates with inconspicuous haploid gametophyte generation.

58. The term angiosperms literally means "enclosed seeded".

59. Out of 360,000 known species of plants, 235,000 are angiosperms.

60. Indian pipe is a parasitic angiosperm.

61. In Angiosperm the fertile leaves having ovules arc folded and joined all the margins to form ovaries.

62. A flower is a modified shoot which consists of a pedicel, thalamus (or torus) and floralleaves.

63. When the pollination is over the sepals usually and the petals always fall off.

64. The ovary contains ovules.

65. The ovule consists of an integument (covering) having a tissue inside called as nucellus.

66. As a result of pollination, the pollen grain is transferred to the stigma. Here it germinates to form a pollen tube.

67. Fusion of one male gamete with the egg to form a zygote and till' second male gamete with the secondary nucleus to form endosperm nucleus is culled double fertilization.

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68. Double fertilization is only in Flowering plants (Angiosperms).

69. The zygote (oospore) develops into an embryo and the endosperm nucleus (endosperm cell) develops into the endosperm. An endosperm is a multicellular nutritive tissue.

70. The integuments of the ovule form testa and tegmen and ovary w all develops into the fruit wall.

QUESTIONS FOR PRACTISE

1. How many cells would be required to produce 100 each of mega and microspores?

(a) 25100 (b) 50.50

(c) 1025 (d) 75.25

2. All of following are fruits except:

(a) tomato (b) cucumber

(c) carrot (d) corn

3. The lodicules represents highly reduced:

(a) perianth (b) anthers

(c) carpels (d) fruits

4. Insecticides kill the delicates first. Which plant will suffer maximum by use ofinsecticides?

(a) ferns (b) bryophytes

(c) gymnosperms (d) angiosperms

5. Hard wood trees are:

(a) gymnosperms (b) dicot

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(c) monocot perennial (d) fem plants

6. Lotus belongs to:

(a) ferns (b) bryophytes

(c) gymnosperms (d) angiosperms

7. Angiosperm with limited lifespan has no:

(a) spores (b) seeds

(c) fruits (d) secondary growth

8. Wood for making pencil should be very light and is obtained from:

(a) ferns (b) bryophytes

(c) gymnosperms (d)angiosperms

9. Which has one kind of spores?

(a) ferns (b) angiosperms

(c) all gymnosperms (d) some gymnosperms

10. Taxus belongs to:

(a) ferns (b) bryophytes

(c) gymnosperms (d) angiosperms

11. Which statement about heterospory is true?

(a) also present is some members of lycopsida

(b) it is seed habit

(e) gymnosperms and angiosperms have heterospory

(d) all of these

12. According to five kingdom system, which one is plant?

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(a) acetabularia (b) Indian-pipe

(c) polysiphonia (d) spirogyra

13. True roots absent in:

(a) ferns (b) bryophytes

(e)gymnospcrms (d) angiosperms

14. Male reproductive part of Sunflower is:

(a) antheridium (b) carpel

(c) stamen (d) antherozoid

15. What is parallel to Venter in Angiosperms?

(a) carpel (b) ovary

(c) ovule (d) pistil

16. Ovary superior means:

(a) epigenous (b) perigynous

(c) hypogynous (d) both b and c

17. Wild Geranium is:

(a) fern (b) bryophyte

(c) gymnosperm (d) angiosperm

18. Which one is fruit?

(a) wheat grain (b) orange

(c) corn grain (d) pistil

19. Which one is a parasitic plant?

(a) cuscuta (b) Indian pipe

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(c) witch weed (d) all of these

20. Antipodals and synergids are part of:

(a) embryo sac (b) ovary

(c) pollen tube (d) carpel

21. Bryophyta has:

(a) 3 sub-division (b) 2 sub-division

(c) 3 division (d) no division and is itself a sub division

22. Alternation of generations is present in:

(a) all plants (b) all photosynthetic plants

(c) most of plants (d) most of the photosynthetic plants

23. Leaf blade is also called:

(a) lamina (b) microphyll

(c) megaphyll (d) plantation

24. The generation developing from zygote is:

(a) sporophyte (b) embryo

(c) gametophyte (d) spore mother cells

25. The first cell of sporophyte is:

(a) zygote (b) spore mother cell

(c) spore (d) gamete

26. Rhizome is present in:

(a) adiantum (b) psilotum

(c) lycopsida (d) both a and b

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27. The sepals and petals protect the:

(a) stamens (b) carpels

(c) stipules (d) A + B

28. Nucellus is present in the:

(a) ovary (b) ovule

(c) seed (d) carpel

29. An embryo sac is:

(a) rapidly growing embryo (b) gametophyte

(c) female gametophyte (d) A sac having seven celled embryo

30. Pericarp sac is:

(a) seed coat (b) fruit wall

(c) integument (d) ovary wall

31. Which statement is true?

(a) gymnosperms have embryo (b) all plants have embryo

(c) bryophytes have embryo (d) pteridophytes have embryo

32. Sex organs in bryophytes are:

(a) unicellular and haploid (b) multicellular and haploid

(c) multicellular and diploid (d) multicellular and diploid

33. The least developed archegonia are found in:

(a) algae (b) bryophytes

(c) pteridophytes (d) gymnosperms

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34. Funaria differs from ferns in having:

(a) motilie sperms (b) a dependent sporophyte

(c) an independent gametophyte (d) gamete and generation

35. Which is the first and last cell of the diploid generation in funaria?

(a) zygote and sporocyte (b) zygot and pore

(c) spore and gamete (d) gamete and sporocyte

36. Which of the following is not common in funaria and selaginella?

(a) roots (b) archegonium

(c) embryo (d) motile sperms

37. Spore mother cells in bryophytes are:

(a) haploid (b) diploid

(c) triploid (d) tetraploid

38. All of following have alternation of generation except:

(a) club-mosses (b) mosses

(c) ferns (d) spirogyra

39. Sperms of ferns are:

(a) biciliated (b) multiciliated

(c) aflagellated (d) flagellated

40. What types of roots are commonly found in adiantum?

(a) top roots (b) fibrous roots

(c) primary toots (d) fibrous adventitious roots

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41. A prothallus in adiantum is:

(a) haploid, monoecious and autotrophic (b) monoecious and heterotrophic

(c) dioecious and autotrophic (d) diploid dioecious and heterotrophic

42. A prthallus is advanced than:

(a) thallus (b) sporophyte

(c) leaf (d) leaf, root and stem

43. Megaphyllous leaves are found in:

(a) mosses (b) ferns

(c) club-mosses (d) psilotum

44. What develops immediately from the Zygote in the Plants?

(a) gametophyte (b) sporophyte

(c) protonema (d) embryo

45. In case of horse-tails, sporangia are borne:

(a) on underside of the disc (b) direct on the stem

(c) underground (d) on the open leaf

46. Which of the following is Dicot?

(a) sunflower (b) adiantum

(c) rice (d) wheat

47. Ovary develops into:

(a) megasporangium (b) microsporangium

(c) microspore (d) fruit

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48. Endosperm of Pinus is:

(a) haploid (b) diploid

(c) triploid (d) polyploidy

49. Plants growing on other plants are:

(a) epiphytes (b) xerophytes

(c) hydrophytes (d) mesophytes

50. Which one is a fruit?

(a) potato (b) turnip

(c) carrot (d) com

51. In Bryophytes, there is entire development of:

(a) sporophyte within·' gametophyte

(b) gametophyte with in sporophyte

(c) sprorophyte and gametophyte underground

(d) sporophyte and gametophyte in the autotrophic form

52. Which one under goes meiosis in the plants?

(a) sporocyte (b) spore

(c) zygote (d) gamete

53. The spore of _____ develops into protonema.

(a) moss (b) liverwort

(c) hornwort (d) gymnosperms

54. Which one is the earliest group of vascular plants?

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(a) psilopsida (b) lycopsida

(c) sphenopsida (d) ptcropsida

55. Mycorrhizal association is between two members which are:

(a) fungi + plant roots (b) fungi + aigae

(c) bacteria + roots (d) all of these

56. Pteropsida group has three:

(a) classes (b) orders

(c) genera (d) divisions

57. All seed producing plants are called:

(a) sperrnatophytcs (b) pteridophytes

(c) gymnosperms (d) angiosperms

58. A healthy megaspore in the megasporangium germinates to form:

(a) female gametophyte (b) embryo sac

(c) female gametophyte embryo sac (d) sporophyte

59. In the angiosperms, the fertile leaves having ovules are folded and joined at the margins to form:

(a) ovary (b) ovule

(c) seed (d) stigma and style

60. Which one is a kind of inflorescence?

(a) racemose (b) cymose

(c) solitary (d) all ofthese

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UNIT NO. 4 (KINGDOM ANIMALIA AND PLANTAE)

1	C	2	C	3	A	4	B	5	B	6	D	7	D	8	C	9	A	10	C
11	D	12.	B	13	B	14	C	15	B	16	D	17	D	18	D	19	D	20	A
21	A	22	A	23	A	24	A	25	A	26	D	27	D	28	B	29	C	30	B
31	B	32	B	33	D	34.	B	35	A	36	A	37	B	38	D	39	B	40	D
41	A	42	A	43	B	44	D	45	A	46	A	47	D	48	A	49	A	50	B
51	A	52	A	53	A	54	A	55	A	56.	A	57	A	58	C	59	A	60	D

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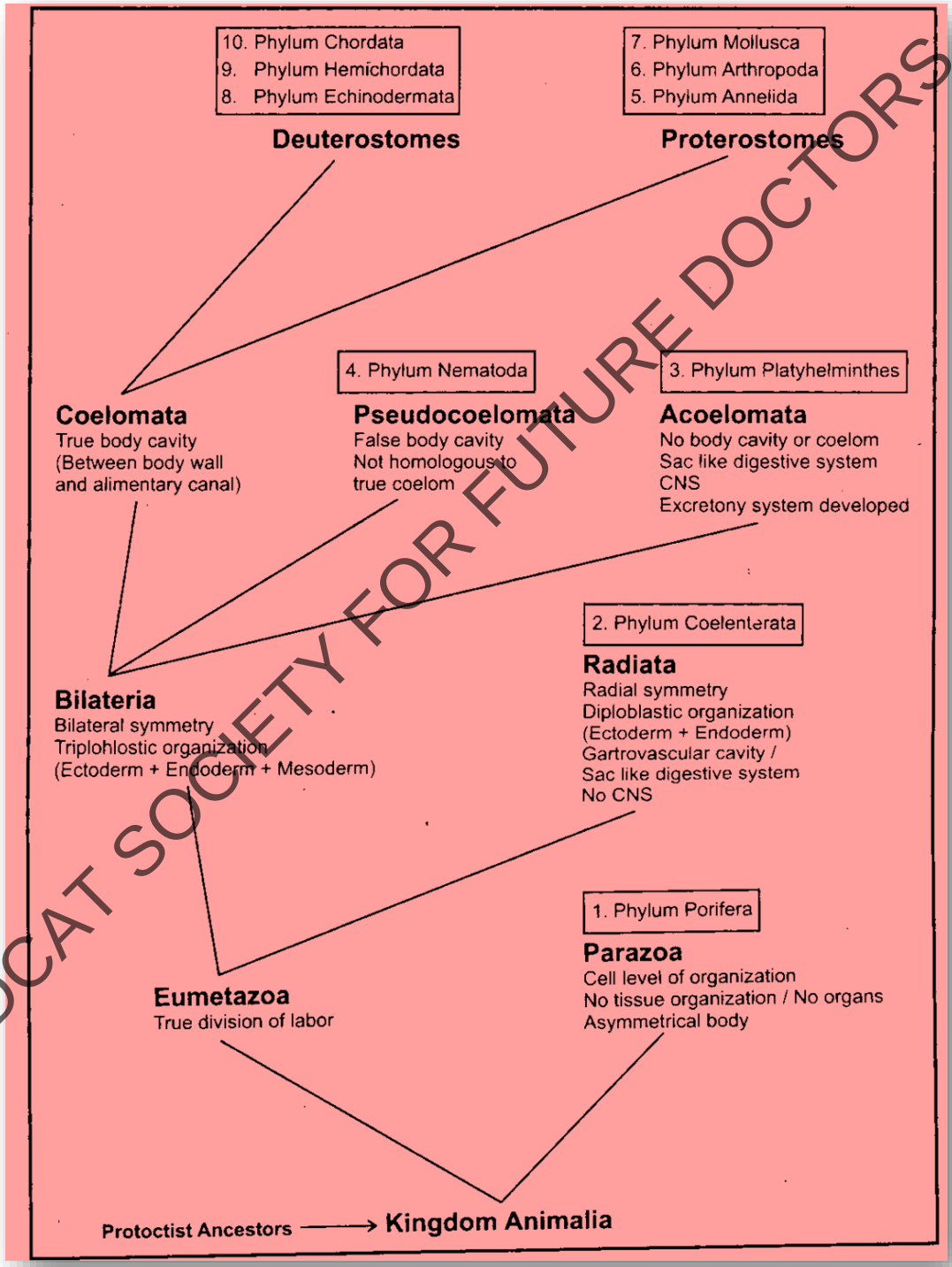
KINGDOM ANIMALIA



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KINGDOM ANIMALIA:

- Kingdom animalia includes all the animals.
- The name animalia is derived from Latin word anima which means breath or soul.
- Kingdom animalia consists of all animals which are multi-cellular, diploid, eukaryotic, ingestive, heterotrophs and develop from two different haploid gamets (a large egg and a smaller sperm).

CLASSIFICATION

Kingdom Animalia is divided into two subkingdoms:

1. **Subkingdom Parazoa:**

   In these animals there is no tissue organization and have organs. They have indeterminate (indefinite) shape and anasymmetrical. These are the simplest snimalsPhylum Porifera is included in this subkingdom.

2. **Subkingdom Eumetazoa:**

   In these animals the tissues are organized into organs and organ systems, most of the phyla of kingdom Animalia (about 29) belongs to subkingdom Eumatazoa. These phyla are other than porifera. Grade Radiata and Grade Bilatera are included in this subkingdom.

GRADE RADIATA/DIPLOBLASTIC ORGANIZATION

These animals arc simplest of Eumctazoa and are diploblastic.

1. **Systematic Position:** Diploblastic animals belong 10 division radiata (subkingdom Eumatazoa)

2. **Body:** The body wall of these animals consists of two layers of cells, outer ectoderm and inner endoderm. There is a jelly like mesenchyme or mesogloca which in most cases is non-cellular.

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3. **Less Specialization:** These animals show lesser specialization and they do not from specializedorgans.

4. **Symmetry:** These animals have radial symmetry. In radial symmetry the parts of the body arc arranged around a central axis in such a way that any plane passing through the central axis divides the animal into two equal halves.

   The cylindrical body of a sea-anemone can be cut in two equal halves vertically in any plane.

5. **Digestive System:** There is only one cavity in the body called gastrovascular cavity which has only mouth. Through this mouth the food and water enters and also the wastes are removed alone withwater. This is known as sac like digestive system.

6. **Transportation:** A special transport system is absent,most substances are distributed within the body by the process of diffusion.

7. **Nervous System:** Central nervous system is absent. However a network of neurons is present.

8. **Animals in this Group:** Animals included in phylum Cnidaria (coelenterata) are diploblastic.

GRADE BILATERIA/TRIPLOBLASTIC ORGANIZATION:

- These animals have bilateral symmetry in bilateral symmetry an animal can he divided into two equal parts by an imaginary line only in one plane.
- In these animals the right side is approximately equal to the left side and there is a distinct anterior and a posterior end. The head is present at the anterior end. They also hay c a dorsal and a ventral surface.
- All the animals included in grade Bilateria are triploblastic. These may be acoelomate, pseudococlomate or coclomate.
- **Acoelomata:** The animals without coelom (body cavity) arc called Acoelomata.
- **Pseudocoelomata:** The animals with a false coelom (pseudocoele) are called Pscudocoelomata.

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- **Coelomata:** The animals with a true coelom arc called Coelomata.
- The body wall of these animals is-made of three layers which are ectoderm mesoderm and endoderm.
- In most triploblastic animals during embryonic development, these layers fonn following structures:
- The ectoderm forms integumentary and nervous system.
- The mesoderm forms muscular, skeletal and reproductive systems.
- The endoderm forms the lining of digestive tract and the glands of digestive system

  (such as liver and pancreas)
- Specialization: The cells of these animals show greater degree of specialization. These have specialized organs and organ systems.
- Symmetry: These animals haw bilateral symmetry.
- Digestive System: The digestive system is mostly of tube type. In tube type digestive system the mouth is at the anterior end while the anus is at the posterior end.
- Transportation: Special trasport system i.e. blood vascular system is present in most of the cases.
- Nervous System: Central nervous system is present
- Types of Triploblastic Animals: Triploblastic animals may be acoelomatepseudocoelomate or coelomate.

  The animals belonging to phyla, Platyhelminthes, Nematoda, Annelida, Mellusca Arthropoda, Echinodermata, Hemichordata and Chordata are included ill grade bilateria.

  Thelarvae of echinoderms have bilateral symmetry. However the adult Echinoderm, have secondarily developed radial symmetry, due to their special mode of life.

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ACOELOMATA, PSEUDOCOELOMATA AND COELOMATA

1. **Acoelomata:** The animals without coelom (body cavity) are called Acoelomata (Phylum, Platyhelminthes).It has following characters:

   (i) Mesenchyma: The mesoderm forms a loose, cellular tissue called mesenchyma or parenchyma which tills the space between the ectoderm and the endoderm.Mesoderm also forms a packing around the internal organs to support and protect them.

   (ii) The Gut: The gut is sac-type

   (iii) Transportation: There is no special transport system and most substances arc distributed within the body by the process of diffusion

   (iv) Excretory System: This system consists of flame cells, excretory ducts and excretory pores;it is for the transport of excretory products.

   (v) Nervous System: The nervous system is well developed.

2. Pseudocoelomata:

- The animals with a false coelom (pseudocoele) are called Pseudocoelomata (Phylum A Scgelminthes/Nematoda).
- In these animals the space between the body wall and the digestive tube is called pseudocoelom (false body cavity). Pseudocoelom is not homologous to true coelom because it is not lined by coelomic epithelium, similarly it has no relation with the reproductive and excretory organs.
- Pseudocoelom develops from the blastocoel of the embryo and is hounded externally by the muscle and internally by the cuticle of the intestine.

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3. Coelomata:

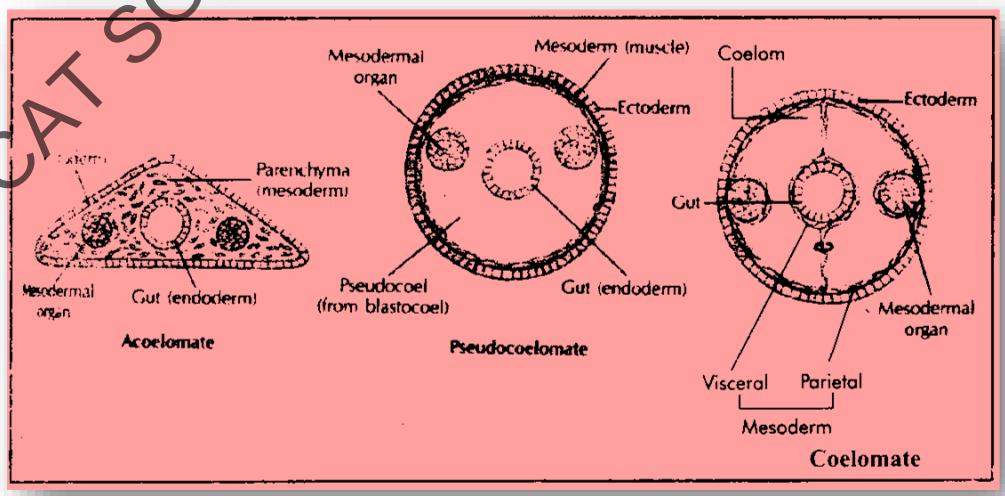
- The animals with a true coelom (body cavity} are called Coelomata, The animals from annelid, to chordates are included. These animals have following characters:

COELOM:

- ❖ These animals have coelom. Coelom is a cavity between the body wall and the alimentary canal and is lined by mesoderm. The mesoderm splits into:
- ❖ Outer parietal layer which underlines the body wall and
- ❖ The visceral layer which covers the alimentary canal
- ❖ The cavity between both is the true coelom. It is filled with fluid called coelomic fluid.

Well-Developed Systems:

- ❖ The gut is more complex
- ❖ The Neuro-sensory system is well developed and centralized
- ❖ They have a well-developed circulatory system
- ❖ A well-developed excretory system not only removes nitrogenous wastes but also osmoregulation in function
- ❖ Respiratory and reproductive systems are also well developed



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PARAZOA

The sub-kingdom Parazoaincludes only one Phylum which is the phylum porifera

REARRANGEMENT, REORGANIZATION AND REGENERATION

- If sponge cells are separated they can rearrange and reorganize. Some sponge has regenerative ability.
- The capacity of sponges to regenerate is for restoration of damaged or lost parts & also for complete regeneration of an adult from fragments or even single cells.
- Sponge cells may be separated by mechanical methods (c.g squeezing a piece of sponge through tine silk cloth) or by chemical methods (e.g. elimination of calcium and magnesium from seawater).
- Dissociated cells settle, migrate and form active aggregates in which the archaeocyte play an important role.
- In order for small aggregates of cells to form larger aggregates, the cells arc attached to a surface. There they flatten and develop an envelope of special cells (pinacocytes) this is called the diamorphstage.
- Reconstitution of the choanocyte chambers and of the canal system follows soon afterward, resulting in a young sponge that is functional and able to grow.
- It is generally believed that the reconstitution process is not comparable with embryonic development, because the various types of dissociated cells participate in the formation of the new sponge.
- During unfavourable conditions, sponges are reduced to small fragments that may consist only one mass of archaeocytes covered by layers of pinacocytes. A complete sponge forms from these fragments when favourable conditions return.

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- The regenerative abilities of sponges, their lack of a central coordinating organ (brain) and the peculiar migratory ability of cells within the organisms combine to make it somewhat difficult to define the individuality of a sponge.

Examples:

(i) **Sycon:** Typical marine sponge.

(ii) **Leucoselenia**: A sponge that consists of a group of erect tubes.

(iii) **Euplectella**: It is beautiful and delicate sponge made up of glass) framework. It IS commonly called Venus flower basket.

(iv) **Spongilla**: It is freshwater sponge.

Importance:

- Many artificial sponges have been made from synthetic material however the natural sponges are still in demand.
- The best commercial sponges are found in the warm waters of Mediterranean Sea. Some uses are as follows:
- The skeleton of sponges has long been used for washing and bathing.
- They have great capacity to absorb water. Therefore they are used in surgical operations for absorbing fluids and blood.
- They are also used for sound absorption in the buildings.

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CORAL REEFS:

- Many colonial coelenterates (such as corals) produce a hard exoskeleton formed of calcium carbonate ($CaCO_3$).
- These polyps are covered by stony cups due to hardening of their secretions.
- It is secreted by epidermal cells that take lime from sea water.
- From the mouth of the stony cup a polyp can pass out its tentacles for keeling and withdraw it when not feeding.
- The stony network or mass of such Coelenterates are called Corals.
- The skeleton of corals is responsible for formation of small coral islands or large coral reefs.
- Most such Coelenterates are colonial.
- Living polyps are found on the surface layer of corals. However on the lower side and at the base are present masses of dead stony structures called Coral reefs.
- Coral reefs are important habitats. They are thought to support more than I million aquatic species. This includes not only several hundred species of coral, hut thousands 01 fish and invertebrate species such as sponges, crabs, shrimps, lobsters, sea anemones, bryozoans, worms, sea stars and sea urchins, octopuses, squid, snails and nudibranchs.
- It is estimated that nearly one-quarter of the world's marine species get shelter and food from coral reefs.
- Coral reefs are found in the coastal waters of Florida, West Indies, East Coast of Africa, Australia and Island of Coral Sea.

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PHYLUM: PLATYHELMINTHES - THE FLATWORMS

Habitat:

- A few species are free living and found in freshwater, for example Dugesia(planaria). Many are parasites (mostly endoparasites). The endoparasite lives inside the host. The most common examples are:
- Taenia sodium (tapeworm)
- Fasciola hepatica (liver fluke) and
- Schistosoma (blood fluke)
- Tile parasites are more common in tropics. Some of these cause diseases in humans.

Reproduction:

- They reproduce both by sexual and asexual means. Asexual reproduction is by fissior: in which the animal constricts in the middle into two pieces. Each piece regenerates the missing part.
- The sexually reproducing species are hermaphrodite (both male and female reproductive organs are present in the same individual).

Development:

- Development is direct. Sometimes larval form is present.

Examples:

(i) Dugesia (Planada): A free-living flatworm with a ciliated outer surface.

(ii) Fasciola (Liver Fluke): It is an endoparasite in sheep and rarely in human beings. It attaches to the host tissue by suckers. It completes its life cycle in two hosts: A snail Sheep or man (in the bile duct) Taenia (Tape Worm):

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It is an endoparasite that completes its life cycle in two hosts:

- Humans
- Cattle/pig

The intermediate host is pig or cattle. The body is ribbon-like and divided into segments called proglottids which contain sex organs. The segments (proglottids) continue to break off and are passed out tram the intestine along with faeces. Let us discuss infestation and disinfestations of tape worm. The relationship between the host and parasite is a delicate one, since each modifies the activities and functions of the other.

INFESTATION:

- The zygote begins to develop while it is still inside the uterus of female in Taenia (tape worm).
- The last segments (or proglottids) contain completely developed embryo in t heir uteri.
- The fully mature proglottids break off from the body and come out of the body of man with faeces (undigested waste). Each proglottid may contain upto 80,000 eggs.
- The embryo inside the egg is round in shape and has six chitinous hooks. It shows limited movement of contraction.
- For further development it must reach a second host which may be a cow (or pig).
- If the embryos are swallowed by the cow (or pig), they bore their way and reach the voluntary muscles. Here they remain embedded. Tape worm in the intermediate host is the bladder worm.
- If an improperly cooked beef is eaten by a person, the parasite (which has not been killed) begins to develop further in the intestine of man. Dexelopment of the tape worm in encysted meat is stimulated by the gastric juices of the host. The adults then attach themselves to the intestinal tract (small intestine) of their host by the scolex and absorb pnniall, digested food through their body wall.

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DISINFESTATION:

Once the parasite has entered the intestine ofman it is difficult to remove completely.

Care and Control:

The beef should he cooked properly before eating it. As a result there is no chance "I' the parasite entering the digestive system.

Medicine:

If the parasite has entered then certain medicines are taken to remove it.Its complete removal is necessarily because if only head remains inside the intestine it can grow into new tape-worm once again.

Anema:

Besides treatment with drugs. physicians also give anema to the patient. to fully remove the parasite.

ADAPTATION FOR PARASITIC MODE OF LIFE

The Platyhelminthes have adapted following characters for parasitic mode of life:

1. **Cuticle:** The epidermis is absent and resistant cuticle is formed for protection.
2. **Adhesive Organs:** They have developed adhesive organs (such as suckers and hooks) for auuchmcut 1,) the host.
3. **Digestive System:** The digestive system is simple due to increased dependence on host.
4. **Muscular and Nervous System:** Then: is degeneration of muscular system and nervous system.
5. **Reproductive Systems:** The reproductive systems are complicated and the ova are produced in a large number. In this way the continuity of the species is ensured.
6. **Life Cycle:** The complex life cycle and the presence of more than one host during the life cycle increases the chances of survival of the parasite.

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PSEUDOCOELOMATES ACHELMINTHES

(Pgylummematoda – The Round Worms)

The name Nematoda means pointed ends. The animals of this group have elongated worm like body with pointed ends.

Habitat:

They are mostly parasites.

Reproduction:

The sexes are separate. The female has female gonads called ovaries which produce eggs. The male has male gonads called testes which produce sperms. A zygote is formed as a result of fertilization.

Development:

A larval stage is present in the life cycle. Therefore the development is indirect. Round worms play important role in breaking down of organic matter. A single rotting apple may contain 90,000 worms. There are billions of roundworms in one acre of topsoil.

PARASITIC DISEASES:

Parasitic Aschelminthes are very important because they cause very serious diseases in man and plants. Some examples are as follows:

1. Ascaris Lumbericoides:

It is an intestinal parasite of man.

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- It is the most common intestinal parasite in the world, infecting an estimated one billion people. It is also the largest of the round worms reaching an average of forty cm (sixteen inches) in length. It can be as thick as a pencil and weigh almost as much.
- It is pink with bright red "speed stripes" The female grows in the intestines producing an enormous number of eggs estimated to be about twenty-seven million in her lifetime of a year or so.
- The eggs expelled in the feces can live outside the body for up to seven years in warm soil. Food, water, and soil contamination are the means of infection for humans. However, humans are not a viable host for the: mature worm but the immature form is the one that causes the disease.
- When the larvae hatch. they travel to various parts of the bod) like the lungs, liver, brain, or eye.
- Children contract the worm since they often play in dirt and then put their hands into their mouths.
- Symptoms in children arenervousness and irritability, allergic reactions, dry cough, restlessness at night, convulsions or spasms,twitching in various parts of the body, itching or irritation of the nose or anus as well as lactose intolerance.
- Symptoms in adults include: abdominal pain, edema of the lips, allergic reactions, insomnia, anorexia, and weight loss.

2. Genus Rhabditis:

It contains Plan: species normally found in soil, organic matter or water and feces of man or animals.

3. Enterobius Vermicularis:

- It is commonly known as pinworm and IS international but more common in Europe and America.
- Pinworms are parasites in the human caecum, colon and appendix.
- Their movement cause intense itching of anus, inflammation of mucous membrane of colon and appendix resulting in insomnia and loss of appetite.

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- **Acyclostoma Duodenale:** It is commonly known as hook worm. It is a parasite of human small intestine in Asia, North Africa and Europe.
- It is a very dangerous because it holds the villi of intestine and sucks blood and body fluid.
- During feeding they produce an anticoagulant to prevent clotting of blood and after feeding leave the wound bleeding.

  In children it can cause severe anemia and retard physical and mental growth.

PHYLUM: ARTHROPODA: ANIMALS WITH JOINTED LEGS

They are commonly called joint footed animals because arthros means joined &pods means feet.

Origin:

These have common origin with annelids because both have segmented body, appendages and cuticle.

Diversity:

The phylum contains mort species than any other phylum. Insects (cockroaches, grasshoppers, butterflies, mosquitoes) are most common arthropods on the earth.They are variable in structure. Some are worm-like centipedes. Other are flying insects with the body divided into three regions which are head, thorax and abdomen.

Habitat:

They are present on the land and in fresh and marine water. Many can fly.

Body Organization:

They are triploblastic, coelom ate and bilaterally symmetrical animals.The coelom is reduced and communicated with blood vascular system. Such a coelom is called blood vascular system.

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Segmentation:

The body is segmented. Each segment is attached to its neighbour by a modified portion of cuticle which is thin and flexible.

Appendages:

They have jointed appendages. These appendages have been modified for specialized functions.

Chitinous Cuticle:

The body is covered with waterproof chitinous cuticle secreted by the epidermis.

Digestive System:

II is in the form of alimentary canal with two openings, the mouth and anus. It has different parts each with a specific function. Nutrition is small plants and animals.

Circulatory System:

They have open circulatory system. The blood flows in the body cavity bathing the tissues of the body. However, there is a primitive heart and a main blood vessel. Blood is colourless because it is without hemoglobin.

Respiration:

Most arthropods have extensive tracheal system formed of air tubes called tracheae for the exchange of gases. Main tubes open to the exterior through openingscalled spiracles. Aquatic arthropods respire through gills.

Excretory System:

It is well developed and consists of Malpighian tubules. The nitrogenous wastes are excreted in the form of solid uric acid ($C_5H_4N_4O_3$).

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Nervous System:

It is well developed and consists of paired ganglia (simple brain) connected to a ventral double nerve cord. On the ventral nerve cord a ganglion is present in each segment. Nerves arise from these ganglia. The sensory organs are usually a pair of compound eyes and antennae.

Skeleton:

They have exoskeleton which is in the form of outer covering called cuticle. The cuticle is light in weight and is formed chiefly of chitin. The muscles are attached to the exoskeleton. Exoskeleton provides protection and helps in locomotion.

Locomotion:

The arthropods exhibit active and swift movements. They swim, crawl or fly depending upon the habitat they occupy. The organs of locomotion are paired appendages. Some may also have wings to fly.

REPRODUCTION AND LIFE CYCLE:

The sexes are separate. The testes produce sperms while the ovaries produce eggs. Metamorphosis occurs in the life cycle of insects. Metamorphosis (meta = change + morphe = form) is an abrupt change of form or structure during the life cycle.

There are three morphological forms in the life cycle:

- The egg develops into Ian a.
- Larva is converted into motionless pupa.
- The pupa finally develops into an adult.

In some primitive insects the metamorphosis is incomplete. The larva resembles adult and called nymph or instar. It lives in the same habitat as adult.

Examples: Crab, lobster, Prawn, woodlouse, mosquito, dragonfly, moth, scorpion, spider, mites, ticks, centipede and millipede.

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CLASSIFICATION OF ARTHROPODA:

Phylum Arthropoda is a large group with a great variety. Some important classes are as follows:

1. Class Crustacea:

(i) **Habitat:** They are aquatic

(ii) **Gills:** The have gills for respiration.

(iii) **Exoskeleton:** An exoskeleton of chitin is present which becomes harder due to deposition of salts. On the dorsal side of the Cephalothroax the exoskeleton is in the form of carapace.

(iv) **Appendages:** The appendages are modified for capturing food, walking, swimming, respiration and reproduction. Head has two pairs of antennal appendages.

(v) **Coelom:** I t is reduced and hemocoel is present.

(vi) **Mandibles and Maxillae:** One pair of Mandibles (jaws) and t\\ 0 pairs of Maxillae.

(vii) **Sexes:** Sexes are mostly separate.

Examples: Daphnia, Cyclops, Crabs, lobsters, prawn, woodlouse etc.

2. Class Insecta:

(i) **Habitat:** Insects are found everywhere. Many show social behaviour.

(ii) **Largest Group:** This is the largest group not only of Arthropoda but of all the animal kingdom. Of species of organisms 53.1 are insects.

(iii) **Biodiversity:** It has great variety.

(iv) **Body Regions:** It has three distinct regions which are head. thorax and abdomen.

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(v) **Head:** The head is usually vertical to the body and jaws are ventrally placed. There is a pail antennae and compound eyes on the head.

(vi) **Thorax:** The thorax has three segments in which are present three pairs of jointed legs. Man) them may have one or two pairs of wings.

(vii) **Abdomen:** Abdomen has varying number of segments.

(viii) **Nervous System:** It is composed of brain and double nerve cord. Brain is formed of fused ganglia double nerve cord is ventral.

(ix) **Reproduction:** Sexes are separate. Animals are oviparous.

(x) **Development:** Metamorphosis takes place during development.

Examples: Dragonfly, mosquito, butterflies, moths, wasps and beetles etc.

3. Class Arachnida:

(i) **Segmentation:** Anterior segments are fused to form Cephalothorax.

(ii) **Appendages:** Cephalothorax bears a pair of appendages called chelicerae with claws, two pairs as pedipalps and four pairs of legs.

(iii) **Antennae:** There are no antennae.

(iv) **Jaws:** They have no true jaws.

(v) **Abdomen:** Abdomen may be segmented or un-segmented and is with or without appendages.

(vi) **Respiration:**It is by gills, lungs or special structures called book lungs.

(vii) **Excretion:** It is by the Malpighian tubules.

(viii) **Eyes:** Eyes arc simple. Most spiders have eight eyes placed in such a way that they can easily look at the predators and prey.

(ix) **Reproduction:** Sexes are separate. They are oviparous (lay eggs).

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(x) **Development:** No true metamorphosis.

Examples: Scorpions, spiders, mites and ticks.

4. Class Myriapoda:

(i) **Body Shape:** Elongated and dorsoventrally flattened.

(ii) **Segmentation:** The body is divided into large number of segments each having a pair of legs.

(iii) **Antenna and Eyes:** A pair of antennae and a pair of eyes are present on the head.

Examples: Centipedes and millipedes.

GENERAL ORGANIZATION OF ARTHROPODS

Arthopods are at the peak of invertebrate evolution. They have some advanced characters such as hi lateral symmetry, triploblastic organization, coelomic cavity and developed organ systems etc. Two main achievements are:

- The chitinous exoskeleton and
- Jointed appendages (locomotoy mechanism)

1. The Chitinous Exoskeleton:

1. Arthopods have chitinous exoskeleton which is formed f chitin.

- Chitin is nun-living, non-cellular protein carbohydrate compound and is secreted by the inderlying epidermis, on the outer side if has a waxy layer.
- In some arthropods chitin is soft and flexible while in others it is hard, in one organization. In some parts of the body it is soft and flexible while in other it is hard.

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Functions of Chitin:

- The exoskeleton protects the body
- It acts as lever for the movement omuscles of jointed limbs.
- The chitin in the jaws is used for biting and crushing food.
- It forms lens of thecompound eye.
- It also forms the copulatroy organs and the organ of defense and offense.
- Moulting or Ecdysis:
- The process of shedding of exoskeleton is called moulting or ecdysis.
- In the young arthropods (such as insect larvae) chitinous exoskeleton is shed from time to timefor the growth of the larva.

2. JOINTED APPENDAGES:

- In Arthropods each somite has a pair of jointed appendages provide an efficient mean of locomotion.
- The segment and appendages are often modified for different functions (like locomotion offence and defense and reproduction) in different sub-groups. These animals call walk swim or fly.

AFFINITIES WITH ANILIDA

Arthropods share following characters with annelids.

- Both have cuticle
- Both have segmented body. However in Arthropods the segmentation is not metameric and organs are not repeated in different segments.
- Both have appendages. However in Arthropods each somite has a pair of jointed appendages. The segments and appendages are often modified for different functions in different habitats.
- Both have similar plan ofnervous system.

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ECONOMIC IMPORTANCE

- Insects compete with man tor same food and space. Insects attack man, domestic animals and crops and produce man) diseases.
- They are not only dangerous to health but also cause economic loss to mall by destroying his property and crops.
- Some insects arc useful (such as the hone) bee or the silk worm). Insects are therefore of great importance to mankind.

HARMFUL ARTHROPODS:

1. Transmission of Disease Causing Organisms:

Many types of mosquitoes, flies, fleas, lice and hugs transmit disease causing organisms to man and domestic animal. Some examples are as follows:

- The female mosquito of genus Anopheles transmit Plasmodium that causes malaria in man.
- Mosquitoes can also cause yellow fever and filariasis.
- The Tse-tsefly of African countries transmits trypanosome, the cause of sleeping sickness and skin diseases. Some species of trypanosome cause diseases in cattle.
- The common housefly carries arthropos. The result is cholera and hepatitis etc.
- Fleas are also a type of harmful arthropod. The bites from fleas transferred the disease-causing bacteria for the bubonic plague.
- Ticks are another type of harmful arthropod. Rocky Mountain spotted fever is characterized by a significant hemorrhagic rash and is caused by rickettsial organism. The infection is transmitted by ticks.

2. Crops Damage:

Many insects lay eggs on fruits and other commercial crops such as sugarcane, maize, cotton and vegetables etc. The larvae of these insects damage fruits and the crops

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resulting in economic loss to farmers.The locust that move in large numbers from country to country cause damage to standing crops and other plants.

BENEFICIAL ARTHROPODS

- The honey bee provides honey and wax Ike wax is used in cosmetics.
- Silkworm gives us silk.
- Some insects are predaceous on other harmful insects. Lady Hugs are another type of beneficial arthropod. They are used to control aphids for gardens and farms.
- Some insects are scavengers. They cat up dead animal and vegetable matter.
- Insect Ian ac arc the source of food for fish.
- Crabs arc also a type of beneficial arthropod. We cook and eat crabs so we have enough energy and nutrition to live.
- Spiders are very beneficial arthropods. Spiders arc beneficial to man by killing harm fill insects. There are very few spider species that actually have venom that are poisonous to man.
- Some insects like ants cat up the dead plants and animals thereby keeping the environment clean.

KEY POINTS

1. The name animalia is derived from Latin word anima which means breath or soul.
2. Kingdom animalia includes all the animals from phylum porifera to phylum chordate.
3. Kingdom animalia consists of all animals which are multi-cellular, diploid, eukaryotic, ingestive, heterotruphs and develop from two different haploid gametes (a large egg and a smaller sperm).

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4. In the two-kingdom classification system the Kingdom Animalia is divided into two different groups which are protozoa and metazoa, The protozoa arc one-celled animals while metazoa are multi-cellular animals.

5. According to five kingdom system of Robert Whittaker the kingdom animalia has two subkingdoms which are parazoa and metazoa. Protozoans are included in kingdom Protoctista.

6. All biologists agree that animals evolved from protoctists.

7. Although multi-cellularity is present in all the kingdoms (Fungi, Plantae and Animalia), but it is well developed in animals.

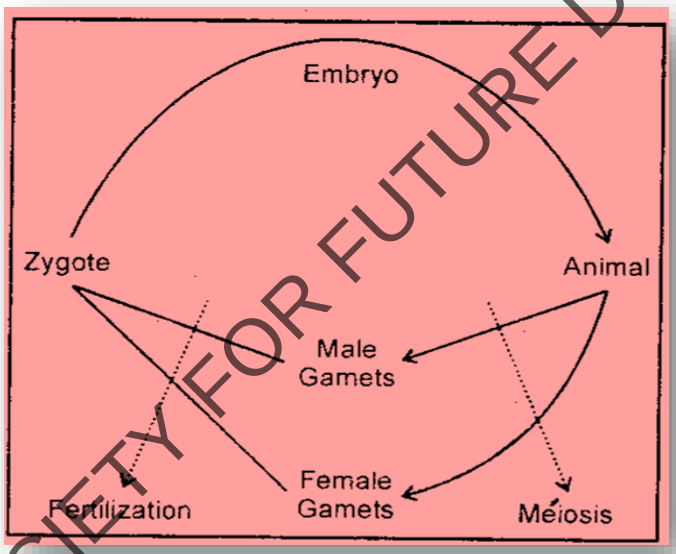

Fig. General life cycle of animals

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ADDITIONAL / RELATED READINGS (ANIMALS)

1. The name Animalia is derived from Latin word anima which means breath or soul.

2. Kingdom Animalia includes all the animals from phylum porifera to phylum chordata.

3. Kingdom Animalia consists of all animals which are multi-cellular, diploid, eukaryotic, ingestive, heterotrophs and develop from two different haploid gametes (a large egg and a smaller sperm).

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4. In the two-kingdom classification system, the Kingdom Animalia is divided into two groups which are protozoa and metazoa. The protozoa are one-celled animals while mctazoa are multicellular animals.

5. According to five kingdom system of Robert Whittaker the kingdom animalia has two subkingdoms which are parazoa and metazoa. Protozoans are included in kingdom Protoctista.

6. All biologists agree that animals evolved from protoctists.

7. Although multi-cellularity is present in all the kingdoms (Fungi, Plantae and Animalia), but it is well developed in animals.

8. In animals the junction that controls communications is the brain. The junction that controls the flow of materials is the heart.

9. The smallest animals are microscopic which are smaller than many protoctists.

10. The largest animals are whales (sea mammals) included in Phylum Chordata.

11. In parazoa there is no tissue organization and have no organs. They have indeterminate (indefinite) shape and are asymmetrical. These are the simplest animals.

12. In the animals of subkingdom eumetazoa, the tissues are organized into -organs and organ systems.

13. Most of the phyla of kingdom Animalia (about 29) belong to subkingdom Eumatazoa.

14. In rural symmetry he parts of the body arc arranged around a central axis in such a way that any plane passing through the central axis divides the animal into two equal halves.

15. In bilateral symmetry an animal can be divided into two equal parts by an imaginary line only in one plane.

16. The larvae of echinoderms have bilateral symmetry. However, the adult echinoderms have secondary developed radial symmetry, due to their special mode of life.

Series Proterostomia (Protostomes)		Series Deuteristomia (Deuterostomes)	
(i)	Cleavage or division of the zygote is spiral and determinate.	(i)	Cleavage is radical and indeterminate.

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(ii)	Suring development the mouth arises from the blastopore from its anterior margin.	(ii)	During development the mouth is formed at some distance anterior to the blastopore and blastopore forms the anus.
(iii)	Coelom or body cavity is formed due to splitting of mesoderm (schizocoelous)	(iii)	Mesoderm is developed as an outpounding of archenterons (enteerocoelous)
(iv)	Mesoderm is derived from cells on the lip of blastopore.	(iv)	Mesodem is derived from the wall of developing gut (archenteron)
(v)	It includes animals belonging to the phyla, aschelminthes (Nomatoda) Annelida, Molusca and arthropoda,	(v)	It includes animals belonging to the phyla Echinodermata, Hemichordata and Chrodata.

Series Proterostomia (Protostomes)		Series Deuteristomia (Deuterostomes)	
(i)	The planes of cleavage are not symmetrical between poles but are diagonal to the polar axis.	(i)	The planes of cleavage are symmetrical to the polar axis.
(ii)	As a result unequal cells are produced around the axis of polarity.	(ii)	As a result the tiers of cells are produced on the top of each other.
(iii)	The fate of each blastomere is predetermined. Therefore, all the blastomeres have determinate role in the formation of embryo.	(iii)	The fate of each blastomere is not predetermined. Therefore in some animals any blastomere can produce a complete embryo.

17. The jelly like mesenchyme or mesugloeu in most cases is non-cellular.

18. A special transport system is absent up to phylum number 4 (Nematoda). Most substances are distributed within the body to the process of diffusion.

19. CNS starts from platyhelminthes.

20. In most triploblastic animals during embryonic development the embryonic layers form the following structures:

    (i) The ectoderm forms integumentary and nervous system.

    (ii) The mesoderm forms muscular, skeletal and reproductive systems

    (iii) The endoderm forms the lining of digestive tract and the glands of digestive system (such as liver and pancreas).

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21. In Platyhelminthes the excretory system consists of flame cells, excretory ducts and excretory pores.

22. In Pseudocoelomates the space between the body wall and the digestive tube is called pseudocoelom (false body cavity).

23. Pseudocoelom is not homologous to true coelom because it is not lined by coelomic epithelium.

24. Pseudocoelom develops from the blastocoel of the embryo and is bounded externally by the muscles and internally by the cuticle of the intestine.

25. The pseudocoelom consists of vacuolated cells filled with a protein-rich fluid. This fluid develops high hydrostatic pressure.

26. Coelom is a cavity between the body wall and the alimentary canal and is lined by mesoderm. The mesoderm splits into:

    (i) Outer parietal layer which underlines the body wall and

    (ii) The visceral layer which covers the alimentary canal

27. The subkingdom parazoa includes only one Phylum which is the phylum porifera.

28. The word Porifera is derived from Latin porus = pore, ferra = to bear

29. Porifers, coelenterates and Echinoderms are aquatic. Echinoderms are only marine

30. Out of total 5000 species of porifers 150 species live in fresh water while all other are marine.

31. Scolymastrajoubini- a barrel like glass sponge (porifer) of Antarctica is more than a metre tall.

32. In porifers the pores through which water enters the body are called ostia and the pore through which the water leaves the body is known as Osculum (main openinu)

33. The cavity in porifers is spongocoel

34. In most sponges the body wall is formed of two layers:

    (i) The outer layer is pinacoderm. It is made up of cells called pinacocytes

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(ii) The inner layer is choanoderm. It is made of flagellated collar cell called choanocytes.

Between these two layers is present gelatinous mesenchyme which may contain amoeboid cells and spicules or sponginfibres.

35. In sponges 20 of their food consists of small animals (zooplankton) and plants (phytoplankton) while 80 consists of detrital organic particles.

36. In sponges there is no definite nervous system. However neurosensory and neuron cells are present which coordinate the flow of water

37. In sponges the skeleton is in the form of spicules or sponging fibres.

38. In sponges the spicules are present among pinacocytesosculum and ostia and provides support.

39. The adult sponges are sessile however their larvae are motile.

40. In sponges asexual reproduction is by budding. The buds may be external or internal. The internal buds are called gemmules.

41. Some sponges reproduce sexually. These are mostly hermaphrodite and mostlyprotandrous (male sex cells develop first).

42. A sponge that consists of a group of erect tubes is Leucoselenia

43. The sponge Euplectella is also called Venus flower basket.

44. Spongilla is freshwater sponge

45. The name Cnidaria is given to phylum coelenterata due to the presence or special cells called cnidocytes. These cells give rise to nematocysts (the stinging cells).

46. The coelenterates range in size from microscopic Hydra to macroscopic. Branchioceranth us. Branchioceranthus is a hydrozoan polyp that may reach two metres in length.

47. In coelenterates the nematocysts develop from ectoderm.

48. In coelenterates there is only one cavity which serves as digestive as well as body cavity. It is called gastro vascular cavity or enteron.

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49. In coelenterates the stinging cells or nematocysts are for defense and offense.

50. In coelenterates there is no central nervous system (CNS). The nervous system is in the form of neuron cells which are irregularly scattered in the body-wall or form a plexus in the body wall.

51. The coelenterates Hydra, Obelia, Sea-anemone and corals etc are sessile.

52. The coelenterates Hydra, jelly fishes and Sea-anemones are solitary.

53. The coelenterates Physalia, Vellelaetc, are colonial.

54. Zooids are of two basic forms which are polyps and the medusae.

55. Polyps / hydroids arc cylindrical, sessile, nutritive and reproduce asexually (by budding).

56. Medusae are umbrella like, motile and reproduce sexually.

57. A colony is an aggregation of individuals of zoo ids that perform different functions for the colony.

58. In many coelenterates the asexual generation alternates with the sexual generation. Both generations are diploid.

Example: obelia.

59. In obelia Gonozooid/Blastostyle develops buds

60. The occurrence of structurally and functionally more than two different types of individuals called the zooids within the same organism is called polymorphism.

61. Obelia has 3 kinds of zooids which are the gastrozooids, the gonozooids (blasto style) and the medusae. Some of the colonial members have up to five different types of zooids. These perform different functions for colony. An example is Physuiia (Portuguese man of war).

62. Hydra: A freshwater coelenterate. It exists only in polyp form. Therefore alternation of generations is absent.

63. Obelia: It is a marine coelenterate and has alternation of generations.

64. Aurelia (jelly fish): The polyp is reduced and medusa is dominant in jell fish.

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65. Actinia (sea anemone): The body consists of polyp only. Enteron is divided by large partitions called mesenteries.

66. Madrepora: The body is covered by exoskeleton of calcium carbonate. The commonly called corals. The skeleton forms large coral reefs and even small islands.

67. The body of Platyhelminthes is soft and dorsoventrally compressed. Therefore, they are called plastyhminthes (means flatworms)

68. In parasites the digestive system poorly developed or absent.

69. In platyhelminthes asexual reproduction is by fission in which the animal constricts, in the middle into two pieces.

70. In platyhelminthes the sexually reproducing species are hermaphrodite I both male and female reproductive organs are present in the same individually.

71. Fasciola (Liver fluke) is an endoparasite in sheep and rarely in human being. It completes its life cycle in two hosts: (i) a snail. (ii) sheep or man (in the bile duct)

72. The name Nematoda means pointed ends.

73. Nematodes are mostly parasites and are un-segmented.

74. A fluid filled space is present between the body wall and the alimentary canal. It provides tube within tube type structure in the nematodes.

75. Nervous system of Nematodes: dorsal ventral and lateral nerve cords + a nerve ring around the pharynx.

76. In Nematodes the muscles are arranged in four bands (two dorso-lateral and two ventre-lateral). The circular muscles are absent. Therefore the bending is dorso-ventral only.

77. In Nematodes the sexes are separate.

78. In Nematodes a larval stage is present in the life cycle. Therefore the development is indirect.

79. Annelid is a Latin word which means little ring. Most of the worms are included in this phylum.

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80. Annelida may be marine (Nereis) freshwater (stylaria) or found in damp soil (earthworms). Some are parasites such as leech (Hirudo).

81. The Annelid body is metamerically segmented and is divided transversely into anumber of segments.

82. In annelids the coelomic fluid serves as hydrostatic skeleton also.

83. In annelids the mouth is overhung by a lobe called prostomium.

84. Annelids are the first group of invertebrates with closed circulatory system.

85. In annelids the skin is kept moist by mucous and coelomic fluid.

86. In annelids excretion is by specialized structures called nephridia. These are present in every segment.

87. In annelids CNS consists of a simple brain and a solid double, longitudinal, ventral nerve cord. Nerves arise in each segment from the nerve cord.

88. In annelids both circular and longitudinal muscles are present.

89. In annelids when circular muscles contract body elongates. When longitudinal musclescontract body becomes short and widen.

90. In annelids the components of locomotion are setae, muscles and hydrostatic skeleton.

91. Neries have parapodia.

92. Setae: chaetae are absent in leech.

93. Most annelids are hermaphrodite (e.g. Earthworm. leech). In some annelids the sexes are separate (e.g. Nereis).

94. A free swimming ciliated larva is Trochophore larva.

95. Phylum Annelida has three classes which are Class Polychaeta, Class Oligochaeta and Class Hirudinea.

96. Nereis and Chaetopterus belongs to Class Polychaeta, they have Palps, tentacles, parapodia and trochophore larva.

97. Earthworms belong to class Oligochaeta.

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98. Leech belongs to class Hirudinea.

99. Leech has fixed number of segments (34). Each segment has additional circular rings or markings called annuli.

100. No distinct head is present in the Leeches. Chitinous jaws are present.

101. Anticoagulant secreted by Leeches is Hirudin

102. Arthropods are commonly called joint footed animals because arthros means joined and pods means feet.

103. Arthropods have common origin with annelids because both hale:

(i) scgmcrredhody

(ii) appendages and

(iii) cuticle

104. Largest phylum is Arthropoda. Second largest phylum of invertebrates is Mollusca.

105. In arthropods: The body i. covered with waterproof chitinous cuticle secreted by the epidermis, Chitin is non-living, non-cellular protein carbohydrate compound. On the outer side it has a waxy layer.

106. Arthropods have open circulatory system, primitive heart and blood is colourless(haernolymph) because it is without hemoglobin.

107. Most arthropods have extensive tracheal system formed of airtubles tracheae for the exchange of gases. Main tubes open to the exterior through openings, called spiracles, aquatic arthropods respire through gills.

108. In arthropods excretory system is well developed and consists of Malpighiail tubules. The nitrogenous wastes are excreted in the form of solid uric acid ($CH_4N_4O_3$).

109. In arthropods CNS is well developed and consists of paired ganglia (simple brain) connected to a ventral double nerve cord.

110. When the larva resembles adult it is called nymph or inster. It lives in the same habitat as adult.

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111. Most spiders have eight eyes placed in such a way that they can easily look at the predators and prey.

112. Latin Molluscus means soft, there are more than 50000 living species in the phylum Mollusca.

113. The body of Mollusks is un-segmented and soft and can be divided into head, a ventral muscular foot and a dorsal visceral mass.

114. The body of Mollusks is covered by a glandular epithelial envelope (especially over the visceral mass) called mantle which secretes calcareous shell.

115. In the mouth cavity of many mollusks there is a rasping tongue-like radula provided with many horny teeth, Except for Caphalopoda the circulatory system of mollusks is open.

116. A respiratory pigment of blue in color, called haemocyanin is present in the mollusks.

117. The space between the shell and the mantle cavity contains gills in some mollusks. The gaseous exchange is by gills mostly, In some cases such as skate, the mantle cavity is converted into a lung.

118. In the Mollusks, the excretory organs are paired nephridia.

119. In the Mollusks the nervous system consists of three pairs of interconnected ganglia present in the head, foot and body regions.

120. The mollusks have six classes. The major classes are Gastropoda, Bivalviaand Cephalopoda.

121. Gastropoda has both aquatic and terrestrial species. Examples are Helix aspersa (garden snail) and Lima (slug).

122. Bivalvia (Pelecypoda) is aquatic, shell of two pieces. Examples are Mytilus: (murine mussel) Anodonta (freshwater mussel) Ostrea (oyster).

123. Cephalopoda are aquatic, examples are loligo (squid), sepia (cuttlefish) and Octopus.

124. Among the invertebrates the brain of Octopus is very large, complex and highly developed. It is enclosed in a shell-like case of ·Cartilage.

125. The giant squid is the largest invertebrate animal. Its length is up to 15 meters (almost 50 feet), including tentacles or arms (weight about 2000 Kg)

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126. Teredo (a shipworm) damages wooden parts of ships.

127. There are over 5.000 known species of Echinoderms.

128. In echinoderms the skeleton / exoskeleton is mesoderm I in origin.

129. In echinoderms the mouth is on lower surface (oral) and anus is on upper surface (aboral).

130. In echinoderms the body may be flattened like biscuit (cake urchin), star-shaped with short arms (starfish), star-shaped with long arms (brittle star), globular (sea urchin) or elongated (sea-cucumber).

131. In echinoderms the water vascular system present in their coelom. It is a complex system of tubes and spaces surrounding the mouth and passing into the arms and tube feet. The water circulates through these channels. Water enters these canals through a sieve-like plate called madreporite present on the aboral (upper) body surface.

132. In Echinodermata no special organs for respiration or excretion, circulatory and Nervous system poorly developed while digestive and reproductive s: stem are well developed.

133. In Echinodermata there is no brain but a nerve ring is present around the pharyngeal region.

134. In Echinodermata locomotion is by tubefeet which are sac-like structures present along the edges of grooves present in the arms.

135. The larvae of Echinodermata are bipinnaria and brachiolaria. These are with bilateral symmetry.

136. Regeneration is very common in the Echinodermates.

137. Echinodermates, hemichordates (Prechordates) and chordates are Deuterostomes

138. Hemichordates are worm-like with soft body.

139. The body of Hemichordates is divided into an anterior proboscis, collar and trunk.

140. The body wall of Hemichordates is made of unicellular epidermis with mucus-secreting cells.

141. Examples of Hemichordates: Balanog/ossusand Saccoglossus .

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142. The name chordata is given due to a common character – the Notochord.

143. All the chordates have three basic characters:

(i) the Notochord

(ii) hollow dorsal CNS

(iii) paired gill slits

144. The Notochord is a rod-like semi rigid body of the vacuolated cells which are filled with proteinacoeus material which may extend the length of the body between enteric canal and the dorsal hollow central nervous system.

145. Notochord is present in all members of the phylum either in the larval or embryonic stages or throughout life. Its main function is to support and stiffen the body. Therefore it acts as skeletal axis.

146. All chordates have paired gill slits in embryonic stage. In some these are non-functional. In others these are functional for some period in their life history (e.g. frogs etc.). In still others these are functional throughout life (e.g. Amphioxus, and fishes etc.).

147. Chordates are divided in to lower chordates/Acraniates (e.g. Amphioxus etc.) and higherchordates (vertebrates/Craniates).

148. Two subphyla of f lower chordates are Urochordata and Cephalochordata.

149. Urochordates are also called Tunicates because they are enclosed in a covering called Tunio. Example is Molgula.

150. In the Cephalochordata Notochord and nerve cord is present in the entire length of the body and remains throughout life (e.g. Amphioxus).

151. Vertebrates may also be divided into:

(i) An amniotes: These are without foetal membranes

(cyclostomata, chondrichthyes, osteichthyes and amphibia).

(ii) Amniotes: These are with foetal membranes (reptiles. aves and mammals).

Foetal membranes are aminion, allantois and chorion.

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152. In class cyclostomata are included most primitive living vertebrates which are withoutjaws.

Examples are Lampreys and hagfish. Hag fishes are helmaphrodite.

153. In Cyclostomata: Eel-like body; Scales absent; No paired appendages; Six to fourteen pairs of gills: Long larval period in larnpray.

154. In class Chondrichthyes: Cartilaginous fishes; Body fusiform; 5 – 7pairs of gills; Examples are sharks and rays; Placoidscales on the body. With the exception of whale the sharks are the largest living vertebrates (some reach 30 – 50feet in length).

155. The skates and rays live in the bottom. In these anterior pairs of fins (pacoral fins) are large and used for swimming like wings.

156. Shark liver oil is extracted and used in medicine as source of vitamin A and D.

157. Class osteichthyes (Bony fishes) Notochord may remain in parts, the skin has dermal scales which are ganoid, cycloid or ctenoid. Mouth is terminal, swim bladder usually pressure, brain with 10 pairs of cranial nerve.

158. Paired fins are pectoral and pelvic, unpaired fins are dorsal, caudal (tail) and anal fins.

159. Dipnoi (double breathing) is lungs fish (lobe-finned fish).

160. Oxygen is more in the air than in water.

161. Temperature changes are more sever in the terrestrial environment.

162. Amphibians are intermediate between aquatic ad true terrestrial animals (Reptiles).

163. In the evolution from water to land, amphibians have developed limbs in place of fin, lungs in place of gills and some changes in the skin.

Note: First land vertebrates are amphibians while first successful land vertebrates are reptiles.

164. Caecllians are legless amphibians.

165. Amphibians and reptiles are cold blooded (poiklothermic) animals and hibernate in winter.

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166. In amphibians there is external fertilization and development while newts and salamander are tailed amphibians.

167. In retiles the ventricle of heart is incompletely partitioned, in crocodile ventricle is completely partitioned into two.

168. Reptiles were dominant in mesozoicperiod (225 – 65 million years).

169. The climate suitable for reptiles becomes less favourable in tertiary period, so most of them become extinct, now out of a dozen or more main lines, only four exist.

170. The reptiles of today have been derived from dinosaurs of Jurassic (195 – 136 million years) and cretaceous period (136 – 65 million years),

171. The crocodiles are the reptiles from which modern birds were derived.

172. Both birds and mammals have evolved from reptiles along different lines.

173. The earliest known fossil bird is archaeopteryx: about the size of a crow, bony teeth in the jaw socket, each wing with three claws.

174. The archaeopteryx is a connecting link between reptiles and birds.

175. The body of the bird has four divisions which are head, neck, trunk and tail.

176. Birds and mammals are homoeothermic.

177. The birds do not have teeth. Therefore, they have developed a thick muscular structure (Gizzard) which is used for crushing the food.

178. In birds the organ of voice is called syrinx. It is present at the lower end of trachea near the origin of the two bronchi. In mammals voice apparatus is Larynx which is present at the upper and of trachea.

179. Ostrich and Kiwi are running birds.

180. In the penguin, the fore-limbs are modified into flippers for swimming (e.g. penguin).

181. The terms mammal was given by Linnaeus to the animals nourished by milk from the breast of the mother.

182. Well-developed brain/CNS in mammals.

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183. The mammals have evolved from reptilian ancestors the cotylosaurs.

184. Varnope fossil (found in Texas) 50 % mammals.

185. Mammals become dominant in the Cenozoic period.

186. Most mammals have hair on the body for insulation and temperature regulation. In some the hair, have become modified into scales (Pangolin) and spines (porcupine).

187. Diaphgram is present in the mammals. Diaphragm is a muscular sheet which separates the thoracic and abdominal cavities.

188. In the mammals there is achain of three bones in the internal ear which are Incus Maleus and stapes.

189. In Mammals red blood cells are non-nucleated.

190. Mammals are classified into three sub-classes. Prototheria (egg lying mammals) metatheria (pouched mammals) and eutheria (Placcental Mammals).

191. Prototheria: connecting link between reptiles and mammals. **Examples** are duck bill platypus and echidna (spiny anteater).

192. In Metatherians, Marsupium is present the young when born are immature in rudimentary form development is complete in the marsupium,

Example opossum kangaroo and Tasmanian wolf

193. Sub class eutheria has placental mammals, placenta is formed between fetus and mother through placenta fetus is nourished. Placenta has endocrine function also.

194. Carnivores: an animal that eats only meat.

195. Deuterostome: any member of the animals in which the blastopore of the developing embryo becomes the anus, while a second opening becomes the mouth.

196. Enterocoelous a coelom formation by out pocking of the archenterons.

197. Gill slit: An opening of the pharynx through which water passing over an aquatic animal's gills leaves the body. Gill slits occur in adult fish and other vertebrate embryos.

198. Hernocoel: A blood-tilled cavity.

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199. Marsupial: A mammal, such as the kangaroo, that possesses an external pouch in which the young are matured.

200. Mesoderm: The middle layer (between ectoderm and endoderm) that arises during gastrulation in an embryo. Mesodermal cells give rise to the skeleton, muscles, and circulatory and immune systems, among other structures.

201. Metamorphosis: Among insects, amphibians, and other animals, the developmental transformation form the larval to the adult form.

202 Nerve cord: The spinal cord, located dorsal to the notochord, which is present in all chordates and which coordinates sequential muscle action.

203. Notochord: The stiff but flexible rod that runs the length of a chordate, just ventral to the nerve cord.

204. Placenta: The organ in sharks and mammals that connects a developing embryo to surrounding maternal tissue and through which the fetus may obtain nutrients, gives off wastes, and exchanges O_2 and CO_2.

205. Poikilotherm: Any animal having a variable body temperature that has the temperature of the surrounding environment.

206. Pseudocoelom: The "false", fluid filled body cavity that is a characteristic of the nematodes.

207. Radial symmetry: A body plan that looks circular when viewed form above or below and in which certain structures radiate outward in all directions from the center.

208. Schizocoelous: A coelom formation by the splitting of mesoderm into two layers.

209. Bilateral symmetry: The animal body plan in which an organism's right and left sides are mirror images.

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QUESTIONS FOR PRACTISE

1. In Earthworm the locomotry structures are:

(a) cilia (b) setae

(c) flagella (d) pseudopodia

2. Which system is absent in Platyhelminthes?

(a) skeletal (b) respiratory

(c) circulatory (d) all of these

3. A spider different from insects because:

(a) it has four pair of legs (b) does not have any antennae

(c) body is divided into two parts (d) all of these

4. Silk worm is:

(a) insect (b) arachnid

(c) myrapod (d) crustacean

5. Study of insects is:

(a) insectology (b) entomology

(c) arthrology (d) insect biology

6. What is Sanguivorous mode of nutrition?

(a) blood sucking (b) to get only liquid food

(c) getting food like snails (d) both b and c

7. Studying Mollusc shell is:

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(a) conchology (b) molluscology

(c) malacology (d) mantalogy

8. The tongue worm are:

(a) endoparasites (b) saprotrophs

(c) ecto parasites (d) flatworms

9. Balanogtossus is a link between:

(a) annelida and mollusca (b) mollusca and Echinodermata

(c) echinodermata and chordate (d) arthropoda and echinodrmata

10. In Chordates, the Nervous system is:

(a) hollow. dorsal CNS (b) hollow, ventral CNS

(c) solid. dorsal CNS (d) ventral. double and non-ganglionated

11. Generally the habitat of cartilaginous fishes is:

(a) fresh water (b) marine: water

(c) shallow fresh water (d) freshwater/marine water

12. An animal with four chambered heart is:

(a) lung fish (b) whale

(c) eel (d) shark

13. Out of following the closet relative of bat is:

(a) robin (b) seal

(c) crow (d) penguin

14. Eustachin tubes are modification of:

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(a) notochord (b) back bone

(c) gill slits (d) hollow dorsal CNS

15. In the vertebrates, circulatory system is:

(a) close type

(b) open type

(c) some have open and most of them hav e close type

(d) some have close but most of them have open type

16. Craniate is the name given to:

(a) fish (b) amphibian

(c) reptile (b) vertebrate

17. Swim bladder is present in:

(a) some bony fishes (b) cartilaginous fishes

(c) most bony fishes (d) all fishes

18. Operculum covers the gills in:

(a) tailed amphibians (b) bony fishes

(c) jawless fishes (d) all fishes

19. Tetrapods are considered to have evolved from:

(a) lobe finned fish (b) lawless fish

(c) amphibians (d) lower chordates

20. Least numerous of terrestrial vertebrates are:

(a) amphibians (b) fish

(c) birds (d) reptiles

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21. Three chambered heart is found in:

(a) fishes (b) amphibians

(c) birds (d) mammals

22. The amniotes include:

(a) fishes (b) amphibians

(c) reptiles (d) lower chordates

23. Parazoa is:

(a) subkingdom (b) grade

(c) sub grade (d) series

24. Which of the following is included in grade Bilateria?

(a) coelentratcs (b) porifers

(c) nernarods (d) both porifers and coelenterates

25. Animals are not:

(a) absorptive heterotrophs (b) multi-cellular

(c) eukaryotic (d) ingestive heterotrophs

26. Which one is asexual reproductive structure?

(a) gemmule (b)gamma cup

(c) bud (d) all of these

27. Octopus is included in class:

(a) gastropoda (b) pclccypoda

(c) cephalopoda (d) myriapoda

28. Which of the following is a similarity between echinoderms and chordates?

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(a) radial cleavage during development of embryos

(b) formation of mouth from blastobpore

(c) body organs

(d) water vascular system

29. External ear is:

(a) malleus (b) incus

(c) pinna (d) stapes

30. Left aortic arch is present in:

(a) mammals (b) birds

(c) birds and mammals (d) some mammals

31. In which of the following Bilateral symmetry is found is:

(a) hydra (b) ascaris

(c) sea anemone (d) jelly fish

32. Most animal phyla in:

(a) marine (b) fresh water

(c) terrestrial (d) only sea

33. Haploid stage in animal life cycle:

(a) gamete (b) zygote

(c) embryo (d) main body

34. Porifers evolved from:

(a) ancestral protozoa (b) euglenoids

(c) coelenterate (d) prokaryotes

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35. The free swimming stage of jelly fish is:

(a) blastula (b) polyp

(c) physalia (d) medusa

36. The worms are:

(a) bilateraly symmetrical (b) radially symmetrical

(c) asymmetrical (d) radially or asymmetrical

37. Which is not arthropod character?

(a) jointed appendages (b) non-segmented body

(c) moulting (d) exoskeleton

38. Which has not Hydrostatic support?

(a) insect (b) earthworm

(c) snail (d) jelly fish

39. All or following are parasitic worms, except:

(a) leech (b) liver fluik

(c) honk worm (d) ring worm

40. Which is gastropod?

(a) clam (b) slug

(c) mussel (d) cuttlefish

41. Coolonin animals is derived form:

(a) ectoderm

(b) mesoderm

(c) endoderm

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(d) sometimes from ectoderm and mostly from endoderm

42. The zooids responsible for nutrition:

(a) gastrozoids (b) gonozoids

(c) biastostyle (d) medusa

43. Air sacs are associated with lungs in:

(a) birds (b) mammals

(c) reptiles (d) fishes

44. Jaws without teeth are found ill:

(a) fish (b) reptiles

(c) birds (d) mammals

45. Right aortic arch is found in:

(a) birds (b) reptiles

(c) mammals (d) some birds

46. Which one is the true fish?

(a) star fish (b) flying fish

(c) silver fish (d) cuttle fish

47. Characteristic of fish heart is that, it has:

(a) only pure blood (b) only impure blood

(c) both pure and impure blood (d) it has no blood

48. Exoskeleton is not found in:

(a) reptiles (b) aves

(c) mammals (d) amphibians

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49. The class to which bat belongs to:

(a) chiroptera (b) eutheria

(c) mammalia (d) metatheria

50. The warm blooded animals are also known as:

(a) poikilothermic (b) homoeothermic

(c) ectothermal (d) heterotherms

51. Diaphragm is not found in:

(a) bat (b) man

(c) rabbit (d)frog

52. Members of which phylum secondarily developed radial symmetry?

(a) annelida (b) mollusca

(c) arthropoda (d) echinodermata

53. Which ofthe following is included in grade Bilateria or Radiata?

(a) coelenterates (b) nematods

(c) annelids (d) all of these

54. Annelida and arthropoda are believed to have common origin because both have:

(a) segmented body (b) appendage

(c) cuticle (d) all of these

55. Protoandrous means:

(a) female sex cells develop first

(b) male sex cells develop later

(c) male and female sex cells develop simultaneously

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(d) male sex cells develop first

54. Squid is included in class:

(a) gastropoda (b) pelecypoda

(c) cephalopoda (d) myriapoda

56. Which of the following is not a similarity between echinoderms and chordates?

(a) radial cleavage during development of embryos

(b) formation .of anus from blastobpore

(c) biochemical peculiarities

(d) water vascular system

57. Mode of nutrition in coelentrates is:

(a) herbivorous (b) carnivorous

(c) omnivorous (d) detritivorous

58. Which of the following is a unisexual group?

(a) porifera (b) Platyhelminthes

(c) nematode (d) annelida

59. Which of the following ar.e adaptations for parasitic mode of life in platyhelminthes?

(a) resistant cuticle (b) adhesive organs like suckers

(c) simplified digestive system (d) all of these

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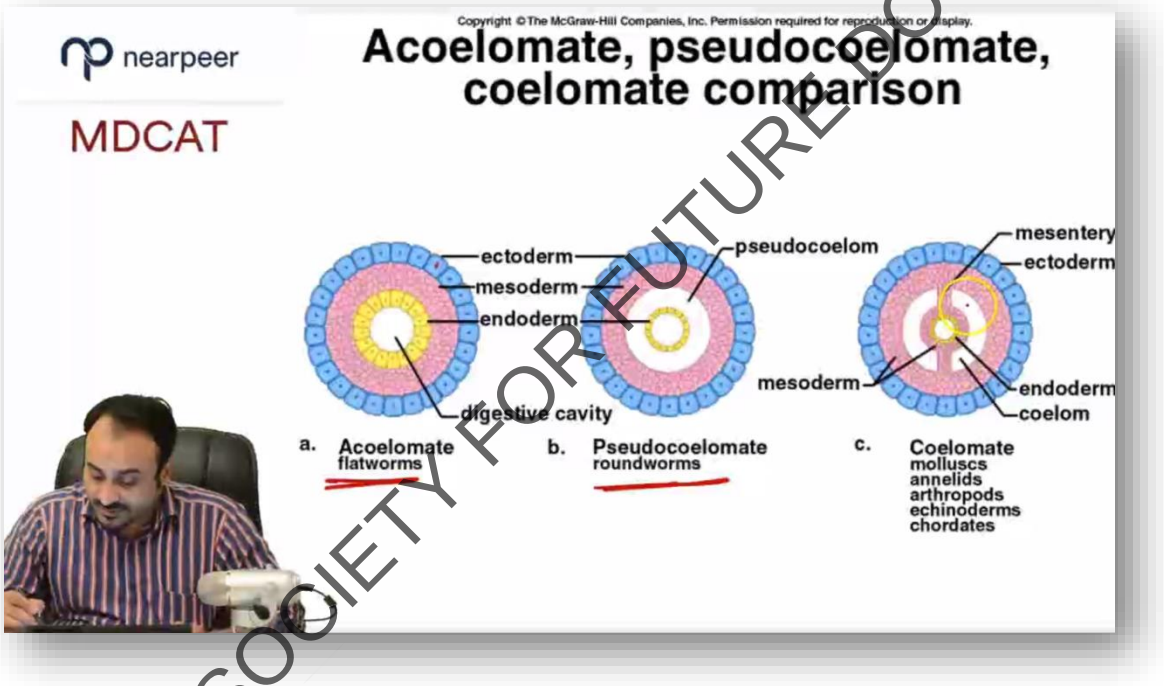
UNIT NO. 4 (KINGDOM ANIMALIA)

1	**B**	2	**D**	3	**D**	4	**A**	5	**B**	6	A	**7**	**A**	**8**	**A**	**9**	**C**	**10**	**A**
11	B	**12.**	B	**13**	B	**14**	C	**15**	A	**16**	**D**	17	C	18	B	19	A	20	A
21	B	**22**	C	**23**	A	**24**	C	**25**	A	**26**	**D**	27	C	28	A	29	C	30	A
31	B	**32**	A	**33**	A	**34.**	A	**35**	D	**36**	**A**	37	B	38	A	39	D	40	B
41	B	**42**	A	**43**	A	**44**	C	**45**	A	**46**	**B**	47	A	48	D	49	C	50	B
51	D	**52**	D	**53**	D	**54**	D	**55**	D	**56.**	**C**	57	D	58	B	59		60	D



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HUMAN PHYSIOLOGY

MAJOR CONTENTS

Content

(a) Digestive System
(b) Gas Exchange and Transportation
(c) Excretion and Osmoregulation
(d) Nervous system
(e) Reproduction
(f) Support and Movement
(g) Hormonal Control (Endocrine Glands)
(g) Immunity

LEARNING OUTCOMES

(a) Digestive System

- Anatomy of digestive system and specify the digestion in:
  1. Oral cavity (Role of teeth, tongue, saliva and enzymes)
  2. Stomach (enzymes)
  3. Small Intestine
  4. Large Intestine

(b) Gas Exchange and Transportation:

- Anatomy of respiratory system (nostrils, trachea, lungs)
- Explain the tem term breathing
- Discuss Blood composition, lymph, structure of heart, carriage of oxygen and Carbon Dioxide

(c) Excretion and Osmoregulation

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- Describe the stricture of kidney and its functions with respect to homeostasis
- What are kidney problems and cures?

  Kidney stones, lithotripsy, kidney transplant, dialysis, renal failure
- What do you understand by the term Homeostasis?

(d) Nervous System

- What are nervous system and its types?
- Explain CNS (Central Nervous System) including forebrain, mid brain, hind brain and spinal cord
- Explain PNS (Peripheral Nervous System) and its types (Autonomic and Sympathetic Nervous System)
- Neurons (Associative, motor and sensory neuron)
- Discuss the Nervous disorders (Parkinson's disease, Epilepsy and Alzheimer's disease)
- What do you understand by Biological clock and circadian Rhythm?

(e) Reproduction:

- Explain the Reproductive system in male in detail
- Explain the Reproductive system in female / menstrual cycle
- Explain:

  (a) Spermatogenesis

  (b) Oogenesis

- Discuss the following Diseases in detail which are sexually transmitted:

  (a) Gonorrhea, Syphilis, Genital Herpes, AIDS and how these diseases can be controlled (treatment is not required)

(f) Support and Movement:

- Explain the role of Human skeleton and skeletal muscles in locomotion

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- Explain the process of muscle contraction
- What is Muscle fatigue, Tetani, Cramps?
- Describe the structure and functions of involuntary, voluntary and cardiac muscles

(g) Hormonal Control (Endocrine glands):

- What are hormones?
- Describe Hypothalamus with its hormones.
- Describe Pituitary gland with hormones secreted from its Anterior, Median and Posterior lobe
- Describe adrenal gland with its hormones
- What are Islets of Langerhans?
- What are the hormones of alimentary canal (Gastrin, secretin)?
- The hormones of ovaries and testes

(h) Immunity:

- Immune system and define its components:
  - (a) Antigen
  - (b) Antibody (structure of antibody)
  - (c) Lymphocytes (B and T cells)
- What is cell mediated response and hormonal immune response?
- Types of Immunity:
  - (a) Active immunity

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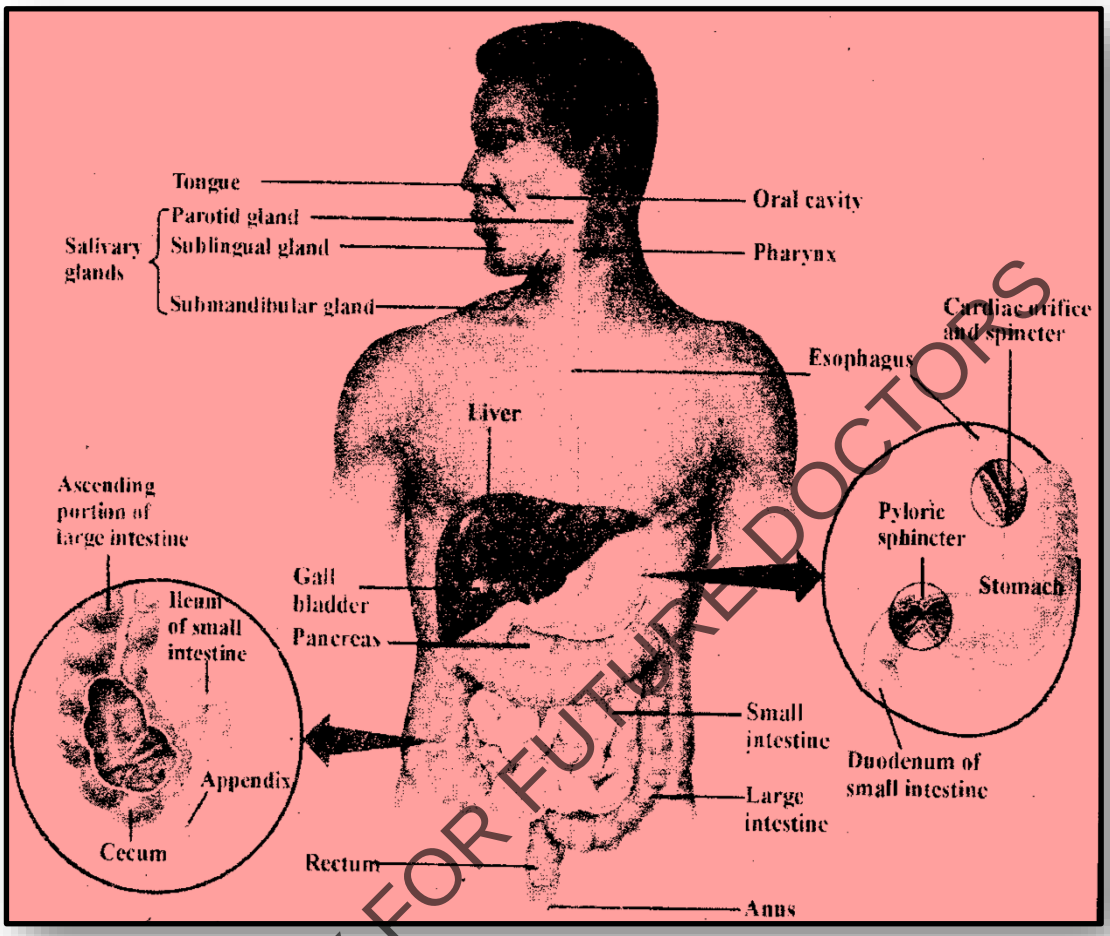

Fig. The digestive system of man

DIGESTIVE SYSTEM

The digestive system of man consists of a long coiled tube that extends from the mouth to the main parts of the digestive system are the oral or buccal cavity, esophagus, stomach, small intestine (duodenum, jejunum and ileum), large intestine (ascending colon, transverse colon, descending colon, caecum and rectum).Associated glands are salivary glands, liver and pancreas. There are three sites of digestion in the digestive system of man oral cavity, stomach and small intestine.

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Basic Features of the Gut Wall:

The gut is not the same all the way along the alimentary canal. Each region has pacific features, which can be related to the function of different parts of the gut.

The gut wall is divided into three main layers:

- An outer muscle layer, protected by a thin coating of fibers.
- A middle layer, the sub-mucsa.
- An inner layer, the mucosa.

ORAL CAVITY IN DIGESTION

Introduction:

The oral cavity is bounded by palate, tongue, teeth and cheeks. There we several functions of oral cavity. Three functions are most important which are:

1. Selection of food
2. Grinding or mastication
3. Lubrication and digestion

1. Selection of Food: When the food enters the oral cavity it is tasted, smelled and felt. If the taste or smell is unpleasant or if hard objects like bone or dirt are present in the food, it is rejected. The senses of smell, taste and sight help the oral cavity in the selection of food. The tongue which is sensory and muscular organ plays the most important role in selection of food through its taste buds.

2. Grinding or Mastication: After selection, the food is ground by means of molar teeth into smaller pieces. This is useful because:

The esophagus allows small pieces to pass through and small pieces have much more surface for the enzymes to attack.

3. Lubrication and Digestion:

These two are the main functions of the oral cavity which occurs by saliva.

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Saliva is secreted by three pairs of salivary glands:

Sublingual glands present below the tongue, Sub maxillary glands behind the jaws and Parotid glands in front of the ears.

Salivary glands produce saliva at the rate of about 1 to 1.5 liters per day. It is produced constantly, but more is released when we see, smell, taste or even just think about food. Saliva is mainly water (99.5 per cell) with some dissolved substances (0.5 percent) including:

Water:

- Mineral salts such as Sodium bicarbonate phosphates and hydrogen carbonates.
- Salivary amylase or Ptyalin, a starch-digesting enzyme that breaks molecules of search into maltose.
- Mucin, a slimy glycoprotein lubricant.
- Lysozyme, an enzyme that kills bacteria.

Salivary amylase, the starch-splitting enzyme in saliva, begins the process of chemical breakdown.

(i) Water and Mucous: Water and Mucous together make a slimy liquid which moisten and lubricate the food. As a result it can be chewed efficiently and passed through the esophagus smoothly.

(ii) Sodium Bicarbonate and Some Other Salts:

Sodium bicarbonate and some other salts arc slightly antiseptic hut their main function is to stabilize the pH of the food. Fresh Saliva is alkaline with a pH nearly 8 it quickly loses carbon dioxide and the pH is now 6.

(iii) Ptyalin: Ptyalin is a carbohydrate digesting enzyme. It digests starch and glycogen to maltose.

Bolus Formation:

As a result of mastication, the softened, partly digested, slimy food is rolled into all oval lumps called bolus. B is pushed to the hack of the mouth by the action of tongue and muscles of pharynx which ensure that the food does not enter the windpipe.

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The mouth is lined by stratified epithelium (epithelial cells stacked on top of' each other). This protects the deeper tissues of the mouth from friction damage and has a very high turnover:

We replace the lining of our mouth and the rest of the gut every 24 hours or so.

Swallowing:

Following steps are involved during swallowing:

(i) The tongue moves upwards and backwards against the roof of the mouth. As a result the bolus is forced to the back of the mouth cavity.

(ii) The backward movement of the tongue pushes the soft palate up and closes the internal nostrils.

At the same time the tongue forces the epiglottis into horizontal position. As a result the opening of the windpipe (the glottis) is closed. (Epiglottis is a flap of cartilage).

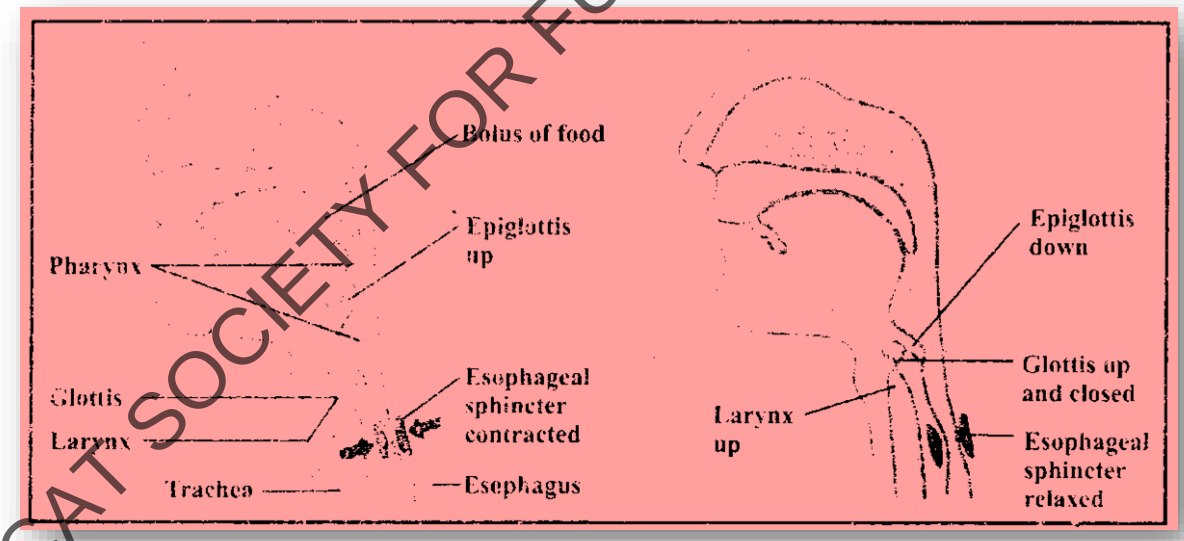

Fig. Swallowing in man

(iii) The larynx moves upward under the back of the tongue.

(iv) The glottis is partly closed by the contraction of a ring like muscle.

(v) The food does not enter the partly open glottis. This is because that the epiglottis diverts the food to one side of the opening and safely down the esophagus.

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The beginning of the swallowing action is voluntary, but once the food reaches the back of the mouth, swallowing becomes automatic. The food is then forced down the esophagus by peristalsis.

PERISTALSIS

The intestine, along with many other tubular organs in the body (ureters, vas deferens and uterus) are made from smooth muscle whose main function is the slow rhythmic contraction known as peristalsis.

Introduction:

Peristaltic movements are characteristics movements of the digestive tract by which food is moved along the cavity of the canal.

Definition:

It is a wave of contraction and relaxation of the circular and longitudinal muscles, which squeezes the food down along the digestive canal.

Occurrence:

Peristalsis starts just behind the food from the buccal cavity along the esophagus to the stomach and then along the whole alimentary canal.

Anti-peristalsis:

The reversal of peristalsis is called anti-peristalsis. As a result of an peristalsis the food may pass from the intestine back into the stomach and even into the mouth leading to vomiting.

Hunger Pang:

Hunger contractions are peristaltic contractions which are increased by low blood glucose level and are sufficiently strong to create an uncomfortable sensation called a “hunger pang”. Hunger pangs usually begin 12 to 24 hours after the previous meal or in less time for some people.

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Effect of Gravity on the Movement of Material:

Gravity helps the movement of material through the esophagus especially when liquid are swallowed. However, the peristaltic contractions that move material through the esophagus are sufficiently forceful. Therefore a person can swallow even while doing a headstand.

DIGESTION IN STOMACH

Introduction:

Overall, the stomach:

- Mixes food with gastric juice by muscular action.
- Retains food, giving enzymes time to act.
- Digests proteins through the action of the enzyme pepsin.
- Curdles milk with the enzyme rennin.
- Absorbs some simple chemicals.

The stomach is located below the diaphragm on the left side of the abdominal cavity. It is an elastic muscular bag. The stomach stores food for some time, making discontinuous feeding possible. Ii also partly digests the food.

Cardiac Sphincter:

At the junction of esophagus and the stomach there is a special ring of muscles called cardiac sphincter. When the sphincter muscles contract, the entrance to the stomach closes, therefore, the contents of the stomach cannot move back into the esophagus. It opens when a wave of peristalsis coming down the esophagus reaches it.

Heart Burn or Pyrosis:

It is a painful burning sensation in the chest usually associated with the back flush of acidic chyme into the esophagus. This is due to:

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- Overeating
- Eating fatty food
- Lying down immediately after a meal
- Consuming too much alcohol, caffeine or smoking

Stomach Wall:

The stomach wall is composed of three principal layers.

Outer Layer:

It is formed of connective tissue.

Middle Layer:

It is formed of smooth muscles. Outer layer is formed of longitudinal muscles while the inner layer is formed of circular muscles. All regions of the gut have two layers of muscle, apart from the stomach, which has three. The extra oblique layer runs at 45° to the other two, and helps churn the food.

The stomach has deep ridges called rugae that help with the mechanical breakdown of food.

Inner Layer (Mucosa):

It is composed of connective tissue. It has many tubular gastric glands. These glands are composed of three kinds of cells:

(i) Mucous Cells:

These cells secrete mucus which is a thick secretion. It covers inside of the stomach due to mucous the underlying is ails arc prevented from digestion.

(ii) Parietal or Oxyntic Cells:

These cells secrete hydrochloric acid (HCI). HCI is secreted in concentration form having pH 1.3; its functions are as follows:

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It adjusts the pH of stomach contents from 2 – 3. At this pH the pepsin can act on proteins. It also softens the food and kills many microorganisms that enter the stomach along with the food, it converts pepsinogen to pepsin.

(iii) Zymogen Cells:

These cells secrete pepsinogen, Pepsinogen is inactive form of Pepsin. Pepsinogen is activated to pepsin by HCI or by already activated pepsin. Pepsin hydrolyzes protein to yield peptones and polypeptides. The secretion of all these cells is collectively called gastric juice.

PROTEIN DIGESTION IN STOMACH

One of the main functions of the stomach is to begin the digest proteins. Pepsin a powerful endopeptidase enzyme digests proteins. The enzyme breaks peptide bends in the middle of the protein chain, turning protein molecules into polypcptides. Protein digestion is completed when exopeptidase enzymes remove amino acids from the ends of the polypeptides.

The stomach avoids digesting its down tissue by secreting pepsin in an inactive form pepsinogen. This is converted to pepsin in the lumen of the stomach only after contact with hydrochloric acid. The hydrogen ions in the acid cause the pepsinogen to unfold and become pepsin the active form of the enzyme.

Milk Digestion:

Caseinogens the proteins in milk are water soluble. They are available nutrients (milk is the sole source of food for young mammals) but if they remained in their soluble form they would leave the stomach before protein digestion had finished. To avoid this, the stomach produces rennins. This curdles milk converting soluble caseinogen into insoluble casein like pepsin remains is also secreted in an inactive form, Prorennin. Like pepsinogen prorennin is converted to its active form by contact with stomach acid.

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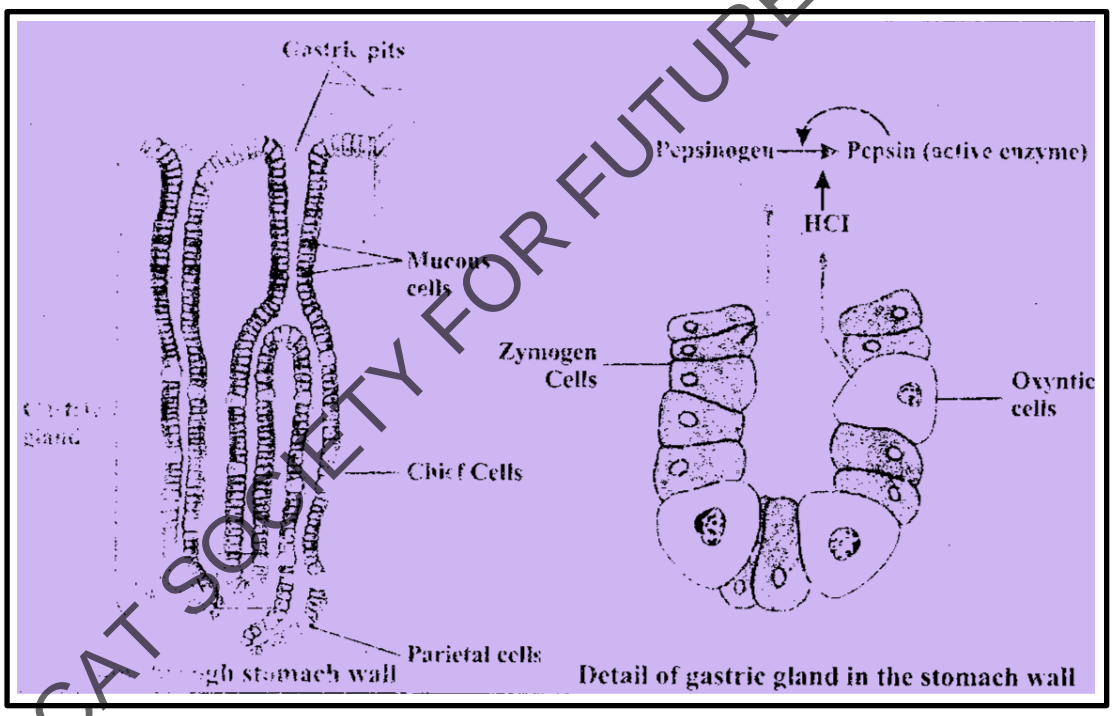
Chyme formation:

The muscles of stomach wall thoroughly mix up the food with gastric juice and convert it to semi-solid mass called chime. Gradually the stomach empties into the duodenum through the relaxed pyloric sphincter.

Control or Regulation of Gastric Juice Production:

The secretion of the gastric juice is regulated by smell, sight and quality of food. If more protein is present in the food it stimulates the production of gastrin hormone from the gastric endocrine gland. The gastrin is carried by blood to the gastric glands. The gastric glands are stimulated and produce more gastric juice. We can say that more proteins, more gastrin and more gastric juice for protein digestion.



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DIGESTION IN SMALL INTESTINE

Introduction:

Small intestine in man consists of duodenum, jejunum an ileum.

Duodenum:

Duodenum is about 20 – 25 cm long. It leads into jejunum and then ileum. When chime passes from stomach into duodenum its acidity stimulated the release of secretions from pancreas, liver and duodenal cells.

Hapatic and pancreatic secretions are also stimulated by a hormone called secretin which is produced by the intestine mucosa on the entry of acidic food from stomach.

The acidity stimulates secretin production in duodenum and secretin is carried by blood to pancreas. The pancreas is stimulated to produce pancreatic juice, secretin also inhibits gastric secretion.

Pancreas:

Pancreas is a large gland whose exocrine tissue secretes a juice that flows through pancreatic duct into the duodenum. Pancreatic juice contains $NaHCO_3$ which partly neutralizes the chyme coming from the stomach. This is necessary because enzymes of the pancreas do not work well in the acidic medium. Pancreatic juice contains enzymes that digest carbohydrates, fats and proteins (principal components of food). These enzymes are as follows:

(i) Amylase:

It is the Carbohydrate digesting enzyme. It is also called amylopsin. It digests starch int omaltose.

(ii) Lipase:

It is fat digesting enzyme. It hydrolyzes a small percentage of fats into fatty acids and glycerol.

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(iii) Trypsin:

Trypsin breaks proteins into peptones and polypeptides. Like pepsin trypsin is also secreted as inactive trypsinogen. It is activated to trypsin by enterokinase, Enterokinase enzyme is secreted by the lining of the duodenum.

LIVER:

The liver is reddish brown gastric gland present in the anterior part of the body cavity. The liver is the large storgan of the body' performing over 500 different chemical functions. It filters over a liter of blood each minute.

Liver secretes bile. It is temporarily stored in the gall bladder and released into the duodenum through the bile duct. The bile is green, watery fluid. It contains no enzymes but salts are present. Its green colour is due to the bile pigments which are formed from the breakdown of hemoglobin in the liver.

Liver cells produce around 0.8 to 1.0 liter of bile daily. Secretions from individual cells pass into tiny canals called bile canaliculi. These lead to the gall bladder, a small sac-like organ which stores the bile until it is needed. Bile is released into the duodenum when the muscle wall of the gall bladder contracts. Bile reaches the duodenum through the bile duct. Bile:

- Emulsifies fats (breaks large far or oil droplets into an emulsion of microscopicdroplets). This process massively increases the surface area available for fat digesting enzymes;
- Neutralizes the (acidic) chyme from the stomach and creates the ideal pH for intestinal enzymes;
- Stimulates peristalsis in the duodenum and ileum;
- Allows the excretion of cholesterol, fats and bile pigments.

The hormone secretin acts with nervous stimulation by the vagus nerve to increase the rate of bile secretion. The acidity of chyme in the duodenum and the hormone CCK-PZ stimulate the gall bladder to contract.

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Malfunctioning of the Liver:

(i) Jaundice:

If bile pigments arc prevented from leaving digestive tract, they may accumulate in blood. The result is a condition called as jaundice.

(ii) Gall Stones:

Cholesterol, secreted by the liver, may precipitate in the gall bladder. As a result gallstones are produced this may block the release of bile.

Liver Damage:

The liver is easily ruptured because it is large, fixed in position and fragile. It may lacerate by a broken rib. Liver rupture or laceration may result in severe internal bleeding.

Liver Enlargement:

The liver may become enlarged as a result of heart malfunctioning or hepatic cancer. Similarly liver may be damaged due to hepatitis or being alcoholic. Urea formation in the liver, liver converts toxic substance ammonia to less toxic compound urea. Urea is then excreted by kidneys. Ammonia is a waste product of amino acid metabolism.

Jejunum and Ileum:

Jejunum is the second part of the small intestine extending from the duodenum to the ileum. It is about 2.4 meter in length comprising about 2/5 (two fifth) of the small intestine. The lower 3/5 (three fifth) of the small intestine from jejunum is the ileum. The food which is not digested in the duodenum is completely digested in the jejunum and ileum.

Jejunum and ileum produces following enzymes. These enzymes are present in the intestinal juice.

ENZYMES	SUBSTRATE	PRODUCTS
Amino peptidase	Polypeptides	Di-peptides
Erypsin	Dipeptides	Amino acids
Lipase	Fats	Fatty acids and glycerol

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Maltase	Maltose	Glucose
Lactase	Lactose	Glucose and galactose

ABSORPTION OF FOOD

Nearly all absorption of the products of digestion takes place hi the ileum. This is because that the internal surface of ileum has many finger-like outgrowths called viilì.

Internal Surface of the Ileum:

The internal surface of the ileum has many folds. These folds show velvety appearance due to the presence of many fingerlike outgrowths called villi.

Structure of a Villus:

A villus is a fingerlike outgrowth.

It is richly supplied with blood capillaries.

It has also a vessel called lacteal of lymphatic system.

Each villus has a covering of epithelial cells.

Ultra Structure of a Villus:

Electron microscope reveal that these cells have countless, closely packed cylindrical processes called microvilli.

Total Area of Absorption:

The total area of absorption is very large due to enfolding, villi and microvilli. An average 70 kg man has approximately 100 square meters of absorbing surface in his small intestine.

Absorption of Digested Food:

Some digested contents are absorbed into the blood while the others into the lacteals.

Absorption into the Blood:

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Simple sugars and amino acids are absorbed by diffusion or active transport into the blood capillaries through the microvilli. Some of the fatty acids and glycerol are also absorbed into blood.

Absorption into the Lacteals:

A large proportion of fatty acids and glycerol enter the epithelial cells of villi. Here they recombine into fats. These fats then enter the lacteals.

Formation and Use of Lipoproteins:

Proteins present in lymph vessels combine with fat molecules to form lipoprotein droplets. These pass into blood stream via thoracic lymphatic duct.

The lipoproteins are then hydrolyzed by blood plasma enzyme and enter body cells. Here they may be used in respiration or stored as fat in the liver or in the muscle present under the skin.

Intestinal Gas:

Many humans develop intestinal gas and diarrhea from consuming milk product because they lack the enzyme (lactase) for digesting lactose in milk.

Formation of New Epithelial Cells of Villi:

The epithelial cells of villi constantly shed into the intestine. These cells are replaced by New cells moving p due to rapid cell division in crypts (underlying cells).

The intestinal contents are pushed along the alimentary canal by normal peristaltic activity.

Leocolic Shincter:

At the end of ileum, there is an ilcocolic sphincter. It opens and closes time to time to allow a small amount of residue from the ileum to enter the large intestine.

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LARGE INTESTINE

Introduction:

At the end of ileum there is an ilcocolic sphincter. It opens and close time to time to allow a small amount of residue from the ileum to enter the large intestine.

The large intestine is compound of a caecum, colon and rectum.

(i) Caecum:

It is a blind sac that projects from the large intestine between ileum and colon.

Appendix: from the blind end of the caecum there arises a finger like process called appendix. Sometimes the appendix is inflamed due to entrapping and then purification (decomposition of fluid causing appendicitis in severe cases it is removed surgically.

(ii) Colon:

It has three parts which are ascending transverse and descending colon,

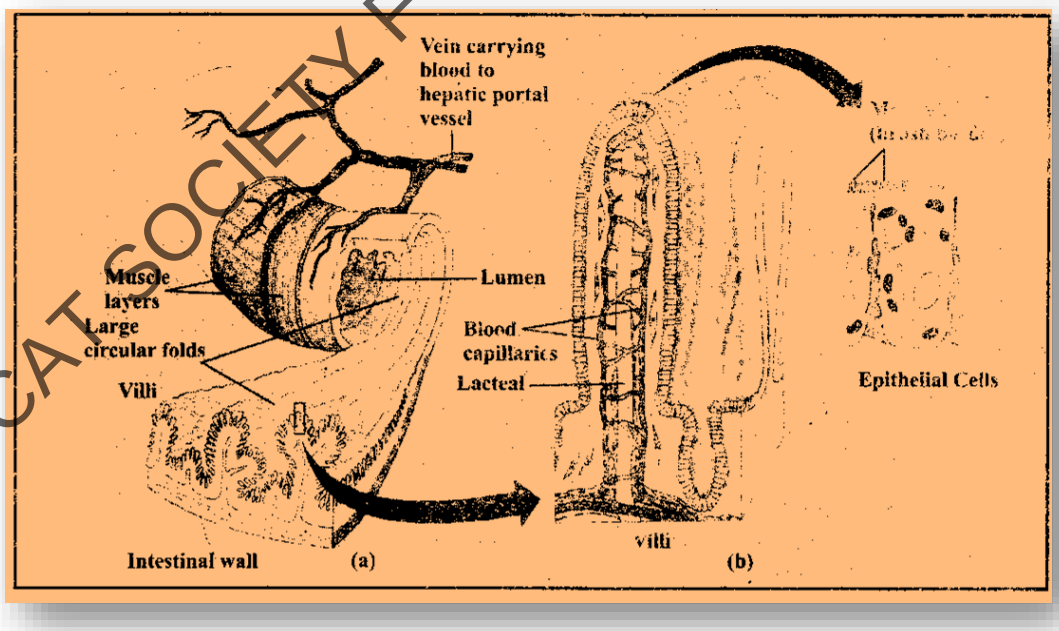

Fig. Part of wall of small intestine showing glands and vilii
(b) Detail of villus structure.

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FUNCTIONS OF COLON

Following are the functions of colon:

1. Absorption of Water and Salts:

The material that passes from the small intestine to the large intestine contains a large amount of water, dissolved salts and undigested material. Water and salts are absorbed into blood, while undigested material is rejected as feces. If the absorption of water and salts does take place due to infection, drug action, physical irritation or emotional disturbance, a condition known as diarrhea occurs. If this condition is not controlled then dehydration develops that may prove to be fatal.

Another extreme condition is constipation which is caused by the excessive absorption of water by the colon.

2. Role of Bacteria:

Large intestine also has many useful bacteria that synthesize some vitamins especially vitamin K. which are absorbed in blood.

3. Rectum:

Rectum is the last part o large intestine. Here feces are temporarily stored and rejected through anus at intervals.

Anus:

Anus is surrounded by two sphincters. The internal is of smooth and external of stripped muscles.

Defecation Reflex:

Under normal conditions, when the rectum is filled up with feces, it gives rise to defecation reflex. This reflex can he consciously inhibited in individuals but not in infants. Gradually the child learns to bring this reflex under control.

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Feces:

The feces contain a large number of bacteria, plant fibers, sloughed off mucosal cells, mucous, cholesterol, bile pigments and water.

TABLE: Functions of the Digestive Organs

ORGAN	FUNCTION	SECRETION
Oral cavity		
Teeth	Mastication (cutting and grinding of food); communication.	None
Lips and Cheeks	Manipulation of food; hold food in position between the teeth; communication.	Saliva from buccal glands (mucus only)
Tongue	Manipulation of food; holds food in position between the teeth; cleansing teeth; taste.	Some mucus; small amount of serous fluid
Salivary Glands		
Parotid gland	Secretion of saliva through ducts to superior and posterior portions of oral cavity	Saliva with amylase.
Submandibular glands	Secretion of saliva in floor of oral cavity	Saliva, with amylase: mucus.
Sublingual glands	Secretion of saliva in floor of oral cavity	Saliva mucus only Some mucus
Pharynx	Swallowing	
Esophagus	Movement of food by peristalsis from pharynx to stomach.	Mucus
Stomach	Mechanical mixing of food; enzymatic digestion; storage; absorption.	
Mucous cells	Protection of stomach wall by mucus production.	Mucus
Parietal cells	Decrease in stomach pH	Hydrochloric acid
Zymogen cells	Protein digestion	Pepsinogen
Endocrine cells	Regulation of secretion and motility	Gastrin
Accessory Glands Liver Gall Bladder	Secretion of bile into duodenum Bile storage; absorbs water and electrolytes to concentrate bile.	Bile No secretion of its own, stores and concentration bile.

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Pancreas	Secretion of several digestive enzymes and bicarbonate ions into duodenum.	Trypsin, chymotrypsin, pancreas, amylase, pancreatic lipase, bicarbonate ions
Small Intestine		
Duodenal glands	Protection	Mucus
Goblet cells	Protection	Mucus
Absorptive cells	Secretion of digestive enzymes and absorption of digested materials.	Enterokinase, amylase, peptidases, sucrose, maltase, lactase, lipase
Endocrine cells	Regulation of secretion and motility.	gastrin, secretin
Large Intestine		
Goblet cells	Absorption, storage and food movement. Protection	Mucus

SOME COMMON DISEASES RELATED TO THE NUTRITION

1. Dyspepsia:

Incomplete or imperfect digestion is called dyspepsia. This is not a disease in itself but symptomatic of other diseases.

(i) **Causes:** Dyspepsia may occur due to excessive acidity in stomach or faulty function of stomach and intestine or insufficient quality or quantity of bile secretions.

(ii) **Symptoms:** Abdominal discomfort, flatulence, heartburn, nausea and vomiting. These symptoms may occur irregularity and indifferent pattern from time to time.

2. Food Poisoning:

It is an illness from indigestion of food containing toxic substances.

(i) **Causes:** A common cause of food poisoning is the toxins production by bacteria, Salmonella and Campylobacter. These bacteria live in the intestines of cattle, chicken and duck without causing disease symptoms. Human may develop food poisoning if they drink milk, eat meat or eggs which are contaminated with these bacteria.

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(ii) **Symptoms:** Diarrhea, vomiting and abdominal pain. They occur from 12 – 24 hours after eating contaminated food, Infection can also occur, if unpasteurized milk is drunk or if meat is not properly cooked.

The liquid that run away during defrosting frozen meat contain Salmonella bacteria
Therefore, when the meat is defrosting the dishes and utensils must not be allowed to come in contact with any other food.

3. Botulism:

It is severe form of food poisoning.

(i) **Cause:** This is caused by toxins produced in bacteria known as Clos tridiumbotulinum.

Botulism develops by the use of improperly canned or otherwise preserved foods especially meat. The toxin produced by these bacteria is very powerful and affects central nervous system (CNS). The result is cardiac and respiratory paralysis.

(ii) **Symptoms:** The early symptoms of these diseases are fatigue, dizziness, double vision, headache, nausea, vomiting, diarrhea and abdominal pain.

4. Obesity:

This term is used when a person has abnormal amount of fat on the body.

(i) **Causes:** If one eats too much food than the body requirement, the surplus is stored as fat. Therefore, he becomes overweight or obese.

(ii) **Adipose Tissue:** The fat is stored in adipose tissue in the abdomen around the kidneys and under the skin. Certain cells accumulate drops of fat in their cytoplasm. As these drops increase in size and number, they form one large globule of fat in the middle of the cell. The cytoplasm is pushed into thin layer and the nucleus one side. Groups of fat cells form adipose tissue.

(iii) **Effect of Hormones and Inheritance:** Some people never become fat no matter how much they eat. Others become fat when they just exceed their need. This is probably due lo inheritance and balance of hormones.

(iv) **Problems of Obesity:** More chances of high blood pressure, heart disease, diabetes mellitus, stomach disorder than a person who has normal body weight.

(v) **Piles:** Piles or hemorrhoids are masses of dilated, tortuous veins in the anorectal mucosa.

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(vi) **Symptoms:** These masses may sometimes start bleeding during bowl movement. It becomes sever during constipation. The urge to defecate is depressed and it becomes difficult to expel the feces. Some other symptoms of ill health also appear because of the physical swelling of the rectum.

(vii) **Treatment:** The only therapy required is the improvement of the hygiene and the use of food softeners such as roughage in food or laxatives. The patients are advised not to sit on hard seats, depending on severity of the symptoms. Sometimes the hemorrhoids have to be removed surgically.

5. Ulcer:

The inner wall of digestive tract is normally covered with mucous, which protects it from enzymes. When the mucous layer breaks down the digestive enzymes begin to eat away the wall of stomach or duodenum. This results in a sore called ulcer.

(i) **Symptoms:** Sometimes an ulcer is very severe and a hole develops in the wall of the digestive tract. The contents of the tract leak into the abdominal cavity. For this severe infection, immediate medical care is required. Otherwise it may prove to be fatal.

(ii) **Causes:** Excess gastric acid secretion is an important factor of peptic ulcer. Smoking, spicy food, alcoholic beverages, coffee, tea and stress should be avoided by the patients suffering from ulcer.

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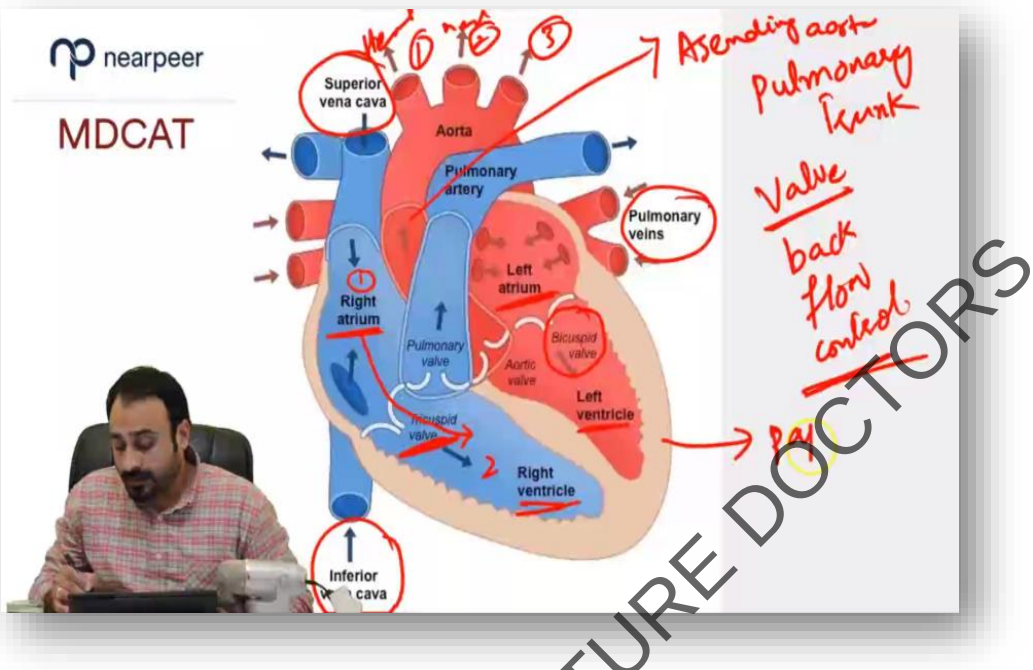

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ADDITIONAL / RELATED READINGS

1. Nutrient is the requirement (food or any substance) of Metabolism.

2. The sum total of all processes in which elements are taken in and utilized by which growth, repair and maintenance of activities are completed is Nutrition.

NAME OF ELEMENT	PRESENT IN
Nitrogen	Amino acids, proteins, nucleic acids
Phosphorus	ATP, nucleic acid and many other compounds
Magnesium	Chlorophyll
Iron	Cytochromes

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3.

SOIL DEFICIENCY OF	SYMPTOMS IN PLANTS
Nitrogen	Stunted growth and strong chlorosis (lack of chlorophyll) especially in older leaves.
Phosphorus	Stunted growth of roots
Potassium	Leaf margins yellow and brown in colour and premature death of the plant
Magnesium	Chlorosis

4. Puccinui is a parasitic fungus that destroys the wheat plant.

Note: All insectivorous plants are true autotrophs. When they capture prey, their growth becomes rapid.

5. Dodder (Cuscuta) is a leafless plant that lives as twining parasite and absorbs food by haustoria.

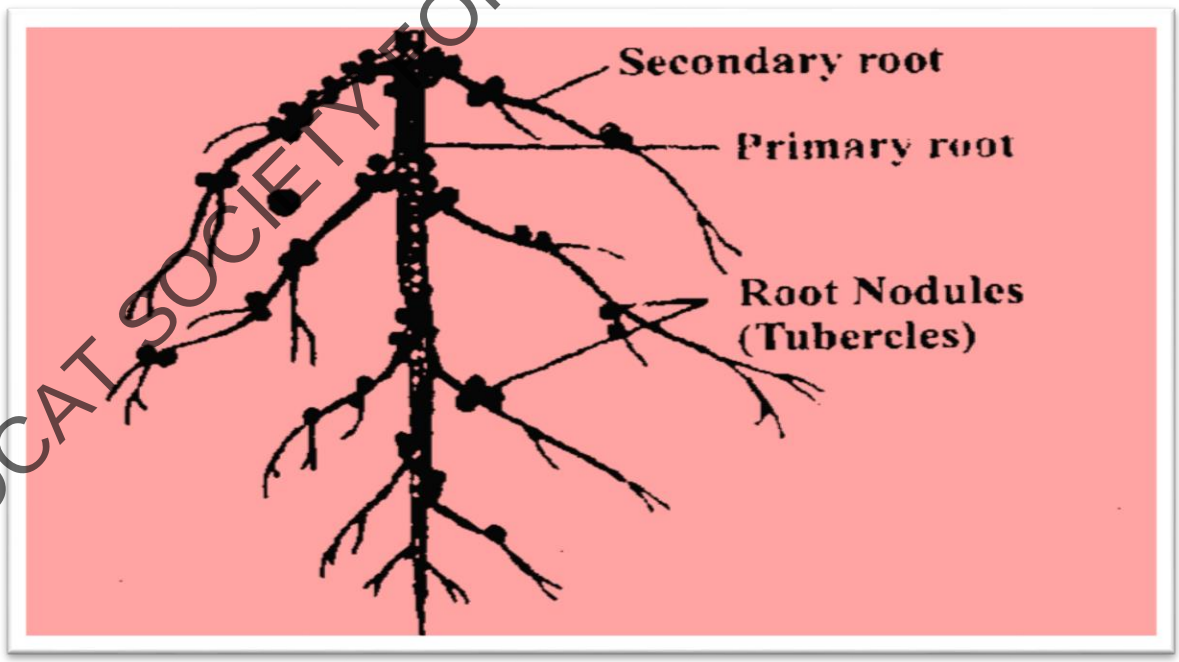

Fig. Undiluted root of a legume

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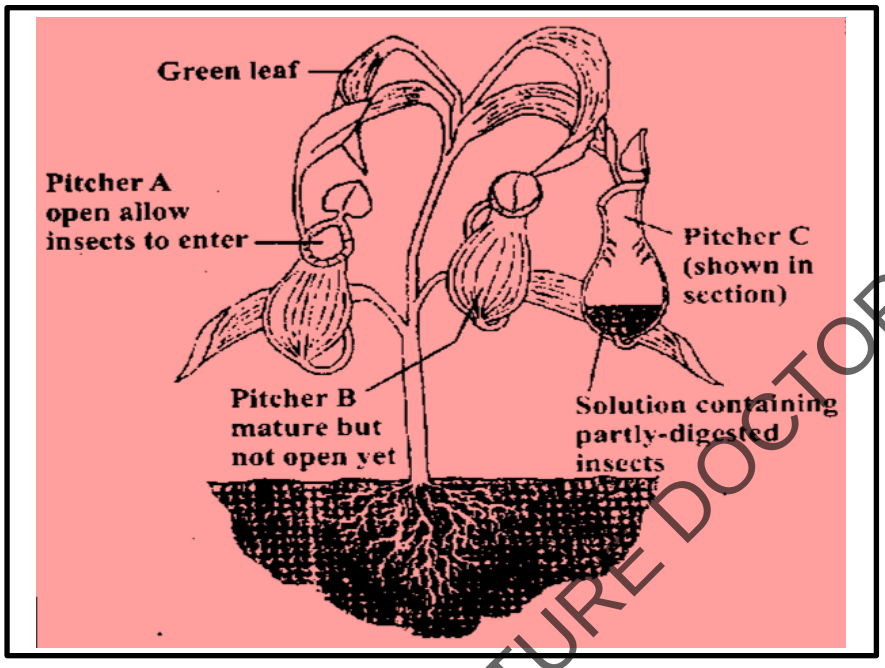

6. The animals which feed on detritus are called detritivores.

7. Two important groups of herbivorous mammals are rodents and ungulates.

8. There are no upper incisors in grazing and browsing herbivores.

9. A predator is an animal which captures and kills live animal for is food. The animal which is eaten by the predator is the prey.

10. Seizing and swallowing type of macrophagous feeding is found in the spotted dogfish (a member of Shark).

11. Flea and lice are ectoparasites that live in the fur or feathers of mammals and birds and suck blood from their skin.

12. Ticks and mites are common ectoparasites in non-human mammals.

13. Large molecules cannot pass the membrane. When they are digested into units then they can cross the membrane.

14. Assimilation utilization of the products of digestion for production of energy or synthesis of cellular materials.

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15. The first phase of digestion in Amoeba is the killing and softening of food. It takes place in the acidic medium (pH 5.6). Later the food vacuole becomes alkaline (pH 7.3). The digestion is completed in the alkaline medium.

16. In Hydra each nematocystconsists of a hollow thread coiled within a capsule and a tiny hair like trigger projecting outside.

17. In cockroach the MIDEGUT is a short narrow tube called stomach.

18. Gizzadr is the Crushing Lone in Foregut of Cockroach.

19. In human, digestion of carbohydrate starts in mouth: digestion of Proteins starts in stomach while the digestion of Lipids starts in first part of small intestine. All digestions completed in jejunum.

20. Epiglottia is a flap of cartilage.

    Note: The pharynx, or is the passageway leading from the mouth and nose to the esophagus and larynx.

21. Peristalsis s throughout alimentary canal.

22. Small intestine has small diameter while large intestine has large diameter.

23. Length of small intestine about 6.5 meters, Length of large intestine about 1.5 meters.

24. Vitamin K is required for synthesis of several blood clotting factors.

25. At the junction of esophagus and the stomach there is a special ring of muscles called cardiac sphincter.

26. Bolus: A moistened lump created by chewing food.

27. Carnivorous plant: A plant such as the Venus's flytrap or the sundew that traps and digests insects as a source of nitrogen.

28. Cecum a blind ended pouch that extends from the intestine and holds food for an extended period of time to enhance the digestion and absorption of nutrients.

29. Chyme: The semifluid watery solution of partially digested food material produced by the neutralization (by bile and pancreatic juices) of chyme.

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30. Chyme: The semifluid mass of food material produced b> the action of digestive juices in the stomach, the material that passes from the stomach to the small intestine.

31. Detritivore: An organism that obtains food energy by consuming disintegrated organs mater.

32. Extracellular digestion: Digestion carried out by enzymes secreted outside of cells as in the organism's gut cavity.

33. Fat soluble vitamin: A vitamin such as A, D, E or K that is transported in the blood and a complex linked to lipids or proteins.

34. Filter feeder: An invertebrate organism that feeds by staining microscopic organisms from water pumped through its hollow body. Some insects, birds, and mammals also have structures to filter food particles.

35. Gastrin: A digestive hormone (also a neuropeptide) secreted in the stomach that causes the secretion of other digestive juices.

36. Ingestion: The taking into the body of food pieces for digestion.

37. Omnivore: An animal that consumes both plant and the animal matter.

38. Symbiosis: An arrangement in which organisms of different species live together in intimate association, in such a way that either both get benefit from each other or one is benefited but the other is not harmed.

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QUESTIONS FOR PRACTISE

1. Secretion of oesophagus is:

(a) HCl (b) mucus

(c) enterokinase (d) GASTRIC juice

2. In lower multi-cellular animals (e.g. Hydra) the type of digestion found is:

(a) intracellular

(b) extracellular

(c) both intracellular and extracellular

(d) sometimes extracellular but mostly intracellular

3. Appendix is present at the junction of:

(a) duodenum and jejunum (b) jejunum and ileum

(c) ileum and caecum (d) caecum and colon

4. Basic purpose of chemical digestion is to convert large food molecule into:

(a) small molecules (b) diffusible molecules

(c) basic molecules (d) larger molecules

5. Anus is provided with two sphincters of:

(a) smooth muscles (b) striated muscles

(c) one smooth one striated (d) none of these

6. The molecule used by most animals for long term energy storage:

(a) glycogen (b) starch

(c) fats (d) cholesterol

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7. The enzymes in lysosomes responsible for intracellular digestion are:

(a) ligases (b) hydrolytic

(c) isomerases (d) kinases

8. Much of salts found in' the bile of man is:

(a) sodium bicarbonate (b) potassium bicarbonate

(c) sodium chloride (d) calcium carbonate

9. In planaria, digestion is:

(a) intracellular

(b) extracellular

(c) some intracellular mainly extracellular

(d) some extracellular but mainly intracellular

10. Secretin controls the secretions of:

(a) gastric glands (b) only exocrine glands of pancreas

(c) endocrine glands of pancreas (d) liver and exocrine glands of pancreases

11. In stomach HC1 is produced by:

(a) parietal cells or chief cells (b) parietal cells or oxyntic cell

(c) parietal cells or zymogene cells (d) only zymogene cells

12. Ptyalin becomes inactive in stomach due to:

(a) HC1 (b) rennin

(c) pepsin (d) mucin

13. One of the following differs from the other three:

(a) trypsin (b) pepsin

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(c) glucagon (d) ptyalin

14. Trypsin is secreted by:

(a) liver (b) pancreas

(c) intestine (d) spleen

15. Digestion in earthworm in it's:

(a) mouth (b) gastro vascular cavity

(c) digestive tract (d) coelom

16. The hormone responsible for the secretion of bile:

(a) secretin (b) gastrin

(c) glucagon (d) parathormone

17. A starving person first start consuming his:

(a) protein reserve (b) fat reserve

(c) glycogen reserve (d) vitamin reserves

18. Photoautotrophs include:

(a) all green plants (b) blue green algae

(c) green and purple sulphur bacteria (d) all of these

19. Digestion in digestive tract is:

(a) incomplete (b) some extracellular

(c) some intracellular (d) irreversible process

20. Which set of vitamins are fat soluble?

(a) A and C (b) D and C

(c) E and B 12 (d) A and D

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21. When Chyme is partial digested and Neutralized, it becomes:

(a) morsel (b) chyle

(c) bolus (d) undigested lubricated lump

22. Premature death of the plant is due to deficiency of:

(a) K (b) N

(c) Mg (d) N and Mg

23. The structure in the mouth that prevents food from entering the nasal cavities is the:

(a) pharynx (b) tongue

(c) soft palate (d) epiglottis

24. Enzyme present in the saliva is:

(a) lipase (b) trypsin

(c) ptyalin (d) diastase

25. Lipoproteins are subsequently hydrolyzed by:

(a) blood plasma (b) blood plasma protein

(c) blood plasma enzyme (d) blood cells

26. N and Mg is present in:

(a) DNA (b) protein

(c) chlorophyll (d) DNA + protein

27. Secretion, which lacks any enzyme is:

(a) saliva (b) pancreatic juice

(c) gastric juice (d) bile

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28. Blind ended pouch is:

(a) caecum (b) stomach

(c) esophagus (d) intestine

29. Excessive absorption of water in the large intestine leads to:

(a) constipation (b) vomiting

(c) food poisoning (d) diarrhea

30. Which one of the following provides ample supply of carbohydrates?

(a) grams (b) meat

(c) carrot (d) rice

31. Nitrogen is present in:

(a) carbohydrates (b) proteins

(c) fats (d) carbonates

32. Chlorophyll contains:

(a) sulphur (b) nitrogen

(c) magnesium (d) both N and Mg

33. Lock of chlorophyll results in:

(a) necrosis (b) chlorosis

(c) phosphorus (d) symbiosis

34. Release of nitrates by saprophytic bacteria helps in:

(a) carbon cycle (b) oxygen cycle

(c) nitrogen cycle (d) water cycle

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35. Feeding b living in or on other organisms is a:

(a) parasite (b) saprophyte

(c) only ectoparasite (d) only endoparasite

36. Canines are missing in:

(a) cats (b) sheep

(c) lions (d) Tigers

37. The animals having structurally and functionally intermediate teeth between herbivores and carnivores are:

(a) insectivores (b) detritivores

(c) saprozoic (d) omnivores

38. A common mussel has two large gills with:

(a) cilia (b) flagella

(c) pseudopodia (d) parapodia

39. The cells scattered among cilia produce sticky mucous with food particles are:

(a) excretor (b) secretary

(c) regulation (d) respirator

40. Which one is fluid feeder?

(a) bats (b) male mosquito

(c) female mosquito (d) female cat

41. The common ectoparasites in non-human mammals are:

(a) lice and kits (b) lice and mites

(c) mice and mites (d) ficks and mites

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42. An ectoparasite attacking both aquatic and terrestrial animals is:

(a) leech (b) dragon fly

(c) butterfly (d) louse

43. It facilitates diffusion of materials to the body cells in planaria:

(a) intestine (b) branched intestine

(c) enzyme (d) chime

44. The food is ground in the cockroach in:

(a) mandible (b) mesenteron

(c) gizzard (d) crop

45. The saclike digestive system is:

(a) more efficient than tube type (b) less efficient than tube type

(c) like tube type (d) of great disadvantageous

46. The digestive system of man consists of a long:

(a) coiled tube (b) spiral tube

(c) dilated tube (d) inflated tube

47. The squeezing of food down along the alimentary canal is by the contraction of:

(a) circular muscles (b) longitudinal muscles

(c) spiral and circular muscles (d) circular and longitudinal muscles

48. The human stomach is situated below:

(a) diaphragm (b) kidneys

(c) spine (d) intestine

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49. HCl adjusts pH of stomach ranging from:

(a) 4 – 5 (b) 2 – 3

(c) 3 – 5 (d) 2 – 4

50. Pepsinogen is activated to pepsin by:

(a) active secretin (b) HCl

(c) HCl and active pepsin (d) gastrin

51. Insectivorous plant lives in soils that are deficient in:

(a) water (b) oxygen

(c) nitrogen (d) iron

52. Earthworm is a common example of:

(a) herbivore (b) carnivore

(c) detritivore (d) omnivore

53. Which is incorrect for mycorrhiza?

(a) it is an association between the fungus and plant roots

(b) it is a symbiont

(c) it is parasite

(d) it is beneficial to both partners

54. Which statement is not related with an obligate parasite?

(a) it gets food from living host (b) it can't prepare its own food

(c) it cannot live without host (d) it never causes diseases in the host

55. What is not true for Planaria?

(a) it has tube-like digestive system (b) it is triploblastic

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(c) it is free-living flatworm (d) it has three-branched intestine

56. Which is the correct order?

(a) buccal cavity, oesophagus, stomach, small intestine

(b) buccal cavity, stomach. oesophagus, small intestine

(c) small intestine, stomach, oesophagus, buccal cavity

(d) oesophagus. buccal cavity, stomach, small intestine

57. Many persons become ill from consuming milk or milk products because they:

(a) possesses bacteria in their intestine (b) possess worms in their intestine

(c) lack an enzyme (d) produce excessive hydrochloric acid

58. The cockroach stores its food in the:

(a) mouth cavity (b) crop

(c) gizzard (d) mesenteron

59. Heartburn is due to:

(a) back flush of acidic chyme into the oesophagus

(b) hydrochloric acid in the gastric juice

(c) over secretion of pancreatic juice

(d) absence of pepsin in the gastric juice

60. Gallstones are produce in the gall bladder due to precipitation of:

(a) milk (b) glucose

(c) cholesterol (d) glycerol

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UNIT NO. 5 (HUMAN PHYSIOLOGY)

1	**B**	2	**C**	3	**D**	4	**B**	5	**C**	6	C	**7**	**B**	**8**	**A**	**9**	**D**	**10**	**D**
11	B	**12.**	A	**13**	C	**14**	B	**15**	C	**16**	**A**	17	C	18	D	19	D	20	D
21	B	**22**	A	**23**	C	**24**	C	**25**	C	**26**	**C**	27	D	28	A	29	A	30	D
31	B	**32**	D	**33**	B	**34.**	C	**35**	A	**36**	**C**	37	D	38	A	39	B	40	C
41	D	**42**	A	**43**	B	**44**	C	**45**	B	**46**	**A**	47	D	48	A	49	B	50	C
51	C	**52**	C	**53**	C	**54**	D	**55**	A	**56.**	**A**	57	C	58	B	59	A	60	C

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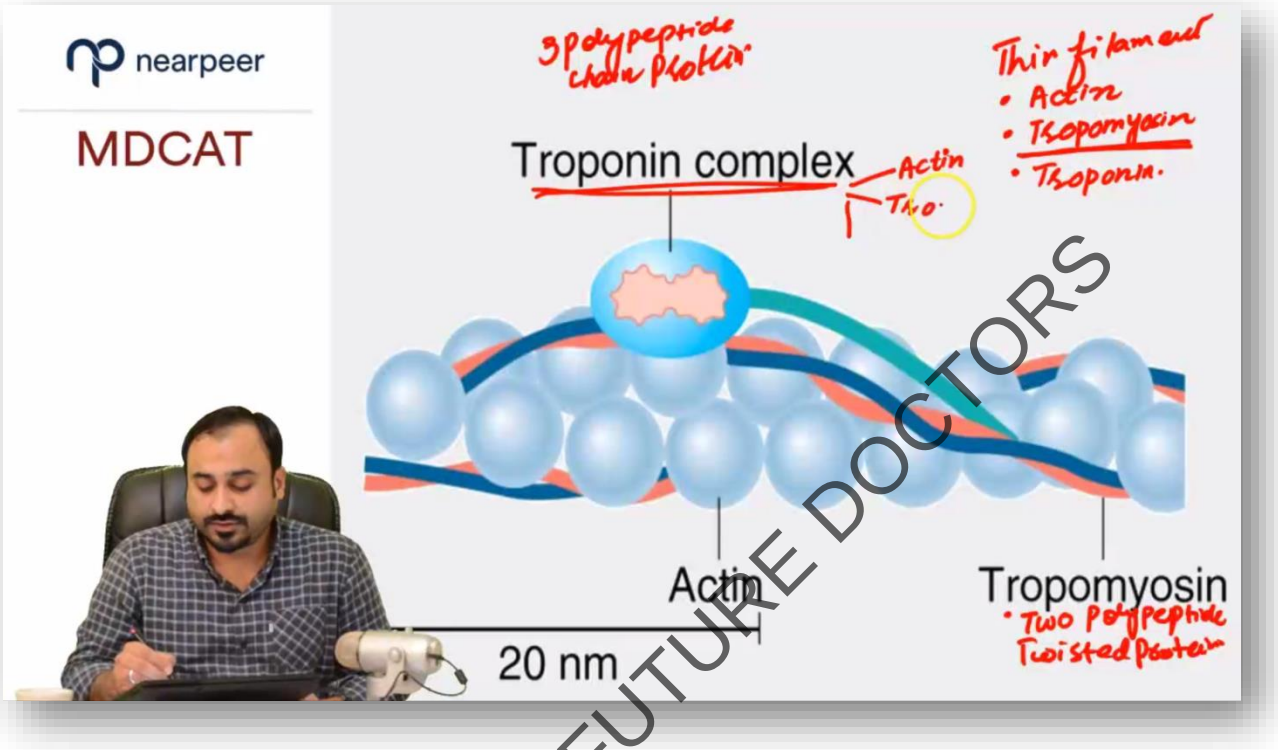

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GAS EXCHANGE

Respiration occurs at two levels:

1. Organismic Level
2. Cellular Level

1. Organismic Respiration:

It is also known as breathing or ventilation. Breathing is the process in which fresh air containing more oxygen is pumped into the lungs and the air with more CO_2 is pumped out of the lungs.

2. Cellular Respiration:

Cellular respiration is the process by which cell utilizes oxygen produces carbon dioxide extracts and conserve the energy from food molecules in biologically useful from such as ATP.

The cellular respiration is directly involved in the production of energy. All living activities are performed by this energy.

Respiration in Man:

In man respiratory system includes lungs and air passages which carry fresh air to the respiratory sites.

AIR PASSAGE WAYS:

Air passage ways consist of nostrils, nasal cavities, pharynx, larynx, trachea, bronchi, bronchioles and alveolar ducts which lead into the alveolar sac.

1. Nasal Cavities:

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Nasal cavities are lined by mucous membrane of the ciliated epithelium. Each nasal cavity is subdivided into three passage ways by the projection of bones from the walls of the internal nose.

Functions of the Nasal Cavities:

(i) Filtration:

When the air enters the nasal cavity through nostril, the larger dust particles are trapped by the hair and mucus in the nostrils.

(ii) Moistening:

When the air passes through the nasal cavity, it becomes moist.

(iii) Temperature Regulation:

While passing through the nasal cavities, the temperature is regulated and becomes closer to the body temperature. In the above functions, mucous membrane is actively involved.

2. Pharynx:

The nasal cavity leads into the throat or pharynx by two internal openings. Pharynx is a muscular passage lined with mucous membrane.

3. Larynx:

The air enters from the pharynx into the larynx. The larynx or voice box is a complex cartilaginous structure surrounding the upper end of the trachea. The opening of larynx is called glottis. It is also lined by mucous membrane.

(i) Epiglottis:

It is a lid which automatically covers the opening of the larynx during swallowing. Therefore food or liquids cannot enter into the larynx. The properties of epiglottis are as follows:

- Epiglottis is a cartilaginous structure
- It is muscularly controlled

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- It has a hinge like action

(ii) Vocal Cords:

In the glottis, the mucous membrane is stretched across into two thin edged fibrous bands called vocal cords. These help in voice production, when vibrated by air.

4. Trachea and Bronchi:

The trachea or wind pipe is a tubular structure. It is ventral to the oesophagus and extends to the chest cavity or thorax where it is divided into right and left branches. In the wall of trachea there are a series of' C shaped cartilage rings. These prevent the trachea from collapsing and keep the passage of air open. Bronchi have the same cartilage rings as the trachea. However the rings are progressively replaced by irregularly placed cartilage plates.

5. Bronchioles:

Each bronchus on entering the lung divides and subdivides progressively into smaller and smaller bronchi. When the smaller bronchi attain a diameter of one mm or less, then they are called bronchioles. The bronchioles totally lack cartilages. Bronchioles are made up of mainly circular smooth muscles.

6. Air Sacs:

The bronchioles continue to divide and subdivide deep into the lungs and finally open into a large number of air-sacs. Air-sac is the functional unit of the lungs. Each air-sac consists of several microscopic single layered structures called alveoli. Overlying the alveoli, there is a rich network of blood capillaries. It is an excellent site for the exchange of gases.

7. Lungs:

The lungs are closed sacs that are connected to the outside by the way of the trachea end the nostrils or mouth.

Note: The human gas exchanging organ, the lung, is located in the thorax, where it's delicate tissues are protected by the bony and muscular thoracic cage.

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Note: The trachea is a tube about 10 to 12 centimeters long and two centimeters wide.

Note: The larynx is an organ of dual function: as an air canal to the lungs and as the organ of phonation.

Note: On average, an adult human lungs as about 300,000,000 alveoli. They are polyhedral structures, with a diameter of about 250 to 300 micrometers.

- Lungs are spongy because of the presence of millions of alveoli.
- Lungs are placed in the chest cavity. Chest cavity is bounded by ribs and muscles on the sides.
- The floor of the chest is called diaphragm. Diaphragm is a sheet of skeletal muscles.
- Lungs are covered with double layered thin membranous sacs called pleura.

BREATHING AND ITS MECHANISM

Breathing is a process in which fresh air containing more oxygen is pumped into the lungs and air with more carbon dioxide is pumped out of the lungs. In other words breathing is a mechanical process consisting of two phases, Inspiration and expiration. During inspiration, fresh air moves in while during expiration the consumed air moves out of the lungs.

BREATHING RATE:

During rest, breathing occurs rhythmically at the frequency of 15 to 20 times per minute in humans. This is sufficient to remove CO_2 from the blood.

1. Inspiration:

During inspiration the space inside the chest cavity is increased by two was the muscles of ribs contract and elevate the ribs upwards and forwards. The muscles of the diaphragm also contract and diaphragm becomes less domelike.

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This downward movement of diaphragm and outward and upward movement of the ribs, causes increase in the chest cavity and reduces internal pressure.

When the pressure from the lungs is removed, they expand. With the expansion of the lungs vacuum is created inside the lungs. The air rushes into the lungs from the outside due to the higher atmospheric pressure. This is called inspiration.

2. Expiration:

During expiration the muscles of the ribs are relaxed and the ribs move downward and inward. In this way from the side of chest cavity the space becomes less. At the same time the muscles of diaphragm also relax, becoming more domes like chest cavity is also reduced from the floor as well. The chest cavity is reduced and a pre-exerted on the lungs. The air inside the lungs moves out. This is called expiration.

Respiratory Distress Syndrome:

It is common in premature infants especially in infants with a gestation age of less than 7 months. This occurs because enough surfactant is not produced to reduce the tendency of the lungs to collapse.

Surfactant is a mixture of lipoprotein molecules produced by the secretary cells of the alveolar epithelium. This mixture forms a layer over the surface of the fluid within the alveoli to reduce the surface tension.

Factors Causing Gaseous Exchange:

Following factors bring about gaseous exchange (Intake of oxygen and release of carbon dioxide) between blood and the alveolar air.

(i) Diffusion of oxygen in and carbon dioxide out occurs because of difference in p artial pressure of these gases.

(ii) The alveoli are surrounded by a network of capillaries. The blood is distributed in thin layers and therefore exposed to large alveolar surface.

(iii) Blood in the lungs is separated from the alveolar air by extremely thin membranes of the capillaries and alveoli.

Transport of Oxygen:

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In human beings the respiratory pigment is haemoglobin. It is contained in the red blood corpuscles (R.B.C.). Haemoglobin combines with oxygen to form bright red oxyhaemoglobin. At low oxygen concentration and less pressure, the reaction becomes reversible. Now oxyhaemoglobin (which is unstable) splits back to its normal purple-red coloured haemoglobin after giving out most of its oxygen. This reaction occurs with the help of an enzyme carbonicanhydrase present in R.B.C.

In this way haemoglobin acts as an efficient oxygen carrier.

A small proportion of oxygen also dissolved in blood plasma.

$$Hb + O_2 \xrightarrow{\text{Carbonic anhydrase}} HbO_2$$

Maximum Absorption Capacity:

Haemoglobin can absorb maximum oxygen at the sea level. The maximum amount of oxygen which normal human blood absorbs and carries at the sea-level is about 20 ml/100 ml of blood. This is the maximum capacity of haemoglobin for oxygen when it is fully oxygenated.

Under normal conditions blood of alveoli of the lungs, is not completely oxygenated. When an oxygen tension is 100 mm mercury then haemoglobin is 98 percent oxygenated. Therefore loo ml of blood contains 19.6 ml of oxygen. This means that haemoglobin can be almost completely oxygenated by an oxygenpressure of 100 mm mercury which is present in the lungs. Any higher oxygen pressure would have the same result.

What happens when O_2 pressure is below 60 mm of Hg?

In many cells and tissues, the oxygen pressure is below 60 mm of mercury. Now the reaction becomes reversible.

$HbO_2 \rightarrow Hb + O$

This results in the liberation of large quantities of oxygen from haemoglobin. In this way in the tissue where oxygen pressure is low oxyhaemoglobin dissociates rapidly.

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FACTORS AFFECTING THE CAPACITY OF HAEMOGLOBIN TO COMBINE WITH OXYGEN:

Three important factors affect the capacity of haemoglobin to combine with oxygen:

1. Carbon Dioxide:

When CO_2 pressure increases, the O_2 pressure decreases. As a result the capacity of haemoglobin to hold oxygen becomes less. In this way increased CO_2 pressure favours the greater liberation of oxygen from theblood to the tissue.

2. Temperature:

Rise in temperature also decreases the oxygen-carrying capacity of blood. For example when muscular activity is increased, 02 is released from the blood and is supplied to the muscles.

3. pH:

When the pH of the blood declines, the amount of oxygen bound to haemoglobin also declines. This occurs because decreased pH results from an increase in hydrogenions. The hydrogen ions combine with the protein part of the haemoglohin. As a result the ability of haemoglobin to bind oxygen is decreased. An increase in blood pH results in an increased ability of haemoglobin to bindoxygen.

TRANSPORT OF CARBON DIOXIDE

Carbon dioxide is more soluble than oxygen and dissolves freely in the tissue fluid surrounding the cells.

From the tissue fluid, dissolved carbon dioxide passes to the plasma with in the blood capillaries.

Carbon dioxide is transported in the blood in several different states.

1. As Carboxyhaemoglobin:

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Some of the CO_2 (about 20%) is carried as carboxyhaemoglobin. Carboxyhaernoglohin is formed when carbon dioxide combines with amino group of haemoglobin.

2. In Combination with Plasma Proteins:

The plasma proteins also carry about 5% carbon dioxide from the body fluids to the capillaries of lungs.

3. In Combination with Potassium:

Small amount of carbon dioxide is also carried by corpuscles combined with potassium.

4. As Bicarbonate:

About 70% carbon dioxide is carried as bicarbonate ion combined with sodium in the plasma. As carbon dioxide from tissue fluid enters in the capillaries, it combines to form carbonic acid.

$$CO_2 + H_2O \rightarrow H_2CO_3$$

The carbonic acid splits quickly and ionizes to produce hydrogen ions and bicarbonateions.

$$H_2CO_3 \rightarrow H^+ + HCO_3^-$$

When blood leaves the capillaries most of the carbon dioxide is in the form of bicarbonate ions.

All these reactions are reversible.

In the lungs bicarbonate ions combine with hydrogen ions to form carbonic acid whichsplits into water and carbon dioxide.

The carbon dioxide diffuses out from the capillaries of the lungs into the space ofalveolar sac.

$$HCO_3^- + H^+ \rightarrow H_2CO_3\ CO_2 + H_2O$$

Carbon Dioxide Concentration in Arterial and Venous Blood:

The arterial blood contains about 50 ml of carbon dioxide per 100 ml of blood. The venous blood has 54 ml of carbon dioxide per 100 ml of blood. Each 100 ml of blood takes

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up 4 ml of CO_2 as it passes through the tissues and gives off 4 ml of CO_2 per 100 ml of blood as it passes through the lungs.

CO_2 as a Ventilation (Breathing) Regulator:

Carbon dioxide is much more important than oxygen as a regulator of normal alveolar Breathing. However under certain conditions a reduced PO_2 (partial pressure of O_2) in the arterial blood plays an important stimulatory role especially during conditions of shock.

IMPORTANT POINTS TO REMEMBER

1. Respiratory distress syndrome occurs because enough surfactant is not produced to reduce the tendency of the lungs to collapse. It is common in premature infants especially in infants with a gestation age of less than 7 months.
2. Alveolar Breathing is regulated by CO_2 and O_2.
3. Normally, at rest we inhale and exhale 15 – 20 times per minutes. During exercise the breathing rate may rise to 30 times per minute.

TABLE: Changes in the composition of the breathed air

	INHALED EXHALED %	SECRETION
Oxygen	21	16
Carbon dioxide	0.04	4
Water vapours	Variable	Saturated
Nitrogen	79	79

4. Lung cancer is one of the most serious diseases of respiratory system. 90% of lung cancer is caused by smoking.
5. More than ten compounds of tar of tobacco smoke are involved to cause cancer.

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6. Cancer or carcinoma is basically malignant tumor of potentially unlimited growth. It expands locally by invasion and systemically by metastasis.

7. Tuberculosis is the general name of a group of diseases caused by Mycobacterium tuberculosis.

8. Asthma is an allergic reaction to pollen, spores, cold, humidity, pollution etc. This allergic reaction causes sudden contraction of small bronchioles.

9. Emphysema is a breakdown of alveoli due to “smoker’s cough”.

10. Haemogiobin is the most important protein present in many animals including man.

11. Haemoglobin in man increases the oxygen carrying capacity of the blood to about 75 times.

12. Myoglobin is haemoglobin like iron containing protein pigment present in the muscle fibers.

13. Myoglobin is also known as muscle haemoglobin. It is an intermediate compound for the transfer of oxygen from haemoglobin to aerobic metabolic processes of the muscle cells. Myoglobin can also store some oxygen.

14. Myoglobin consists of one polypeptide chain associated with an iron containing ring structure which can bind with the molecule of oxygen. The affinity of myoglobin to combine with oxygen is much higher as compared to haemoglobin.

15. Aquatic mammals especially the Cetaceans can stay in the depth of the ocean for about two hours without coming up for air. Diving mammals have almost twice the volume of the blood in relation to their body weight as compared to the non-divers. Most of the diving mammals have high concentration of myoglobin in their muscles. Myoglobinbinds extra oxygen.

16. When a mammal dives to its limit, the diving reflex is activated. Now the breathing stops, rate of heart beat slows down to $1/10^{th}$ of the normal, most of the blood goes to the brain and heart which can least withstand anoxia, Muscles shift from aerobic to an aerobic respiration.

17. In an adult human being when the lungs are fully inflated, the total inside capacity of the lungs is about 5 liters.

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18. Normally when we are at rest or asleep, the exchange is only about half a liter. The volume of air taken inside the lungs and expelled during exercise is about 3.5 liters. It means, there is a residual volume of 1.5 liters even during exercise which cannot be expelled.

ADDITIONAL/ RELATED READINGS

1. Respiration is the most important metabolic activity of all living organisms.
2. Respiration occurs at two levels:
   (i) Organismic level
   (ii) Cellular level.
3. Organismic respiration is also known as breathing or ventilation.
4. Cellular respiration is the process by which cell utilizes oxygen, produces carbon dioxide, extracts and conserve the energy from food molecules in biologically useful form such as ATP.
5. Respiratory gases are exchanged between body fluid and outside medium. The outside medium may be water or air.
6. Exchange of gases occurs only by diffusion.
7. Air is better respiratory medium than water. In the equal volumes of air and water, oxygen is higher in the air. A liter of air has about 200 ml oxygen while one liter water cannot contain even 10 ml oxygen.
8. Oxygen diffuses about 8000 times more quickly in air than in water. Water is 8000 times denser than air.
9. Water is 50 times more viscous than the air.
10. The transport system of plants (xylem and phloem) is not involved in the transport of gases. This is because that in plants there is no special organ or system for gaseous exchange.

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11. Land plants get their oxygen from air through stomata. Therefore stomata are the main source of exchange of gases in plants. Stomata are largely present in the leaves and in young stem.

12. There are about 12000 stomata per square centimeter of leaf surface in Tobacco plant.

13. The stomata lead to the intercellular spaces between mesophyll cells.

14. The air spaces in the leaf are similar to honey comb. The air spaces cover up to 40% of the total volume of the leaf.

15. In the older stems, cork tissue is present which is formed of dead cells. The cork tissue has special pores called lenticels which are involved in gaseous exchange.

16. The roots of the land plants get their oxygen from the air present in the spaces between the soil particles.

17. Respiratory activity which occurs in plants during daytime is called photorespiration.

    OR

    The pathway in which RuBP is converted into serine is called photorespiration.

18. Photorespiration starts in hot dry weather when temperature above 40° C. Now ABA is released and stomata close. But light reaction will continue. As a result the level of oxygen inside the leaf rises while the level of carbon dioxide falls due to its consumption. Now photorespiration starts.

19. The process of photorespiration uses ATP and NADPH produced in the light reactions just like Calvin-Benson cycle. However photorespiration is reverse of the Calvin cycle. In this process carbon dioxide is released and oxygen is absorbed. This oxygen is produced in the light reactions.

20. Three main reactions in the photorespiration:

    (i) $RuBP + O_2 \rightarrow$ Glycolate (in the Chloroplast)

    (ii) Glycolate → Glycine (in the Peroxisomes)

    (iii) 2 glycine → Serine + CO_2 (in the Mitochondria)

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21. The rubisco is carboxylase as well as oxygenase. When the rubisco acts as carboxylase it adds carbon dioxide to RuBP, which is an accepter molecule. On the other hand when rubisco is oxygenase it adds oxygen to RuBP. Both these reactions compete with each other.

22. The photorespiration reduces the photosynthetic process. In most plants, by photorespiration, the carbohydrate production is reduced up to 25%.

23. The distance across which diffusion of gases has to take place should be little. In most animals the epithelium which separates air and blood is only two cells thick.

    Therefore the distance for diffusion is very short.

24. Blood in the lungs is separated from the alveolar air by extremely thin membranes of the capillaries and alveoli.

25. Organismic respiration/breathing/Ventilation maintains a steep diffusion gradient.

26. Hydra has no specialized organs for respiration. Exchange of gases (intake of 02 and removal of CO_2)occurs through the entire surface of the body by diffusion.

27. Earthworm has no specialized organs for respiration. The exchange of gases occurs mainly through the skin.

28. The respiratory system of the cockroach consists of branching systems of air tubules called tracheae lined by chitin.

29. In the cockroach the main tracheal trunk communicates with exterior by 10 pairs of apertures called spiracles. These are present on the lateral sides of the body. Two pairs are in the thorax while eight pairs in the first eight abdominal segments.

30. In the cockroach Air is pumped in and out of the tracheae by the expansion and contraction of the abdominal muscles (Dorsoventral muscles). When abdomen expands the first four pairs of spiracles open, the air rushes in through these spiracles into the tracheoles. When the abdomen contracts, the anterior four pairs of spiracles close and posterior six pairs of spiracles open. The air is forced out of the body through these spiracles.

31. Fish respires through the gills Gills are paired structures present on the either side of the body almost at the junction of head and trunk. There are four to five pairs of gills which

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may be visible on the surface of the pharynx (in the cartilaginous fishes) or placed in the branchial cavities (in bony fishes).

32. In frog, the gaseous exchange occurs through the lungs, by skin and the buccal chamber. The gaseous exchange through the skin is known as cutaneous respiration. Gaseous exchange through the lungs is called pulmonary respiration.

33. Respiratory system in birds is the most efficient and complicated. The birds are very active animals with high metabolic rate. Therefore they need large amount of oxygen.

34. In birds there is one way flow of the air through the lungs and the air is renewed after inspiration.

35. The lungs of birds have parabronchi instead of alveoli. These are tiny thin walled ducts. These parabronchi are opened at both ends and the air is constantly ventilated. The walls of the parabronchi are chief sites of gaseous exchange. The direction of the blood flow in the lungs is opposes to the air flow through the parabronchi. This counter current exchange increases the amount of oxygen which enters the blood.

36. In birds the lungs have also developed several extensions known as air sacs. These reach into all parts of the body and even penetrate some of the bones. In most birds the air sacs are nine in number. The air sacs send air into the parabronchi.

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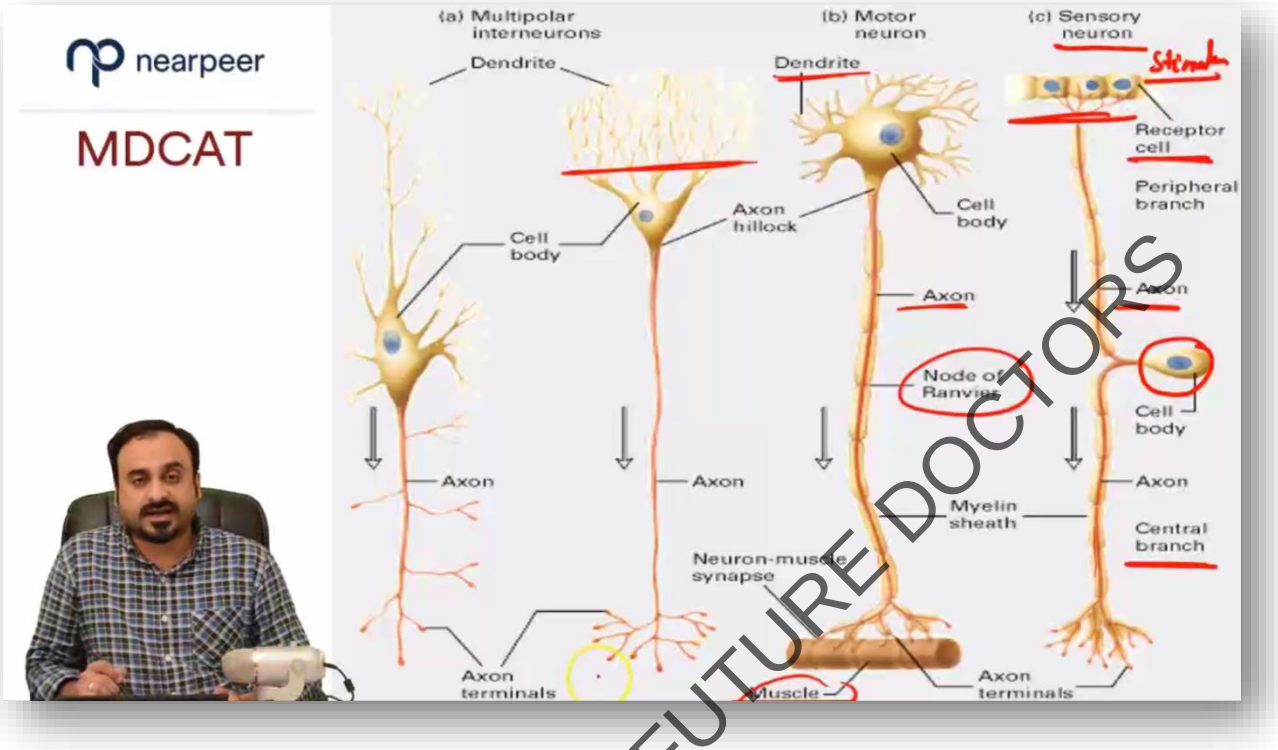

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QUESTIONS FOR PRACTISE

1. Photo respiration is a process which is reverse of:

(a) photosynthesis (b) respiration

(c) Calvin cycle (d)light reaction

2. In birds gases exchange occurs at:

(a) alveoli (b) parabronchi

(c) air sacs (d) lungs

3. Maximum O_2 carrying capacity of the blood in the body is.

(a) 19.6 ml /100 ml of blood (b) 1.96 ml / 100 ml of blood

(c) 20 ml /100 ml of blood (d) 2.0 ml / 100 ml of blood

4. The amount of CO_2 in exhaled air is during exercise as compare to rest.

(a) same (b) more

(c) less (d) variable

5. Oxyhaemoglobin and oxymyoglobin are placed at PO_2 100 mm of Hg, which will lose O_2 first:

(a) oxyhaernoglobin (c) both simultaneously

(b) oxymyoglobin (d) it depends upon environmental factors

6. The gas exchange surfaces of larger aquatic animals are:

(a) trachea (b) gills

(c) book lungs (d) malpighian tubules

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7. How many atoms of O_2 can associate with a molecule of Myoglobin in man?

(a) 2 (b) 4

(c) 8 (d) 16

8. Inhalation and exhalation in Grasshopper is brought about by:

(a) chest and abdomen (b) only chest

(c) only abdomen (d) tracheoles

9. In man, wind pipe is present on _____ side of esophagus.

(a) dorsal (b) ventral

(c) anterior (d) posterior

10. Breathing rate in mammals is controlled by:

(a) lungs (b) chest and lungs

(c) medulla oblongata (d) chest and diaphragm

11. The exchange of O_2 and CO_2 through cell membrane occurs by:

(a) diffusion (b) osmosis

(c) active transport (d) facilitated diffusion

12. Oxyhaemoglobin dissociates into haemoglobin due to _____ in tissues.

(a) low CO_2 tension (b) low O_2 tension

(c) low O_2 and high CO_2 tension (d) high CO_2 tension

13. CO_2 is carried as bicarbonate ion in:

(a) plasma (b) RBCs

(c) lymph (d)WBCs

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14. The rate of metabolism per unit volume is:

(a) higher in small organism

(b) higher in large organism

(c) is same in all kinds of organism

(d) sometimes higher in small organisms a sometimes higher in larger organisms

15. Which one is the feature of respiratory surface?

(a) large (b) thin and moist

(c) well ventilated (d) all of these

16. During inspiration:

(a) diaphragm contracts

(b) chest muscles contracts

(c) both contract

(d) diaphragm contracts and chest muscles relax

17. Respiration in animals takes place in:

(a) lungs cells (b) kidneys cells

(c) liver cells (d) all kinds of cells

18. Breathing slows during:

(a) fever (b) exercise

(c) sleep (d) emotional upset

19. Ciliated epithelial cells are located in:

(a) esophagus (b) trachea

(c) villi (d) aorta

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20. Which event is not associated with the activity of expiration?

(a) contraction of diaphragm

(b) more dome like shape of diaphragm

(c) back ward and down ward movement of rib cage

(d) relaxation of intercostals muscles

21. How much area of leaf is covered by air spaces?

(a) 10 % (b) 40 %

(c) 50 % (d) 90 %

22. Which of the following have higher content of oxygen?

(a) fresh water (b) marine water

(c) air (d) green house

23. The Membrane covering the lungs and reduces the friction:

(a) mesentry (b) peritoneum

(c) pericardium (d) pleura

24. The irritant substances of smoke generally cause:

(a) diarrhea (b) cough

(c) sneezing (d) smoker's cough

25. Operculum is present in:

(a) cartilaginous fishes (b) bony fishes

(c) jawless fishes (d) all of these

26. Exhaled air is saturated with:

(a) carbon dioxide (b) oxygen

(c) dust particles (d) water

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27. Gills are present:

(a) on the surface of pharynx

(b) in branchial cavities

(c) attached to operculum

(d) on the surface of pharynx or in branchial cavities

28. A common mussel has two large gills with:

(a) cilia (b) flagella

(c) pseudopodia (d) parapodia

29. Sound box or voice box is also called:

(a) pharynx (b) oral cavity

(c) larynx (d) trachea

30. When blood leaves capillary bed most of Carbon dioxide is in the form of:

(a) carbonate ions (b) bicarbonate ions

(c) hydrogen ions (d) hydroxyl ions

31. Which statement is incorrect about functioning of human lungs?

(a) they neither pull air nor can they push it out

(b) passive expansion and contraction occurs during expiration and inspiration respectively

(c) diaphragm becomes less dome like during inspiration

(d) when muscles between ribs an: relaxed the ribs arc settle down

32. During exercise the breathing rate may rise to:

(a) 30 times per minute (b) 20 times per minute

(c) 25 times per minute (d) 35 times per minute

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33. Blood is not involved in transport of gases in:

(a) frog (b) cockroach

(c) earthworm (d) man

34. Skin is the respiratory structure in the:

(a) hydra (b) earthworm

(c) planaria (d) grasshopper

35. In the fish, the blood is directly pumped from the heart to the:

(a) body tissue (b) gills

(c) head (d) all of these parts

36. The wall of the trachea (windpipe) and bronchi of man is furnished with a series of incomplete:

(a) cartilaginous plates (b) chitinous rings

(c) cartilaginous rings (d) muscular rings

37. What does not happen during inspiration man?

(a) intcrcostals muscles contract (b) ribs arc elevated

(c) diaphragm becomes more dome-shaped (d) ribs move forwards

38. The lateral walls of the chest cavity of man are composed of the:

(a) ribs (b) lntercostals muscles

(c) ribs and intercostals muscles (d) ribs, lntercostals muscles and diaphragm

39. The most abundant protein in the world is the:

(a) hemoglobin (b) insulin

(c) myoglobin (d) rubisco

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40. The amount of CO_2 that 100 ml of human blood can take up from the tissue is:

(a) 50 ml (b) 54 ml

(c) 20 ml (d) 4 ml

41. The irritant substance of smoke generally causes "smoker's cough" which bursts some of the weakened:

(a) bronchioles (b) alvcolar ducts

(c) alvcoli (d) all of the above

42. Which condition is responsible for the rubisco to act as carboxylase?

(a) increased CO_2 concentration (b) increased O_2 concentration

(c) high temperature (d) low CO_2 concentration

43. Which part of the air passage way possess cartilage plates in. its wall?

(a) bronchioles (b) distal region of bronchi

(c) proximal region of bronchi (d) trachea

44. Any of the tiny, blind-ended cavities in lungs in which gas exchange takes place:

(a) air sac (b) aivcolus

(c) parabronchi (d) tracheolcs

45. In which animal blood is involved in transport of respiratory gases?

(a) hydra (b) earthworm

(c) cockroach (d) both earthworm and cockroach

46. What happen in cockroach during inspiration?

(a) abdomen expands and posterior six pairs of spiracles open

(b) abdomen contracts and anterior four pairs of spiracles close

(c) abdomen contracts and anterior four pairs of spiracles open

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(d) abdomen expand and anterior four pairs of spiracles open

47. It is observed that if photorespiration is inhibited chemically, the plant can still grow, then why photorespiration exist:

(a) CO_2 released in this process later on can he used in photosynthesis

(b) serine is an essential component of plant that is produced by this process

(c) active site ofrubisco is evolved to hind both CO_2 and O_2

(d) actual growth occurs in fishes

48. In which animal respiratory surface are found in more than one organ:

(a) human (b) birds

(c) frog (d) fishes

49. The direction of blood flow in the lungs of birds is always:

(a) opposite to the air flow (b) similar to the air how

(c) right angle to the air how (d) circular to the air how

50. Which sequence of organs is correct in air passageway of man?

(a) nasal cavities → larynx → pharynx → trachea → bronchi

(b) nasal cavities → pharynx → trachea → larynx → bronchi

(c) nasal cavities → pharynx → larynx → bronchi → trachea

(d) nasal cavities → pharynx → larynx → trachea → bronchi

51. An inefficient form of the dark reactions of photosynthesis in which O_2 accumulates, CO_2 is depleted, and no carbohydrates are generated:

(a) photorespiration (b) photosynthesis

(c) chemosynthesis (d) light reaction

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UNIT NO. 5 (HUMAN PHYSIOLOGY)

1	**C**	2	**B**	3	**A**	4	**B**	5	**B**	6	B	**7**	**A**	**8**	**C**	**9**	**B**	**10**	**C**
11	A	**12.**	C	**13**	A	**14**	A	**15**	D	**16**	**C**	17	D	18	C	19	B	20	A
21	B	**22**	C	**23**	D	**24**	D	**25**	B	**26**	**D**	27	D	28	A	29	C	30	B
31	B	**32**	A	**33**	B	**34.**	B	**35**	B	**36**	**C**	37	C	38	D	39	D	40	C
41	A	**42**	B	**43**	B	**44**	B	**45**	D	**46**	**C**	47	C	48	A	49	D	50	A

TRANSPORTATION

Blood Circulatory System:

The circulatory system of man has the following basic components.

(i) Circulating fluid – the blood

(ii) The pumping organ – the heart

(iii) The blood vessels – arteries, capillaries and veins

The Circulatory Fluid the Blood:

- The blood is the medium in which dissolved nutrients, gases, hormones, and wastes are transported through the body.
- It is made up of two main components:

(i) plasma and

(ii) cells or cell like bodies (white blood cells, red blood cells. platelets)

- The weight of the blood in our body is about $1/12^{th}$ of our body

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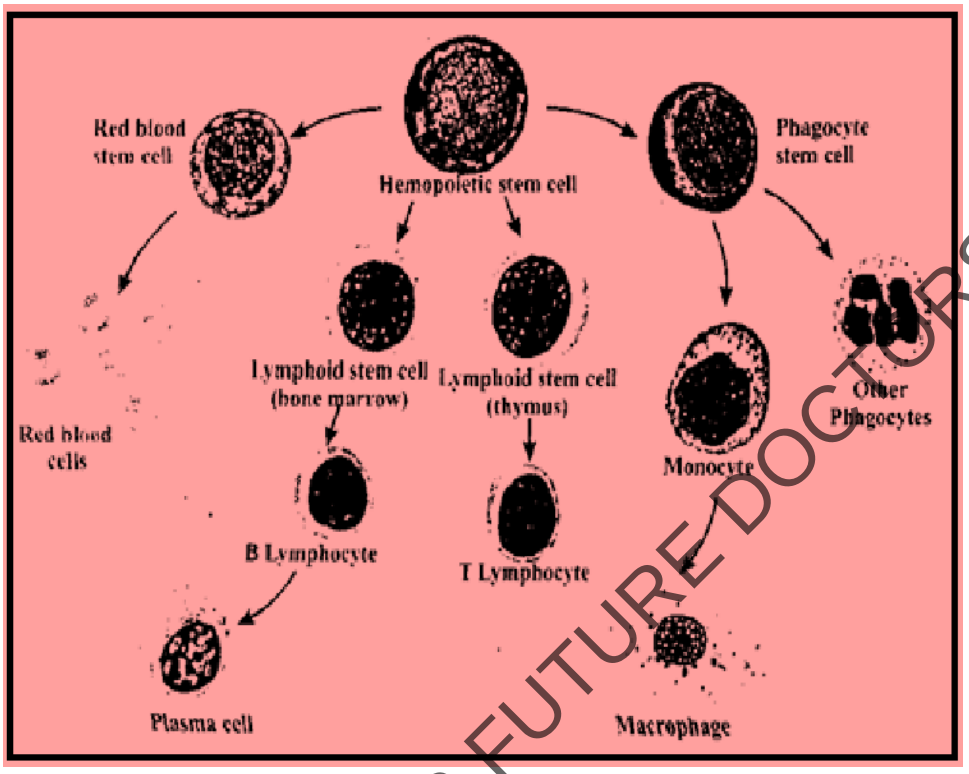

Fig. Red blood cells (erythrocytes) and white blood cells (Leucocytes) both develop from stem cells in bone marrow.

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PLASMA:

- In a normal person plasma is 55 by volume of the blood, and cells or cell-like bodies about 45 % by volume of the blood.
- Plasma is primarily water in which proteins, salts, nutrients and wastes are dissolved/ Water constitutes about 90 of plasma, 10 are solutes which are as follows:
- The inorganic ions and salts make up 0,9 per cent of the plasma, of humans, by weight. More than two thirds of this amount is sodium chloride the 'ordinary table salt.
- The normal pH of human blood is 7.4 and it is maintained between narrow limits because the change in pH would affect the chemical reactions of the body.
- The plasma proteins constitute 7-9 percent by weight of the plasma. Most of these proteins are synthesized in the liver. Some of the globulins, called immune globulins or antibodies are produced in response to antigens by lymphocytes cells and then are

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passed to plasma and lymph immuneglobulins play important role in body's defenses against disease.

- The proteins like Prothrombin acts as a catalyst in blood clotting process. Fibrinogen takes part in the blood clotting process.
- Organic nutrients in the blood include glucose, fats, phospholipids amino acids and lactic acids. Some of them enter the blood from the intestine (absorption).
- Lactic acid is produced in muscles as a result of glycolysis and is transported by blood to liver. Cholesterol is metabolized to some extent but also sense as precursor of steroid hormones.
- Plasma also contains nitrogenous waste products formed as a result of cellular metabolism. These products are carried from the liver where they are produced to the organs from where they are removed i.e. kidneys. Urea and small amounts of uric acid are present in plasma.
- All the hormones in the body are carried by blood - so they are present in the plasma.
- The gases such as CO_2 and O_2 are present in the plasma of the blood.

BLOOD CELLS AND CELL LIKE BODIES:

These include Red blood cells (Erythrocytes), white blood cells (Leucocytes) and platelets (Thrombocytes).

a) **Red Blood Cells (Erythrocytes):** These are most numerous of the cells in the blood. A cubic millimeter of blood contains 5-5 ½ million of them in males and 4-4 ½ million in females.

- These cells when formed have nucleus but is lost before they enter the circulatory fluid or blood.
- 95 % of the cytoplasm of red blood cells is the red pigment, called hemoglobin. The remaining 5 % consists of enzymes, salts and other proteins.
- The red cells once mature do not divide.

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- These cells are biconcave and have an elastic cell membrane.
- Red blood cells are formed principally in the red bone marrow of short bones, such as the sternum, ribs and vertebrae. In the embryonic life, they are formed in the liver and spleen.
- The average life span of red blood cell is about four months after which it breaks down and disintegrated in the liver and spleen - partly by phagocytes by phagocytosis.
- About 2 – 10 million red blood cells are formed and destroyed every second in a normal person.
- Their main function is to transport O_2 and CO_2.
- Having Hb inside red blood cells rather than In solution In the plasma gives several advantages:
- A much greater volume of Hb can be carried in cells than could be' dissolved in plasma.
- Hb can be kept in a favourable chemical environment to allow taster loading and unloading of respiratory gases.
- Hb molecules of particular age are kept together and can be easily replaced when old.
- Hb in cells does not affect the osmotic properties of the blood (free Hb would).
- Hb in cells cannot be lost by excretion.

(b) White Blood Cells (Leucocytes):

- These blood cells are colourless, as they do not contain pigments.
- One cubic millimeter of blood contains 7000 to 8000 of them. They are much larger than the red blood cells.
- There are at least five different types which can be distinguished on the basis of the shape of the nucleus and density of granules in the cytoplasm. They can be grouped into two main types, granulocytes and agranulocytes.
- Granulocytes include neutrophils, eosinophils and basophils. They are formed in the red bone marrow.

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- Agranulocytes are formed in the lymphoid tissue such as those of the lymph nodes, spleen, tonsils, adenoids and the thymus. Agranulocytes include monocytes and lymphocytes (B and T),
- Monocytes stay from 10 – 20 hours in the blood, then enter tissues and become tissue macrophuges, performing phagocytic function.
- Lymphocytes have life spans of months or even years but this depends on the body's need for these cells.

Functions of WBCs:

- Leucocytes protect the body against foreign invaders, and use circulatory system to travel to the site of invasion.
- Monocytes and neutrophils travel through capillaries and reach the site of wound where bacteria have gained entry.
- Macrophages and neutrophils feed on bacterial invaders or other forcing cells including cancer cells. They typically die in the process and their dead bodies accumulate and contribute to the white substance called pus, seen at infection sites.
- Basophils produce heparin - a substance that inhibit blood clotting these also produce chemicals, such as histamine that participate In allergic reaction and in responses to tissue damage and microbial invasion.

  Lymphocytes help provide immunity against the disease.

(c) Platelets (Thrombocytes):

- These are not cells, but are fragments of large cells called megakaryocytes. There is no nucleus in them. There is no pigment in them.
- Platelets help in conversion of fibrinogen, a solid plasma protein, into insoluble form fibrin. The fibrin threads enmesh red blood cells and other platelets in the area of damaged tissue, ultimately forming blood clot. The clot serves as a temporary seal to prevent bleeding until the damaged tissue can be repaired.

FUNCTIONS OF BLOOD

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- The plasma proteins maintain colloid osmotic pressure of the blood (75 % by albumins 25 % by globulins and almost none by fibrinogen).
- Blood helps to transport of materials, in the body including nutrients, water, salts and waster products. All hormones are transported by blood from the endocrine tissues to the larger cells.
- O_2 and CO_2 are transported by blood.
- Blood helps in body defenses against disease neutrophils and monocytes engulf and destroy invading microorganisms e.g. bacteria. Blood provides immunity by the lymphocytes.
- Blood produces interferon and antitoxins which are proteins and protects our body from nucleic acids of invading organism; and toxins of the invaders.
- Blood acts as a buffer to maintain the acid base balance i.e, concentration of H^+ and OH^- ions of the body.
- Helps in maintaining the body temperature, concentration of water and silts, this helps in homeostasis.
- Blood helps in the exchange of materials between blood and body tissue tissues through blood capillaries.
- Blood helps the body in maintaining the internal environment, by producing, heparin, histamines and also maintaining the amounts of chemicals in the body to a constant or nearly constant level.

Blood undergoes a clotting process under certain circumstances due to specific proteins.

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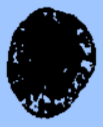
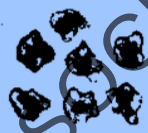
TABLE : Showing Different cell types comparing their characteristics & functions

Cell Type		Description	Average Number Present	Major Function
Red blood cell (erythrocyte)		Biconcave disc without nucleus, Approximately 8 μm in diameter	5,000,000 per mm^3	Transports oxygen and a small amount of carbon dioxide.
White blood cell (leucocytes)			7500 per mm^3	
(a) Granulocytes				
1. Neutrophil		About twice the size of red cells, nucleus two to five lobed	62% of white cells	Destroys small particles by phagocytosis.
2. Eosinophil		About twice the size of red cells, nucleus bilobed	2% of white cells	Inactivates inflammation-producing substances; attacks parasites.
3. Basophil		About twice the size of red cells nucleus bilobed	Less than 1% of white cells	Releases heparin to prevent blood clots and histamine, which causes inflammation.
(b) Agranulocytes				
4. Monocyte		Two to three times larger than red cells, nuclear shape from round to lobed	3% of white cells	Gives rise to macrophage, which destroys larger particle by phagocytosis.
5. Lymphocyte		Slightly large than red cell, nucleus nearly fills cell	32% of white cells	Functions in the immune response by producing anti bodies.
Platelet		Membrane bounded cytoplasmic fragment of cells in bone marrow called megakaryocytes	250,000 per mm^3	Involved in blood clotting.

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DISORDERS OF BLOOD

1. Leucaemia (Blood Cancer):

It is the result of uncontrolled production of white blood cells (Leucocytes). This is cause by a cancerous mutation of a myelogenous or lymphogenous cell. The Leucaemia is usually characterized by greatly increased numbers of abnormal white blood cells in the circulating blood.

Myelogenous cells (bone marrow cells) are in the bone marrow and may spread throughout the body so that white blood cells are produced in many other organs. These white blood cells are not completely differentiated and so arc detective.

Leucaemia may be of different kinds depending on the type of white blood cells, which are undifferentiated and being produced at a faster, than normal rate. There may be neutrophilic leucaemia, eosinophilic leucaemiaand basophilic leucaemia, monocytic or lymphocytic leucaemia.

It is a very serious disorder and the patient needs to change the blood regularly with the normal blood, got from donors. It can be cured by bone marrow transplant, which is in most cases effective but very expensive treatment.

2. Thalassemia (G. Thalassa = Thesea; haema = blood):

It is also called Cooley's anaemia on the name of Thomas B. Cooley American pediatrician. It is a genetically transmitted haemoglobin abnormality. Haemoglobin molecules in most cases, does not have β-chains in it instead F chain is present.

(F is foetal haemoglobin)

It is characterized by the presence of microcytes by spleenomegaly(enlargement of spleen) and by changes in the bones and skin.

This disease is more common in children especially of Mediterranean parents. The blood of these patients is to be replaced regularly, with normal blood.

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It can be cured by bone marrow transplant - which is very expensive and does not give 100 % cure rate.

3. Oedema:

It means the presence of excess fluid in the tissues of the body.The excess fluid may be in the cells or outside the cells. The intracellular «edema is caused by osmosis of water into the cells and cause, depression of metabolic systems (due to lack of nutrition and O_2 in the tissues) especially and the Na-pump.

The extracellular oedema may result by:

(i) Abnormal leakage of fluid from the blood capillaries or failure of the lymphatic system to return fluid from the interstitial fluid.

(ii) Oedma is caused by renal retention of salts and water.

Oedema disturbs the exchange and concentration of minerals and ions ill the blood and body cells, it also affects blood pressure, increases heart load etc.

THE HEART (PUMPING ORGAN)

STRUCTURE AND ACTION:

1. Location:

The heart of humans is located in the chest cavity.

2. Pericardium:

The heart is enclosed in a double membranous sac - the pericardial cavity which contains the pericardial fluid. Pericardium protects the heart, prevents it from overextension.

3. Wall of Heart:

The wail of the heart is composed of three layers.

(i) I-picardium

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(ii) Myocardium

(iii) Endocardium

- Mycodium of the heart is made up of cardiac muscles.
- These muscle contain myofibrils, and myofilaments of myosin and actin.
- Their arrangement is similar to those in skeletal muscle fibres and their mechanism of contraction is also the same, except they are branched cells, in which the successive cells are separated by junctions called intercalated discs.
- The heart contracts automatically within rhythmicity, due to the autonomic nervous system of the body.

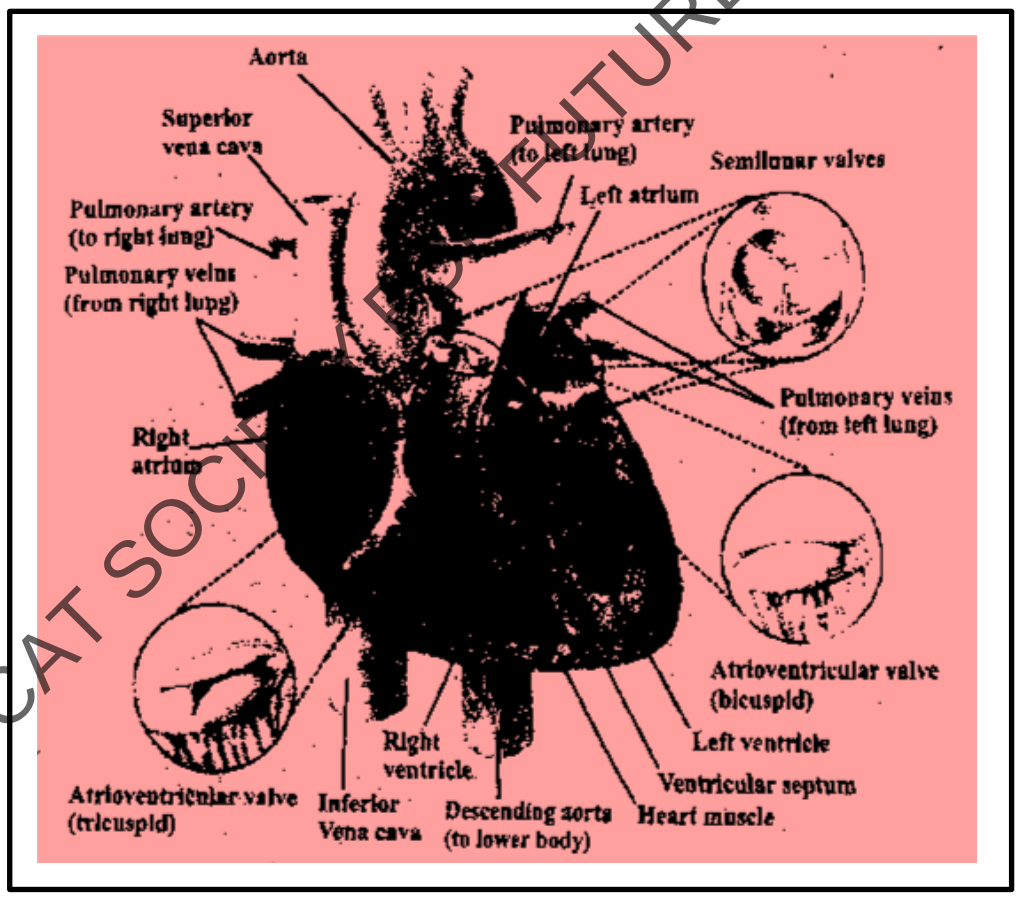

Fig. The human heart and its valves and vessels

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Chambers of Heart:

There are four chambers of the heart, two upper thin walled atria and two lower thick walled ventricles. Atria receive the blood and pass on to the ventricle which distribute the blood.

Double Pump:

Human heart functions as a double pump, and is responsible for pulmonary and systemic circulation. Complete separation of deoxygenated blood (Right side) and oxygenated blood (left side) in the heart is maintained.

Function:

(i) The right atrium receives deoxygenated blood via vena cava (inferior and superior) from the body.

(ii) The blood is passed on to right ventricle through tricuspid valve (because it has 3 naps).These naps are attached with fibrous cords called chordaetendinae, to the papillary muscles which are extensions of wall of the right ventricle.

(iii) When right ventricle contracts, the blood is passed to pulmonary trunk which carry blood via left and right pulmonary arteries, to the lungs.

(iv) At the base of the pulmonary trunk, semi lunar valves are present.

(v) After oxygenation in the lungs the blood is brought by pulmonary veins to the left atrium which passes this blood via bicuspid valve (because it has two flaps) to the left ventricle. The flaps of bicuspid valve are similarly attached through chordae tendinae, with papillary muscles of wall of left ventricle.

(vi) When the left ventricle contracts. it pushes the blood through aorta to all parts of the body (except lungs).

(vii) At the base of aorta semi lunar valves are also present. The valves of the heart control the direction of flow of blood.

(viii) The wall of left ventricle is thicker (about 3 time) than that of the right ventricle.

(ix) At the base of aorta, first pair of arteries, the coronary arteries, arise and supply blood to the heart.

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(x) The aorta forms an arch, and before descending down gives three branches supplying blood to head, arms shoulders.

(xi) Aorts descends down in the chest cavity. It gives many small branches to the chest wall and then passes down to the abdominal region. Here it gives branches which supply blood to different parts of alimentary canal, kidneys and the lower abdomen.

(xii) Aorta bifurcates into iliac arteries, each of which divides into two femoral and sciatic arteries supplying blood to legs.

(xiii) The blood from the upper part of the body is collected by different veins, which join to form superior vena cava; which pass the blood to right atrium.

(xiv) Two iliac veins are formed by veins which collect blood from legs, and unite to form inferior vena cava. It receives renal vein form each kidney; and hepatic vein from liver, before it enters right atrium. The liver receives hepatic portal vein which is formed by many veins collecting deoxygenated blood with absorbed food from different parts of alimentary canal.

IMPORTANT POINTS TO REMEMBER

1. Myocardium of the heart is made up of special type of muscles the cardiac muscles.
2. Human heart functions as a double pump, and is responsible for pulmonary and systemic circulation.
3. In human heart: The right atrium receives deoxygenated blood via vena cava (inferior and superior) from the body.
4. Heartbeat involves three distinct stages:

   (i) Diastole

   (ii) Atrial systole

   (iii) Ventricular systole.

   One complete heart beat consists of one systole and one diastole, and lasts for about 0.8 seconds.

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5. The heart beat cycle starts when the sino-atrial node (Pace maker) at the upper end of right atrium sends out electrical impulses to the atrial muscles and causing both atria to contract.

6. The recording of heart beat is known as electrocardiogram which is taken by electrocardiograph (E.C.G) machine.

7. Pacemaker is responsible for initiating the impulse which triggers the heart beat rate.

8. If there is some block in the flow of the electrical impulses, or if the impulses initiated by S.A, node are weak; it may lead to death of the individual. So an artificial pacemaker which is battery operated producing electrical stimulus is used.

9. Failure of interatrial foramen (an opening in the inter-atrial septum) to dose or of ductus arteriosus to fully constrict results in cyanosis (blueness of skin) of new born.

10. The contraction. of the circular (smooth) muscles of arteries and arterioles is under the control of nervous and endocrine systems

    (**Examples**: Vasoconstriction and Vasodilation),

11. Capillaries are only one cell thick, Exchange only at capillary level.

12. The diameter of capillary can be altered by nervous stimulation; which tends to close them and by chemicals such as histamine which dilates them.

13. The pre capillary sphincters also regulate the amount of blood flowing capillaries, Thus the amount llf blood flowing in a certain tissue is controlled.

14. Capillaries join to form venules, which join to form veins.

15. The pressure within capillaries causes a continuous leakage of fluid from the blood plasma into the spaces that surround the capillaries and tissues, This fluid is interstitial fluid, It has water in which are dissolved nutrients, Hormones, gases, wastes and small proteins from the blood.

16. Large proteins. red blood cells and platelets cannot go to the intercellular spaces of, capillary wall. so they remain within capillaries.

17. Atheroma + arteriosclerosis = Atherosclerosis

18. Atherosclerosis causes narrowing and hardening of arteries.

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19. Blood pressure is the measure of force with which, blood pushes up against blood vessel walls.

20. The pressure reaching its high point during systole (systolic pressure which in normal individuals is 120 mm Hg) and its low point during diastole (diastolic pressure which in normal individuals ranges between 75-85 mm Hg).

21. The walls of arteries are elastic and the flow of blood stretches them, and it is felt as pulse.

22. Hypertension is a condition of high blood pressure.

23. Thrombus is a solid mass or plug of blood constituents (clot) in a blood vessel.

24. Thrombosis is the formation of thrombus.

25. Blockage of blood vessel in the heart by an embolus (or by locally formed thrombus) causes necrosis or damage to portion of the heart muscles. a condition known as a heart attack or technically myocardial infarction.

26. If the normal flow of blood is blocked by an embolus (or a locally formed thrombus), in a blood vessel in the brain, and causes necrosis, or death, of the surrounding neural tissue (owing to lack of O_2) the condition is called a stroke or cerebral infarction.

27. Haemorrhage is the discharge of blood from blood vessels.

LYMPHATIC SYSTEM:

- In humans in addition to blood vascular system there is another system which is responsible for the transport and returning of materials from the tissues of the body to the blood this system is called lymphatic system.
- It consists of lymph capillaries, lymph vessels, lymphoid masses lymph nodes and lymph (the fluid) which flows in the system.
- The Lymph capillaries end blindly in the body tissues where pressure from the accumulation of interstitial fluid or extracellular fluid forces the fluid into the lymph capillaries, when this fluid enters the lymph capillaries it is called lymph. The lymph

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vessels empty in veins; so lymph is a fluid in transit between interstitial fluid and the blood.

- The intercellular spaces in the walls of lymph vessels are larger than those of the capillaries of blood vascular system. So larger molecules, from the interstitial fluid can also enter the lymph capillaries.
- Lymph capillaries join to form larger and larger lymph vessels and ultimately form thoracic lymph duct, which opens into subclavian vein. The flow of lymph is always towards the thoracic duct.
- In the intestine the branches of lymph capillaries within villi are called lacteals.
- The flow of lymph is maintained by:

  (i) Activity of skeleton muscles

  (ii) Movement of viscera

  (iii) Breathing movements

  (iv) The valves which prevent back flow of lymph

- Along the pathway, the lymph vessels, have, at certain points, masses of connective tissue where lymphocytes are present, these are lymph nodes.
- Several afferent lymph vessels enter a lymph node which is drained by a single efferent lymph vessel. Lymph nodes are present in the neck region axilla and groin of humans.
- In addition several lymphoid masses are present in the walls of digestive tract in the mucosa and sub-mucosa. The larger masses, spleen and thymus, tonsils and adenoids are all lymphoid masses. These produce lymphocytes.

Functions:

These are several functions performed by lymphatic system.

- In an average person, about three liters more fluid leaves the blood capillaries than is reabsorbed by them each day. It returns this excess fluid and its dissolved proteins and other substances to the blood.

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- The lacteals of villi absorb large fat globules, which are released by interstitial cells after the products of digestion of fats are absorbed. After a fatty meal these fat globules may make up 1 of the lymph.

- The lymphatic system helps to defend the body against foreign invaders; Lymph nodes have lymphocytes and macrophages that destroy the bacteria and viruses. The painful swelling of lymph nodes ill certain diseases (mumps is an extreme example) is largely a result of the accumulation of dead lymphocytes and macrophages.

- Just as the lymph nodes filter lymph, the spleen filters blood, exposing it to macrophages and lymphocytes that destroy foreign particles and aged red blood cells.

Note: Lymphatic system is actually a subsystem of the circulatory system in the vertebrate body that consists of a complex network of vessels, tissues, and organs.

SUMMARY

The lymphatic system is part of the immune system. It is also part of the circulatory system; it returns to the heart the small amount of tissue fluid that cannot be returned by the veins. Lymphatic summery flow begins in the capillary beds, where small amounts of tissue fluid drain into tin y lymphatic capillaries. The walls of these vessels are more permeable than blood capillaries) lipids and large molecules such as proteins, and so lymph contains a high proportion of the» ~ substances. Many cells secrete substances that are too large to enter the blood directly, and so can only pass into the general circulation via the lymphatic's. The lymph capillaries drain into larger lymph vessels that look like thin, transparent veins. These vessels have valves to prevent backflow. Lymph contains no red blood cells, and so is pale and clear

.

IMMUNITY

- In animals in addition to physical barriers (skin + mucous membranes) and phagocytes, there is a third mechanism, to defend their bodies against the foreign invaders; this is the immune system.

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- Immunity is the capacity to recognize the material entered in the body and to mobilize cells and cell products for removal of this foreign material with greater speed and effectiveness.
- The components of immune system include the lymphocytes (B and T) and the antibodies which are special type of proteins.
- These antibodies are immunoglobulin's which are synthesized by vertebrates, in response to antigens.
- Antigen or immunogenic is a foreign substance often a protein which stimulates the formation of antibodies.
- Antibodies are specific i.e. cause the destruction of the antigen, which stimulated their production.
- Antibodies are manufactured in B-lymphocytes then secreted into the lymph and blood where they circulate freely.
- Lymphocyte T and B have been named due to their relationship with Thymus gland, and Bursa of Fabricius respectively.
- B-cells recognize antigen then combat micro-organisms and or effect the rejection of foreign tissues (in case of tissue transplant). This is called cell-mediated response.
- B-cells recognize antigen and form plasma cell clone. These plasma cells synthesize and liberate antibodies into the blood plasma and tissue fluid. Here antibodies attach to the surfaces of bacteria and speed up their phagocytosis, or combine with and neutralize toxins produced by micro-organisms by producing antitoxins. This is called humoral immune response.

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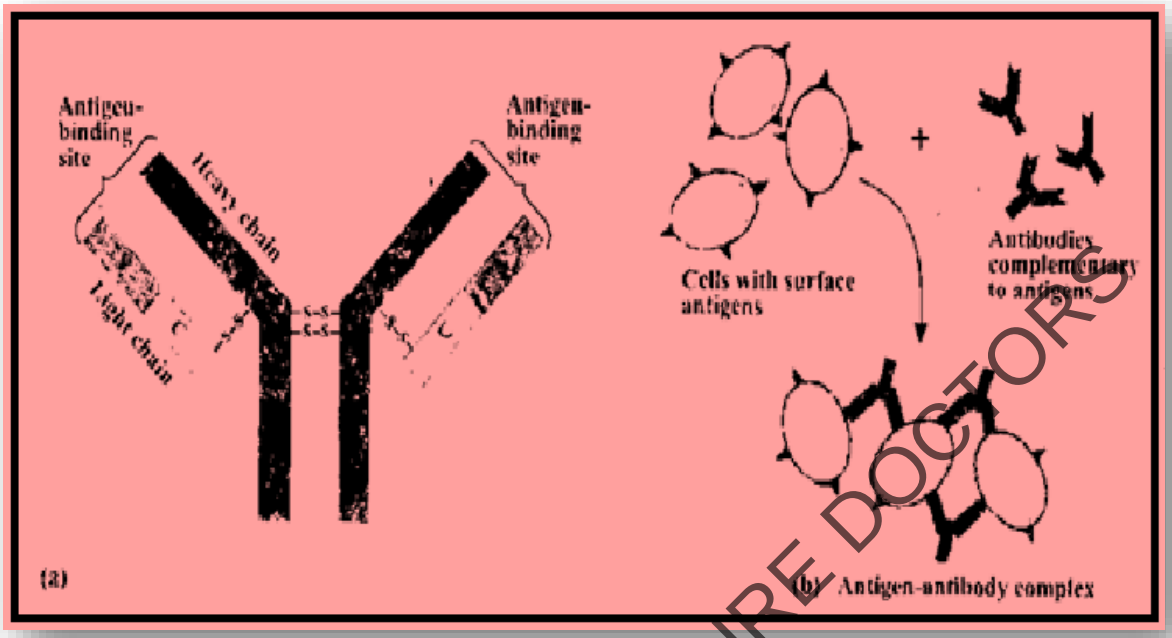

Fig. (a) An antibody molecule consists of four polypeptide chains, two identical light chains and two identical heave chain - linked by disulfide (- S - S -) bridges. Variable amino acid Sequences (V) in the light chains and upper regions of the heave chains determine which antigen will bind to that particular antibody constant amino acid sequences (e) are the same for all the antibodies in one class (b) large antigen-antibody complexes will form if there are multiple copies of the antigenic molecule on the foreign cell's surface.

TYPES OF IMMUNITY:

There are following two types of immunity.

Active Immunity:

- The use of vaccines, which stimulate the production of antibodies in the body, and making a person immune against the disease or infection, is called active immunity. But this active immunity has been achieved by artificially introducing antigens in the body, so it is called artificially induced active immunity. Most of the vaccines consist of non-virulent, mutant strains of the poliovirus.

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- When a person is exposed to an infection (antigen) - becomes ill, and in most cases survives then this immunity, developed against that disease is called naturally induced immunity or autoimmune response.

- When we get vaccination, against a specific disease (antigen), we become immune to that infection or disease. If we get vaccination against, Polio, Smallpox, measles, mumps etc. once in our life time, we are protected or become immune to that infection in our future life.

Passive Immunity:

- If antibodies are injected in the form of antisera (Antiserum is a serum containing antibodies), to make a • person immune against a disease. This called passive immunity.

- Passive immunity response is immediate, but not long lasting.

- The method of passive immunization is used to combat active infections of, tetanus, infectious hepatitis, rabies, snake bite venom etc.

- Antiserum is a serum containing antibodies.

- In the case of snake bite venom passive immunity is produced by the antitoxins - so the serum is called antivenin serum. The patient is the complications (or possibly death) caused by the infection or venom, spared.

- In the body antigen - antibody complexes are formed which are taken up by phagocytes and destroyed.

  In AIDS the affected suffer deficiency in the immune system of the body. This is because that the Viruses live in the Helper T-lymphocytes.

Immunization:

- Immunization is the process of making a person immune to a disease by inoculating them against it.

- Inoculation is the introduction of an antigen into the body--usually through an injection-to stimulate the production of antibodies.

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- The medical practice of immunization began at the end of the eighteenth century, when English physician Edward Jenner (1749-1823) successfully vaccinated 23 people against small pox. Jenner called his method "vaccination," using the Latin words vacca, meaning "cow" and vaccinia, meaning "cowpox" Because the two diseases are caused by similar viruses that have the same antigens, antibodies that work against cowpox will also fight smallpox.
- In 1885 a rabies vaccine developed by French scientist Louis Pasteur (1822-1895) from the spinal fluid of infected rabbits proved to be successful, Since that time, vaccines have been developed for many diseases including diphtheria, polio, pertussis (whooping cough), measles, mumps, rubella (German measles), hepatitis and influenza.
- Vaccines are made from either weakened live or killed microorganisms. When introduced into the body they stimulate the production of antibodies providing active immunity against bacterial and viral diseases.

ADDITIONAL / RELATED READINGS

1. The materials move in and out of the cells by the processes of diffusion, facilitated diffusion, osmosis, active transport, endocytosis and exocytosis etc.
2. In animals, the materials move into within and out of the body in digestive, circulatory, respiratory, and excretory systems.
3. In plants the materials move into within and out of the body by the processes of absorption by roots, transportation (conduction of water, and the nutrients), photosynthesis and respiration.
4. The root hairs are extensions of epidermal cells' of roots.
5. A rye plant less than one meter tall has about 14 million branch roots of a combined length of over 600 kilometers.
6. Out of total surface area provided by roots 67 is provided by the root hairs.
7. Prosopis trees of leguminoceae family have maximum depth of their roots which is 50 meters.
8. When the soil minerals are not in the solution hut are bounded by ionic bonds to soil particles they are not available to the plants.

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9. Most of the minerals enter the root hairs or epidermal cells of roots along with water in bulk flow. Some are taken in by diffusion, facilitated diffusion, or active transport.

10. The diffusion of ions along with water can take plan: by mass flow along the apoplast pathway.

11. In the roots apoplast pathway becomes discontinuous in the endodermis due to the presence of casparian strips.

12. Casparian strips act as valve.

13. Some nutrients are carried from the soil to the epidermal eel is of roots through their cell membrane by the facilitated diffusion.

14. Movement of charged partices from high to low through carrier proteins of the cell membrane is Facilitated diffusion.

15. Most of ions are taken up by the roots by active transport.

16. Mycorrhizae are present in 90 families of flowering plants.

17. Water molecules have ability to move: This is water potential.

18. Solute molecules have ability to stop water molecules: This is solute potential.

    Note: Apoplast pathway is intercellular; Symplast and vacuolar pathway are intracellular.

19. Pressure has ability to increase water potential: This is pressure potential.

20. Pure water has maximum water potential which is zero.

21. Water potential = Solute potential + Pressure potential

22. Kpa = 1000 Pascals – which is the pressure exerted by a vertical force of one Newton on an area of I meter square.

23. Plasmolysis is the shrinkage of protoplast due to exosmosis of water.

24. The point at which plasmolysis is just about to happen is called incipient plasmolysis.

25. Maximum pressure potential (full turgidity) is achieved when a cell is placed in pure water or distilled water.

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26. Cohesion tension theory was proposed by Dixon.

27. Water column is maintained by cohesive force and Adhesive force. Water column moves up due to low pressure at the top and high pressure at the bottom.

28. The xylem water tension is very strong and can pull water up to 200 meters (more than 600 feet) in plants.

29. The lignin and cellulose provide strength to cell wall of xylem vessels.

30. In Cohesion Tension theory large quantities of water arc carried at relatively high speed which is upto 8 mh^{-1} in tall trees and at 1 mh^{-1} in other plants.

31. Root pressure is created by the active secretion of salts and other solutes from the other cells into the xylem sap.

32. A positive hydrostatic pressure of around 100 to 200 KPa (exceptionally 800 KPa) IS generated by mot pressure. Therefore water can raises upto 10 meters.

33. Root Pressure: During night or when no light in some plants up to limited height.

Note: Of the total water pulled up in the leaves, 99is transpired. Only about 1 is used by plant in various activities including photosynthesis.

34. Transpiration Pull: During day time/all plants/any height.

35. Guttation is the - loss of liquid water through water secreting glands or hydathodes.

36. Guttation or exudation is more notable when transpiration almost stops and the relative humidity is high (as at night).

37. The cell wall components (especially cellulose. pectin and lignin) take up water, increase in volume but do not dissolve in water. This is called imbibition.

38. Imbibition is a reversible process.

39. Flow of sap from the cut ends or surfaces of plants with a considerable force called bleeding.

40. In some palms when tapped there may be a flow of 10-15 liters of sap per day.

41. There are two main factors responsible for bleeding: The hydrostatic pressure in xylem and phloem elements, the root pressure which is exerted by the xylem tissues of roots.

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42. About 5-7 of total transpiration takes place through cuticle.

43. The lenticular transpiration is 1-2 of the total transpiration by a plant. All plants do not have lenticels.

44. Lenticel consists of a loose mass of small, thin-walled cells.

45. At each lenticel the cork cambium forms oval, spherical, or irregular cells which are loosely arranged and haw many intercellular spaces.

46. 90 % of total transpiration in a plant is stomatal.

47. In isobilateral leaves the stomata are present on the upper and lower epidermis (e.g. lily and maize leaf), In dorsiventral leaves the stomata are present only on the lower epidermis.

48. The inner concave sides of two guard cells enclose the stoma.

49. In monocots (e.g. grasses) there are also subsidiary cells on the outer side of each guard cell.

50. The guard cells are normally dumble or bean-seed-shaped. The inner side of the guard cell has thick ccli wall while the outer convex side has thin cell wall.

51. The guard cells function as multisensory hydraulic valves.

52. The German botanist H. Van Mohl proposed that the guard cells are the only photosynthetic cells of epidermis of leaf.

53. Morning / light photosynthesis / glucose in Guard cells / water in guard cells guard cells turgid / stoma opens (Starch sugar hypothesis).

54. Morning / light / light reaction / H^+ formation / H^+ stimulates guard cell membrane / K^+ in / water in guard cells turgid stoma opens (Influx of K ions).

55. Level of carbon dioxide in the spaces inside the leaf and light also controls the opening and closing of stomata.

56. A low level of carbon dioxide favors opening of the stomata thus allowing an increased carbon dioxide level and increased rare of photosynthesis.

57. Wet surface of leaf cells allow gaseous exchange.

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58. The rate of transpiration doubles every rise to 10^{o} C in temperature.

59. Very high environmental temperature (i.e. 40 – 45^{o} C) causes closure of stomata. As a result transpiration is very much reduced.

60. At high temperature when the leaf cells start wilting a hormone released by the mesophyll cells. This hormone is called abscisic acid. This hormone suppress of light effect of light and CO_2 concentration. Therefore the active transport of K into the guard cells stops and the stomata close.

61. Low carbon dioxide concentration (when photosynthesis is more than respiration) stimulates the active transport of Potassium ions into the guard cells.

62. The air in motion is called wind.

63. Generally the Xylem is inside while the Phloem is outside of the vascular bundle.

64. The phloem forms the inner bark.

65. Sieve elements (sieve tube cells) are directly involved in the transport of sugars and other organic solutes throughout the plant.

    Note: Phloem tissue consists of sieve elements, companion cells, parenchyma cells, and in some cases fibers, sclereids and latex containing cells.

66. Each sieve tube member is associated by one or more companion cells.

67. Sieve tubes and companion cells are in contact with each other by plasmodesmata.

68. Companion cells supply ATP and proteins to sieve tubes.

69. Translocation does not occur totally in upward or in downward direction, similarly it has no effect of gravity.

70. Composition of material in the phloem: There is 10-25 % dry matter. 90 or more of the dry matter is sucrose. Nitrogenous compounds are about 1 %.

71. Pressure flow theory was proposed by Ernst Munch as a hypothesis. It states that the flow of solution in the sieve elements is driven by an osmotically generated pressure gradient between source and sink.

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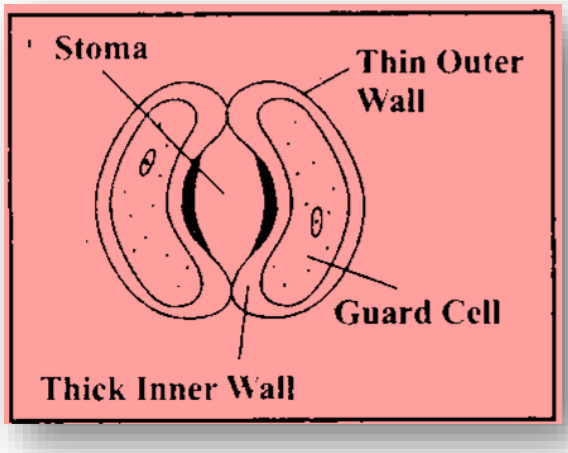

72. The carbohydrates move from the mesophyll cells to phloem tissue by diffusion and actin: transport.

73. When the carbohydrates move from the phloem to the sink (fruit) again there is diffusion and active transport (carrier mediated transport).

74. Open circulatory system is present in animals belonging to Phylum Arthropoda (crustaceans, spiders, and insects), Phylum Mollusca (snails and clams) and group of protochordates (the tunicates).

Note: Unicellular animals have maximum surface area to volume ratio. The body of larger and complex animals has very little exposed surface area to volume ratio.

75. Closed circulator system is present in animals belonging to annelids, cephalopod molluses (squids and octopus), echinoderms and vertebrates.

76. Earthworm (pheretima) Cockroach (Periplanata)

77. In earthworm there are 4 or 5 pairs of lateral hearts present on the lateral side of the oesophagus in 7^{th} to 13^{th} segments. Hearts pumps the blood from the dorsal to the\central\vessel.

78. In cockroach the heart is 13 chambered tubular vessels present in the pericardial sinus and placed in the mid-dorsal region below terga in abdominal region.

79. In fishes sinus venosus receives deoxygenated blood from the body and then blood is passed to atrium, which on contraction passes it to ventricle.

80. Ventricle has thick muscular wall.

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81. Blood circulation in fishes is: Sinus venosus → atrium → ventricle → conus arteriosus → ventral aorta → gills → dorsal aorta → body → sinus vcnovux.

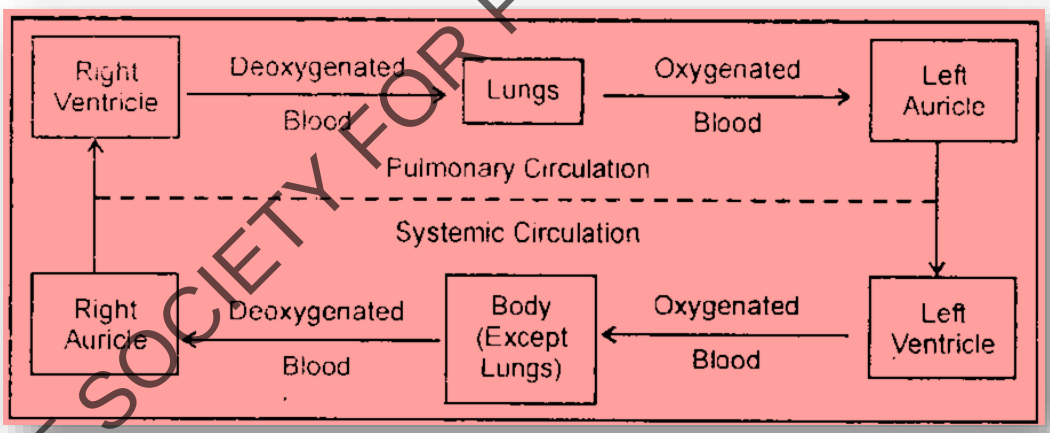
82. The heart of reptiles and all other amniotes practically function as four chambered heart.

83. The reptiles have incompletely partitioned ventricle but in crocodiles the inter-ventricular septum is complete and heart is four chambered.

84. In the birds and mammals the heart is four chambered and oxygenated and deoxygenated blood does not mix at all.

85. Pulmonary circulation is by pulmonary arch carrying deoxygenated blood from right ventricle of heart to lungs and the blood returns to left atrium after deoxygenated blood from right ventricle to heart to lungs in the atrium after oxygenation via pulmonary veins.

86. The systemic arch distributes blood to different parts of the body and then the blood from the body returns to the heart in the right atrium via precaval and postcaval. This is systemic circulation.



87. Abscisic acid: A plant hormone that suppresses growth.

88. Adhesive: The tendency of unlike molecules to cling together

89. Aortic arch: Any of the paired blood vessels running through the gill arches of vertebrate embryos and adult fish.

90. Apical meristem: The undifferentiated actively dividing cells at the growing tip of a plant shoot, such a tissue is the source of a plant's leaves, stem, branches, and flowers.

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91. Apoplastic pathway: In a plant root the “compartment” made up of all extracellular spaces along with the spaces with in cell walls through which the water can traverse without crossing any plasma membrane.

92. Autoimmune response: An abnormal process in which the immune system attacks the body’s own cells or substances.

93. Blood pressure: The hydrostatic pressure exerted by the blood in an animal's circulatory system as a result of the rhythmic contractions of the heart and peristaltic waves of contraction in some blood vessels.

94. Capillary: Any of the tiny blood vessel having single-cell layered wall and interwoven throughout body tissues.

95. Cardiac muscle: The specialized striated muscle tissue of the heart.

96. Cardiac output: A measure of the amount of blood pumped by the heart per unit of time.

97. Carrier-facilitated diffusion: A process in which specialized protein, act as carriers that transport substances across a cell's plasma membrane.

98. Casparian strip: Any of the waterproof, suberin-coated walls of endodermal in a plant.

99. Cell-mediated immunity: The direct attack on foreign cells (If substances b) T lymphocytes.

100. Cohesion tension theory: The idea that water is pulled up through the xylem due' to transpiration from the plant's leaves. The adhesion of water to plant vessel walls and the cohesion of water molecules to each other rather than being pushed upward due to root pressure.

101. Cork cambium: A layer of cells just beneath the epidermis of woody plant which produces cork (the outer, nonliving component of the bark).

102. Diastole: The phase of relaxation of the heart muscles.

103. Guttation: The formation of water droplets on pores at the edge of a leaf.

104. Heartwood: Dark wood at the center of a tree trunk composed of dead xylem which no longer conducts water or nutrients.

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105. Hemolymph: A fluid found in coelom of some invertebrates, regarded as equivalent to blood and lymph of higher forms.

106. Hypertonic: A condition of solution reflecting the presence of a solute concentration that is higher than that of some other solution.

107. Hypotonic solution: A solution in which the salt .concentration is lower than that of another solution.

108. Imbibition: A process in which water enters soil and binds to clay and humus panicles.

109. Isotonic solution: A solution which has the same salt concentration as that of a comparison solution.

110. Kilopascal (Kpa): = 1000 Pascals-which is the pressure exerted by a vertical force of one Newton on an area of 1 meter square.

111. Leaf primordium: A flattened mound on the side of a plant meristem that will develop into a leaf.

112. Lymph node: A mass of tissue that contains lymphocytes and through which lymph is filtered.

113. Lymphatic system: A system of vessels that drains excess extracellular fluid from the spaces around cells and houses important parts of the immune system.

114. Lymphocyte: A cell of the immune system which responds to foreign substances: some lymphocytes secrete antibodies.

115. Meristem: In plants, an organizing center of undifferentiated, actively dividing cells forming zones where new organs can be generated throughout the life of the plant.

116. Meristematic region: Major areas of growth and development in plant roots and stems behind which cells elongate and allow primary growth.

117. Open circulatory system: A circulatory system in which the circulating that is not entirely enclosed within the continuous set of interconnected vessels.

118. Osmotic potential: The tendency of water to move to areas of lower solute concentration across a semi permeable membrane.

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119. Osmotic pressure: The pressure exerted by a solution separated by a semi permeable membrane from pure water; practically measured as the pressure that must be applied to such a solution to prevent it from gaining additional water through the membrane.

120. Palisade parenchyma: A tightly packed layer of rod shaped, chloroplast filled cellsjust below the upper epidermis of a leaf.

121. Root pressure theory: A theory that water pressure builds up in roots and pushes upward toward the leaves as a result of mineral uptake and transfer to the root xylem.

122. Sieve Plate: One of the two end walls of a sieve tube elemen.t that a. e perforated b) pores.

123. Sieve tube: A pipe like arrangement of phloem cells that are stacked vertically with in a stem or other structures.

124. T cell (T lymphocyte): One of the two major types of white blood cells in the immune system; T cells come together at sites of infection and directly attack foreign substances, organisms, or tissues.

125. Transpiration: Evaporative water loss from aerial parts of plant especially through stomata of leaves.

126. Transpiration-pull theory: Also called the cohesion tension theory which states that water is pulled up through a plant's xylem. by transpiration pull, and cohesion and adhesion of H_2O molecules.

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QUESTIONS FOR PRACTISE

1. Which of the following is true about mammals?

(a) they have right aortic arch only

(b) they have left aortic arch only

(c) they have right and left aortic arches both

(d) they do not have aortic arch

2. The rate of absorption of each mineral by root is essentially independent:

(a) of its concentration both inside and outside the roots

(b) of the rate of absorption of water

(c) of the rate of absorption of other minerals

(d) of the rate of absorption of water and the rate of absorption of other minerals

3. The ions moving in the apoplast while its transport from root hairs to xylem can only reach up to:

(a) xylem vessels (b) xylem parenchyma RNA

(c) endodermis (d) cortex

4. During uptake of mineral ions active transport is selective and is dependent on:

(a) ascent of sap (b) respiration

(c) uptake of water (d) transpiration

5. Which of the following cells possess casparian strips?

(a) epidermis (b) cortex

(c) endodermis (d) xylem vessels

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6. No entry of water into the cells in:

(a) apoplast pathway (b) symplast pathway

(c) vacuolar pathway (d) all of these pathway

7. If cell A has Ψ_w = – 3600 kPa and Ψ_s = – 6000 kPa.

What will be the nearest value of Ψ_p?

(a) – 9600 kPa (b) – 400 kPa

(c) 2400 kPa (d) 7200 kPa

8. Root pressure is generated by active secretion of salts into:

(a) xylem (b) phloem

(c) endodermis (d) cortex

9. What causes the movement of K+ into guard cells while opening of stomata?

(a) flaccidity of guard cells (b) high level of CO_2

(c) photosynthesis (d) acid pH of guard cells

10. If a cell with Ψ_s of – 2200 kPa is placed in solution with Ψ_s of – 2500 kPa.

What will happen?

(a) endosmosis (b) exosmosis

(c) first exosmosis then endosmosis (d) equilibrium state is achieved

11. Of the total transpiration, the cuticular transpiration is about:

(a) 5 – 7 % (b) 1 – 2 %

(c) 90 % (d) 10 – 20 %

12. Which animal has high surface area to volume ratio?

(a) earthworm (b) grasshopper

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(c) amoeba (d) starfish

13. Each heart beat (cardiac cycle) of man takes:

(a) 0.15 seconds (b) 0.5 seconds

(c) 0.8 seconds (d) 1.8 seconds

14. In humans, the aorta bifurcates at the lower abdomen into the:

(a) femoral arteries (b) sciatic arteries

(c) iliac arteries (d) mesenteric arteries

15. What is not true for pulmonary artery?

(a) it carries deoxygenated blood (b) it takes blood to lungs

(c) it arises from left ventricle (d) it has semi lunar valve at its base

16. In cockroach which sequence of organs is involved during blood flow from heart?

(a) aorta → haemocoel → perinural sinus → perivisceral sinus → pericardial sinus → heart

(b) aorta → perinural sinus → haemocoel → perivisceral sinus → pericardial sinus → heart

(c) aorta → pericardial sinus → perivisceral sinus → perinural sinus → hacnocoel→ heart

(d) aorta → perivisceral sinus → perinural sinus → perivisceral sinus → pericardial sinus → heart

17. What sequence of organs is involved in blood circulation of fish?

(a) heart → sinus venosus → ventral aorta → dorsal aorta → gills → body

(d) heart → dorsal aorta → gills → ventral aorta → body → sinus venosus

(c) heart → ventral aorta → gills → dorsal aorta → body → sinus venosus

(d) heart → dorsal aorta → body → ventral aorta → gills → sinus venosus

18. A white substance called pus is produced at infectious site due to accumulation of dead:

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(a) neutrophills and basophils (b) basophills and esinophills

(c) monocytes and neutrophils (d) lymphocytes and monocytes

19. Which of the following is considered as blood cancer?

(a) leukemia (b) thalassaemia

(c) sickle cell anemia (d) oedema

20. The protein that acts as catalysts in blood clotting process in human being is called:

(a) fibrin (b) fibrinogen

(c) thrombin (d) prothrombin

21. Cardiac muscles can be distinguished from other muscles because they:

(a) contain only actin (b) are voluntary in action

(c) lack regular arrangement of sarcomeres (d) have intercalated discs

22. Heart beat sound is due to:

(a) contraction of muscles (b) contraction of atria

(c) contraction of ventricles (d) action of valves in heart

23. From the 14thsegment backwards, the dorsal blood vessel of earthworm serves as a:

(a) collecting vessel (b) link vessel only

(c) distributing vessel (d) both collecting and distributing vessel

24. In grasshopper tubular dorsal vessel extends in the mid-dorsal line immediately below the:

(a) sterna (b) terga

(c) endoskeleton (d) muscles

25. Each chamber of heart of grasshopper is provided with a pair of lateral openings, the:

(a) osculum (b) aperture

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(c) ostia (d) stomium

26. The heart is enclosed by a tough membrane, the:

(a) pericardium (b) peritoneum

(c) epithelium (d) endothelium

27. Arteries transport blood away from the:

(a) heart (b) liver

(c) kidney (d) stomach

28. The average diameter of a capillary is about:

(a) 5 µm (b) 6 µm

(c) 7 µm (d) µm

29. The right and left femoral veins return blood from the right and left:

(a) arms (b) legs

(c) eyes (d) ears

30. The liver also receives a:

(a) renal portal vein (b) hepatic vein

(c) hepatic portal vein (d) vena cava

31. In earthworm there are three main blood vessels running in longitudinal direction, namely:

(a) dorsal, ventral and lateral (b) dorsal, ventral and anterior

(c) anterior, posterior and lateral (d) dorsal, ventral and subneural

32. A central role in the clotting of blood is played by:

(a) RBC (b) WBC

(c) platelets (d) oxygen

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33. Lymph nodes not present in the:

(a) back bone (b) neck

(c) axilla (d) groin

34. At the junction of smaller lymph vessels, there is special aggregation of cells forming lumpy masses called:

(a) lymph nodes (b) lymph nodules

(c) lymph bumps (d) lymph knobs

35. In which group heart functions as single circuit?

(a) fishes (b) reptiles

(c) mammals (d) birds

36. from right ventricle blood is pushed to:

(a) pulmonary trunk (b) aorta

(c) lungs (d) body

37. In moles a cubic blood contains 5 – 5 ½ millions of:

(a) lymphocytes (b) erythrocytes

(c) platelets (d) monocytes

38. What is true Sino atrial node?

(a) it is pacemaker

(b) Present in the wall of the right atrium

(c) it is the main control of the heart/ heart rate

(d) all of these

39. The blood cells which sty from 10 – 20 hours in the blood are:

(a) neutrophils (b) monocytes

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(c) basophils (d) lymphocytes

40. Leucoaemia is usually characterized by greatly increased numbers of abnormal:

(a) white blood cells (b) red blood cells

(c) platelets (d) both RBC's and WBC's

41. The presence of the microcytes by splenomegaly and by change in the bones and skin is the characteristic of:

(a) oedema (b) thalasaemia

(c) leucaemia (d) hepatitis

42. Myocardium of the heart is made up of special type of muscles:

(a) smooth muscles (b) skeletal muscles

(c) cardiac muscles (d) both a and c

43. An artery carries:

(a) high O_2 (b) low O_2

(c) away from heart (d) to the heart

44. Blood from head, neck and arms enters into the heart through:

(a) superior vena cava (b) inferior vena cava

(c) pulmonary artery (d) pulmonary vein

45. Plasma in relation to lymphocytes is:

(a) hypotonic (b) hypertonic

(c) isotonic (d)supersaturated solution

46. Which one is abundant in Lymph?

(a) water (b) proteins

(c) lipids (d) minerals

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47. Which has mixing of oxygenated and deoxygenated blood?

(a) frog (b) fish

(c) mammals (d) birds

48. Guttation usually occurs when:

(a) atmosphere is warm (b) atmosphere is humid

(c) atmosphere is dry (d) in my atmosphere

49. The normal pH of human blood is:

(a) 4.7 (b) 7.0

(c) 7.4 (d) 4.0

50. When there is extracellular edema, the interstitum is _____ as compared to blood.

(a) hypotonic (b) hypertonic

(c) isotonic (d) supersaturated solution

51. Energy source that derives the upward flow of water is:

(a) light (b) sucrose

(c) solar heat (d) ATP

52. A root concentrates minerals by:

(a) diffusion (b) osmosis

(c) facilitated diffusion (d) active transport

53. Water potential measures the tendency beat is called:

(a) condense (b) adhere

(c) move from one place to another (d) evaporation

54. The relation of heart during heart beat is called:

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(a) systole (b) diastole

(c) diastasis (d) cardiac cycle

55. The most abundant leucocytes are:

(a) lymphocytes (b) monocytes

(c) eosinophils (d) neutrophils

56. Plasma proteins are:

(a) 7 – 9 % by wt (b) 7 – 9 % by vol.

(c) 0.7 – 0.9 % by wt (d) 0.7 – 0.9 by vol.

57. The blood vessel in earthworm which is both collective and distributing is:

(a) dorsal blood vessel (b) ventral blood vessel

(c) subnural vessels (d) all of these

58. The amino acid content of the blood increases as the blood flows through which organ?

(a) kidney (b) gall bladder

(c) live r (d) small intestine

59. Valves are found in the:

(a) arteries only (b) veins only

(c) capillaries only (d) both lymphatic vessels and veins

60. After vigorous muscular exercise which of the following blood vessels contains more bicarbonate ions in plasma:

(a) hepatic artery (b) pulmonary vein

(c) renal artery (d) vena cana

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UNIT NO. 5 (HUMAN PHYSIOLOGY)

1	B	2	D	3	C	4	B	5	C	6	A	7	C	8	A	9	D	10	B
11	A	12.	C	13	C	14	C	15	C	16	D	17	C	18	C	19	A	20	D
21	D	22	D	23	A	24	B	25	C	26	A	27	A	28	C	29	B	30	C
31	D	32	C	33	A	34.	A	35	A	36	A	37	B	38	D	39	B	40	A
41	B	42	C	43	C	44	A	45	C	46	A	47	A	48	B	49	C	50	B
51	C	52	D	53	C	54	B	55	D	56.	A	57	D	58	C	59	D	60	D

EXCRETON AND OSMOREGULATION

EXCRETION IN HUMAN:

Metabolic Wastes:

The wastes produced during the metabolism are called as metabolic wastes. The production of wastes depends upon the metabolic pathway and the chemicals present in the organism. The presence of the wastes in body in body is very dangerous. Therefore, these must be eliminated by the excretory system. The metabolic wastes and their sources are as follows.

Metabolic Wastes	Sources
Urea	Produced from the metabolism of amino acids
Creatinine	Produced from the muscle creatine
Uric acid	Produced from muscleic acid
Bilirubin	End products of heamoglobin, breakdown and metabolites of various hormones
Pesticides, drugs and food additives	Ingested into the body
Other toxins	Produced within the body and ingested into the body

Liver and kidney are the primary structures for eliminating waste products.

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Why is the Skin not an Excretory Organ?

Removal of salts with water by the sweat glands and of sebum by sebaceous glands seems to be excretory in nature.

The removal of water and salts from sweat glands is for thermoregulation. Similarly the sebum which is the oily secretion of sebaceous glands on the skin is:

- For protection against microorganisms
- Lubricant for hair and skin.

Therefore the skin may not be considered as an excretory organ.

MAIN FUNCTIONS OF THE LIVER:

Liver and Kidneys arc the primarystructures for eliminating wastes products, following are the main functions of the liver:

1. Interaction with most of Body's Organ Systems:

Liver is involved in interaction with most ofbody's organs systems.

2. Supports the Excretory Role of the Kidney:

Liver supports the excretory role of the kidney by detoxifying many chemical poisons. It produces nitrogenous wastes (ammonia. urea and uric acids) from the nitrogen of amino acids.

However urea is the principal excretory product and is detoxified form of ammonia. Liver forms it from the waste nitrogen (ammonia).

Urea can be retained in the body in greater amounts than ammonia and can be eliminated with 1/10 quantity of water as compared to ammonia.

3. Urea Cycle:

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The metabolic pathways involved in the production of urea are termed as urea cycle. Two ammonia and one carbon dioxide molecules arc shunted into the cycle to generate one molecule of urea. One ammonia molecule combines with carbon dioxide and omithine of the cycle to form citrulline. Then ammonia combines to form arginine. The arginine is split by arginase to form urea and the precursor omithine for next cycle.

4. Key Role in Homeostasis:

Liver is the central station of metabolism and has many key functions of homeostasis importance. Therefore, it is called as the central metabolic clearing house of the body.

Major homeostatic functions of the Liver are of synthesis, storage, conversion, recycling and detoxification type.

TABLE: Major homeostatic functions of the liver

FUNCTIONS	MAJOR EFFECTS ON HOMEOSTASIS
SYNTHESIS	
Nitrogenous wastes: NH_3 urea. uric acid	Support kidney in waste disposal
Plasma proteins: Like a) Prothrombinfibrinogen b) albumin etc.	 a) Blood Clotting b) maintain osmotic balance of blood
Bile	Emulsifies fats in small intestine
Lipids, cholesterol. Lipoproteins	Regulate blood chemistry, store energy and help to maintain cell membranes
STORAGE	
Iron	Oxygenation of tissues as constituent of haemoglobin
Glycogen	Energy reserves
CONVERSION	
Excess glucose in blood to glycogen, Lactic acid to glycogen and stored glycogen ant glucose	Energy storage and used
RECYCLING	
Contents of old red blood cells (e.g. iron and other constituents of hemoglobin)	Oxygenation of tissue
DETOXIFICATION	

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Many harmful chemicals (e.g. food additives pesticides, drugs etc.)	Assist kidney in toxin disposal

Liver and kidneys are the primary structures for eliminating waste products.

URINARY SYSTEM

Kidneys and their associated structures form urinary system. A pair of kidneys is located against the dorsal abdominal wall. The right kidney is little lower than the left kidney. Each Kidney is enclosed in a transparent membrane called the renal capsule which helps to protect them against infections and trauma.

The kidney is divided into two main areas, a light outer area called the renal cortex and a darker inner area called the renal medulla. Within the medulla there are 8 or more cone-shaped sections known as renal pyramids. The areas between the pyramids are called renal columns.

The normal kidney size of an adult human is about 10 to 13 cm (4 to 5 inches) long and about 5 to 7.5 cm (2 to 3 inches) wide Kidney weighs approximant 150 grams.

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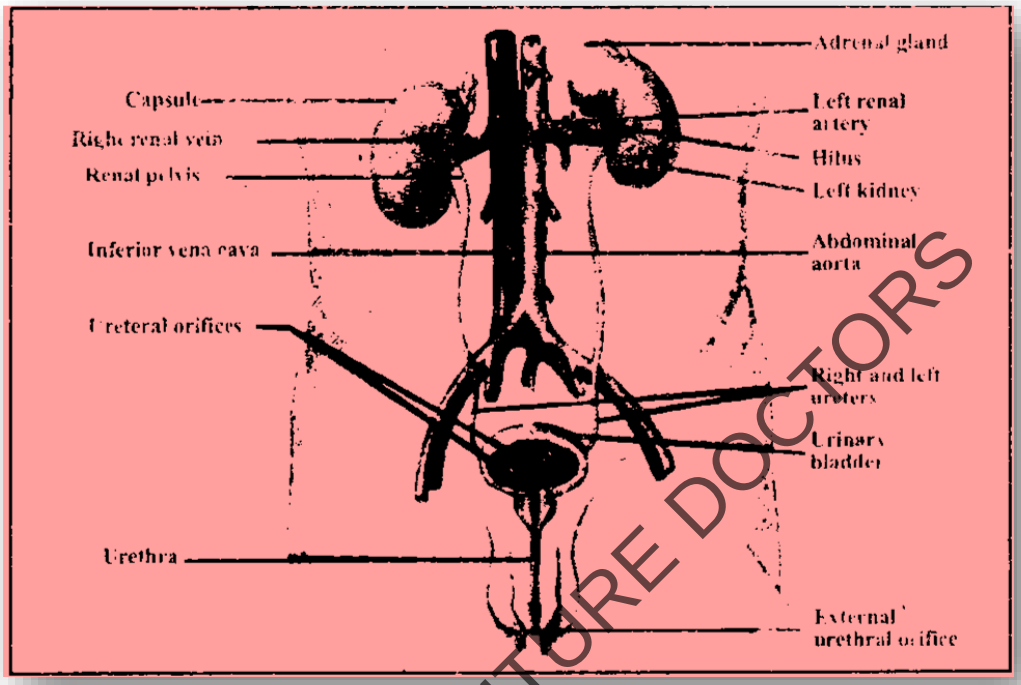

Fig. Human urinary system

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UNIT OF A KIDNEY

A kidney consists of millions of functional units called as nephrons. The nephrons have extensive blood supply via the renal arteries, which leave each kidney via the renal vein.

Pelvis:

After filtration of blood and further processing through tubular system, urine is collected in a central cavity of the kidney called as pelvis.

Ureter:

Urine leaves the kidney through a duct called ureter.

Urinary Bladder:

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The ureters of both the kidneys drain into urinary bladder.

Urethera:

Urine leaves the body during urination from the bladder through a tube called the urethcra. The urethra empties near the vagina in females or through the penis in males.

Sphincter Muscles:

Sphincter muscles near the junction of the urethra and the bladder control the urine in bladder.

NEPHRON

Nephrons are the functional units in human kidneys. Each human kidney contains about 1.25 million nephrons, together with a maze of blood vessels and some connective tissue.

TYPES OF NEPHRONS:

Nephrons are of two types:

1. Cortical Nephrons:

The nephrons arranged along the cortex are called as cortical nephron. (About 0.25 million/kidney)

2. Juxtamedullary Nephrons:

The nephrons arranged along the border of cortex and medulla with their tubular system looping deep in inner medulla are juxtamedullary nephrons (about one million/kidney).Juxtamedullary nephrons are especially helpful in the production of concentrated urine.

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STRUCTURE OF A NEPHRON:

Each nephron has following parts:

1. Bowman's Capsule:

In each nephron inner end forms a cup-shaped swelling called Bowman's capsule.

2. Glomerulus and Peritubular Capillaries:

The Bowman's capsule encloses a ball of capillaries called glomerulus. Glomerulus circulates blood through capsule as it arrives through afferent arteriole and leaves the capsule by efferent arterioles.The blood vessel subdivides again into another network of capillaries the pertiubular Capillaries. The peritubular capillaries intermingle with proximal and distal tubules of the nephron.

3. Vasa Recta:

In judxtamedullary nephrons additional capillaries extend down to from a loop of vessels called vasa recta.

4. Convoluted Tubules and Loop of Henle:

Bowman capsule continues as extensively convoluted proximal tubule loop of Henle and the distal convoluted tubule which empties into collecting tubules.

5. Collecting Tubules:

The collecting tubules open into pelvis. The filtrate from glomerulus passes through these structures (convoluted proximal tubule. Loop of Henle and the distal convoluted tubule) and is processed for urine formation.

The outer cortex of the kidney contains the renal capsules (also called Bowman’s capsules) and the first convoluted and second convoluted tubules (also called the proximal and distal tubules). While the medulla houses the loop of Henle and the

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collecting ducts. Bundles of collecting ducts form Pyramids that deliver urine into an open space called the pelvis. From here, urine flows down the ureters to 'the bladder.

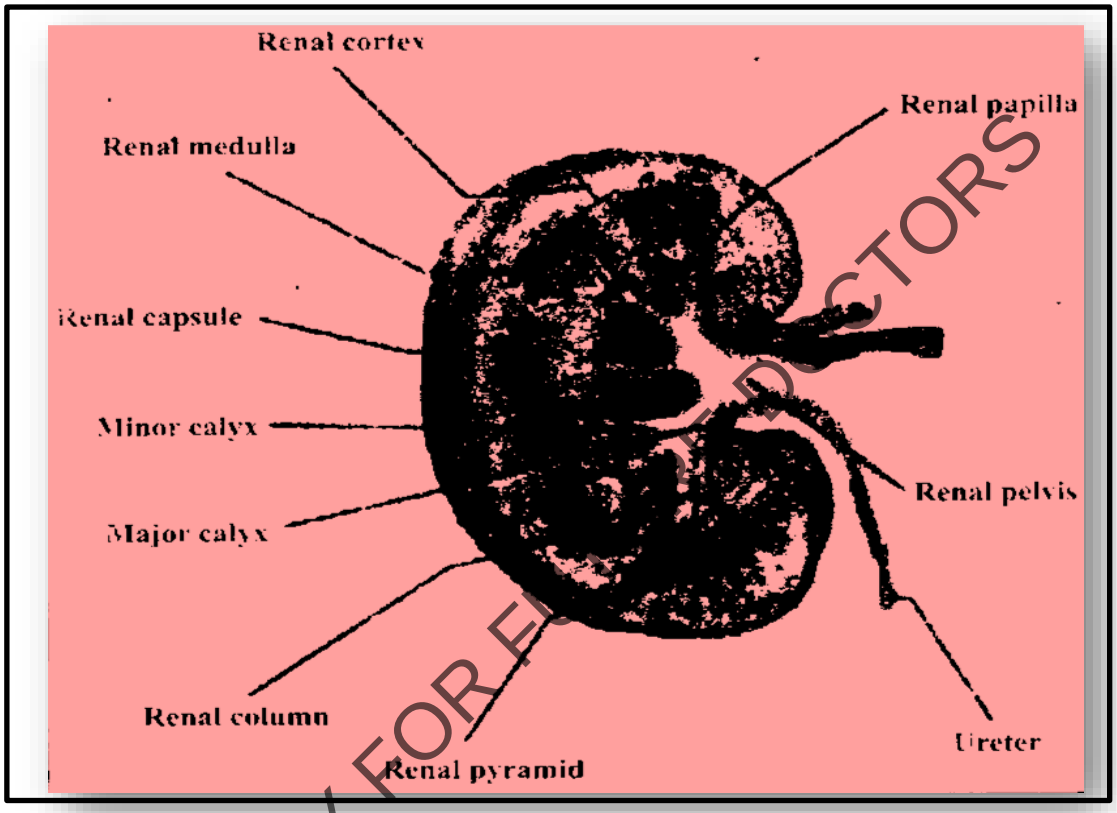

Fig. The structure of a kidney

FUNCTIONING OF THE KIDNEY/NEPHRON:

The function of kidney (and blood) is to clear the wastes. This function is clear from the fact that weight of kidneys are less than 1 % of the total body weight while receive 20 % of the blood supplied with each cardiac beat. The kidney forms urine by the following processes:

1. **Filtration / Pressure Filtration:** The glomerulus walls are porous, and the fraction of the blood pressure reaching here provides the filtration pressure. Therefore the blood passing through the glomerulus is filtered into Bowman's capsule. The rate of filtrate production is high; about 125 cm/per minute.The filtrate in the glomerulus is called as glomerular filtrate. It contains numerous useful substances such as glucose, amino acids,

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salts etc. in aqueous solution. Over 180 liters (50 gallons) of blood pass through the kidneys every day. When this blood enters the kidneys it is filtered and returned to the heart via the renal vein.

2. **Re-absorption of the Filtrate:** All the important components of the glomerular filtrate are reabsorbed and when filtrate leaves proximal tubules, it mostly contains nitrogenous wastes.

3. **Secretion:** The tubular epithelium also secretes substances into the lumen. This secretion is very selective and is mainly of hydrogen ions (H^+) to balance pH value of the filtrate passing through the tubule.

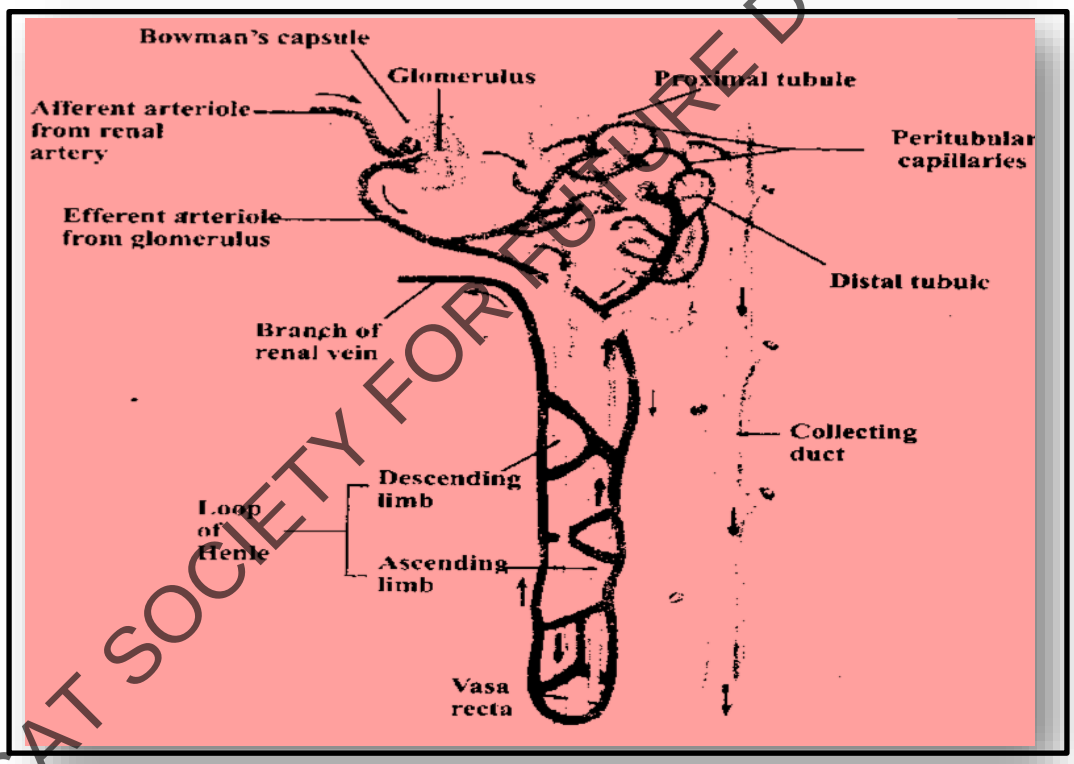

Fig: A nephron with vacular supply

CONCENTRATION OF EXCRETORY PRODUCTS:

In limited supply of water, the conservation of water is the main function of the body. This is done by concentration (absorption) of the filtrate by counter en mechanisms and by hormonal mechanisms.

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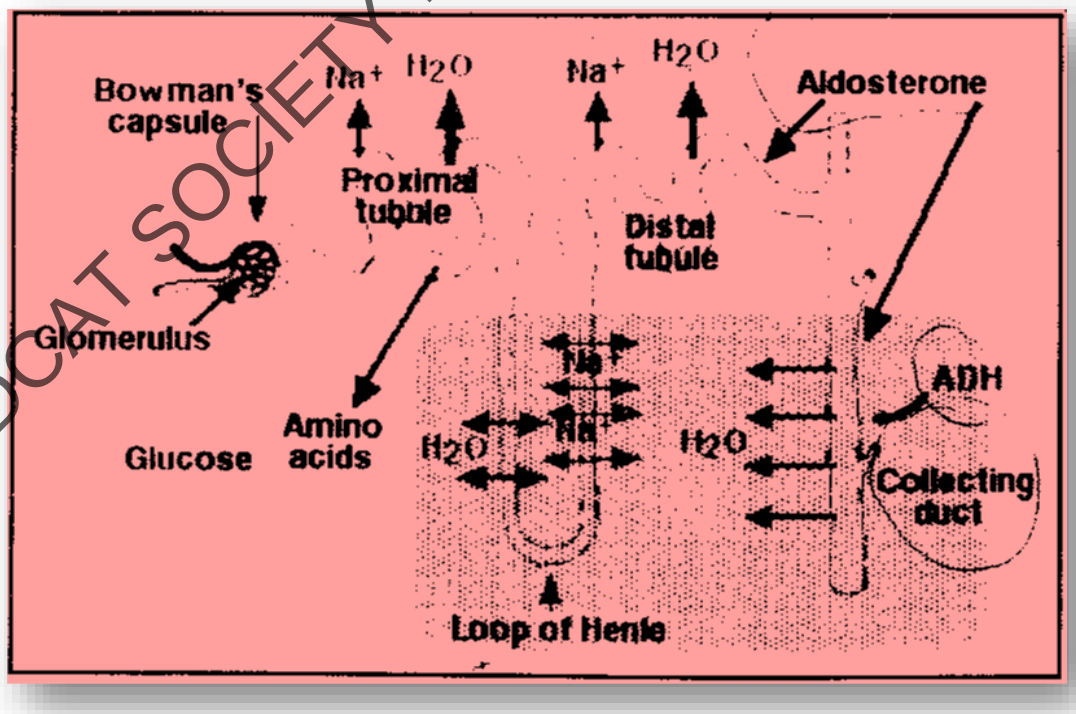
1. **Counter Current Mechanism:** The descending and ascending limbs of loop of Henle of long Juxtamedullary nephron and the overlying vasa recta forms counter current Multiplier.

The descending limb has selective permeability for water while the ascending limb actively secretes salts. The ascending limb of loop of Henle actively transports Na^+ into kidney interstitium to maintain its high concentration.

The interstitial fluid of the kidney is gradually concentrated from cortical to medullary part. Therefore there is gradual osmotic outflow of water from the filtrate back to kidney as it passes downward in the descending loop of Henle. Consequently, the urine becomes more and more concentrated (compared with body fluids) as it passes down the duct. So due to loop human and other land-living organisms get rid of waste without losing too much water.

Mammalian kidney including human is able to conserve water by over 99.5 re-absorption of glomerular filtrate. On average we produce about 1 cm^3 of urine per minute.

The second convoluted tubule reabsorbs the remaining fluid, according to the immediate needs of the body. This tubule plays an important role in the regulation of pH salt and water balance.



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WATER GAIN	VOLUME/cm^3	WATER LOSS	VOLUME/cm^3
Food and drink Metabolic water	2100 200	Through skin Sweat in breath urine feces	350 100 350 1400 100
Total	2300	Total	2300

TABLE: The water balance sheet for a 24-hour period

2. Hormones:

The absorption of the filtrate is also done by hormonal mechanisms. Following hormones are involved:

Aldosterone:

The active uptake of sodium in the ascending limb or thick loop of Henle is promoted by the action of aldosterone. This hormone is secreted from adrenal cortex. Like most homeostatic mechanisms, maintenance of water balance involves a negative feedback. A part of the brain, the hypothalamus, contains osmoreceptor cells that are sensitive to the solute concentration of the blood. When the solute concentration rises, indicating that water loss has exceeded intake, the hypothalamus responds in two ways: It stimulates the thirst center in the brain. It stimulates the pituitary gland to release anti-diuretic hormone (ADH). Antidiuretic hormone (ADH) is released from posterior pituitary.

ADH act on the kidney to reduce the volume of urine produced it achieve, this by increasing the permeability of the second convoluted tubule and the collecting duct to water. The action of ADH causes more water to leave the tubule and re-enter the blood. Much more concentrated urine is produced and vital water is conserved.

When fluid intake exceeds loss, the blood becomes more dilute. When the hypothalamus detects this it reduces ADH production. The action of ADH on the kidneys lessens, resulting in less water re-absorption and the production of larger volumes of dilute or insipid urine.

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People with the disease diabetes insipidus cannot produce ADH because they have a faulty pituitary gland. Today it can be treated by giving extracted or synthesized ADH.

Kidney as Osmoregulatory Organ:

The production of different concentrations of urine depending on the availability of water shows that kidney functions as an osmoregulatory organ along its excretory role of nitrogenous wastes.

Hormones and Enzymes of the Kidneys:

The human kidney is also an endocrine gland secreting two hormones:

Erythropoietin (EPO) is a glycoprotein hormone that controls erythropoiesis, or red blood cell production, It is produced by the peritubular capillary endothelial cells in the kidney. EPO is also involved in the wound healing process.

Calcitriol: It increases the level of calcium (Ca^{2+}) in the blood by:

(1) increasing the uptake of calcium from the gut into the blood.

(2) decreasing the transfer of calcium from blood to the urine by the kidney, and

(3) increasing the release of calcium into the blood from bone.

The enzyme Renin is secreted by the kidneys to regulate the body's balance of fluids and electrolytes.

This enzyme is also involved in the in the regulation of blood pressure, Renin should not be confused with rennin. Rennin is an enzyme generated in the stomachs of young mammals to help them digest milk.

KIDNEY PROBLEMS AND CURES

Sometimes unusual condition may arise in the function of kidney by factors originating within the kidney or outside, this cause serious kidney diseases.

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1. KIDNEY STONES:

Causes of Kidney Stones: These are formed in the following metabolic diseases:

(i) Hypercalcemia:

It is the high level of circulating calcium in blood because of other diseases.

(ii) Hyperoxaluria:

It is the higher level of oxalates in the blood. This is the major cause of the formation of calcium oxalate stones. Oxalates are present in green vegetables and tomatoes therefore may be the source of hyperoxaluria.

Chemical Nature of Kidney Stones:

- Kidney stones have specific chemical nature.

(i) Calcium Oxalate Types:

The incidence of calcium oxalate type is 70 of all the kidney stones.

(ii) Calcium Phosphate Types:

The incidence of calcium phosphate type of kidney stone is 15 %.

(iii) Uric Acid Types:

The incidence of uric acid type of kidney stone is 10 %.

Formation of Kidney Stone:

The above mentioned salts (calcium oxalate, calcium phosphate and uric acid) are precipitated out during urine formation and accumulate later to form stone. Stones of phosphates are generally formed and trapped in the pelvis area.

Effects of Kidney Stone:

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Stony materials in the kidney cause urinary obstruction. As a result complicated infections may arise.

Removal of Kidney Stones:

The kidney stones are removed by kidney surgery. Presently Lithotripsy is used for non-surgical removal of kidney stone.

Lithotripsy:

It is the technique used to break up stones that form in the kidney, ureter or gall bladder. There are several ways to do it. However the most common is extracorporeal shock wave lithotripsy.

Extracorporeal Shock Wave Lithotripsy:

In this technique high concentrations of X-ray or ultrasound are directed from a mechanic outside the body to the stone inside. The shock waves break the stone in tiny pieces or into sand, which are passed out of the body in urine.

2. Renal Failure:

Causes of Renal Failure:

Various factors of pathological and chemical nature may progressively destroy the Nephron, particularly its glomerular part. As a result the level of urea and other nitrogenous wastes increases in the blood plasma. The rise in urea causes increase in blood pressure and anemia etc.

Renal failure is of two types:

(i) Chronic Renal Failure:

In chronic renal failure, the function of the kidney is lost completely and it can never remove nitrogenous wastes. To remove nitrogenous wastes particularly the urea, the blood of the patient is treated through dialysis. There are two types of dialysis: hemodialysis and peritoneal dialysis.

(a) Hemodialysis: Hemodialysis means cleaning the blood. In this procedure blood is circulated through a machine which contains a dialyzer also called an artificial kidney. Dialyzer is a kidney machine that works on the same principles as in the

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kidney for the removal of nitrogenous wastes and excess water from the blood. It is used after kidney failure and dialysis is done again and again until a matching donor's kidney is transplanted. Dialyzer has two spaces separated by thin membrane. Blood passes from one side of the membrane and dialysis fluid on the other.

The wastes and excess water pass from the blood through the membrane into the dialysis fluid.

(b) Peritoneal Dialysis: Peritoneal dialysis works on the same principle except that abdomen has a peritoneal cavity, lined by a thin epithelium called peritoneum. Peritoneal cavity is filled with dialysis fluid that enters the body through a catheter. Excess water and wastes pass through the peritoneum into the dialysis fluid. This process is repeated several times in a day. In both types of dialysis (hemodialysis and peritoneal dialysis) the wastes and excess water arc removed during the treatment as being done by the healthy kidneys. However dialysis may be used as a temporary measure.

(ii) High Degree Renal Failure:

High degree renal failure is also called as uremia or end-stage renal disease. In this case the dialysis cannot be done. The permanent treatment is the surgical transplantation of a matching donor kidney.

ADDITIONAL / RELATED READINGS

1. The plants growing in aquatic habitats are called hydrophytes. Examples are Hydrilla, Vallisnaria and Nelumbium etc.

2. Hydrophytes have plenty of water. Therefore, cuticle absent on the root, stem and leaves of hydrophytes, Stomata on the upper surface. Leaves with large surface area result are excessive transpiration. Parenchyma also present for storage of Oxygen.

3. The plants growing in moderate habitats are called mesophytes. Examples are Brassica, Rose, Mango, Cereals and Banyan etc. These plants face varying condition of water availability. Leaves and branches with cuticle, Stomata usually on lower epidermis.

4. The plants growing in severely dry habitats are called xerophytes. Examples are Opuntia, Cactus. Calatropis etc. These plants have following adaptations for reduced rate of

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transpiration. Thick cuticle, sunken stomata and some Xerophytes store water (Succulent plants).

5. The animals which do not need to adjust their internal osmotic state and the body fluids arc kept isotonic to the external environment are known as osmoconformers.

6. The animals whose body fluid concentrations differ with outside environment regulate internal state by discharging excess water in hypotonic and excreting salts in hypertonic conditions. Therefore these animals are called as osmoregulators.

Note: Osmoconformers are only Marine. Why are Osmoconformers not Freshwater?

7. Osmoconformers: Most marine invertebrates are osmoconformers. Among the vertebrates Hagfishes are isotonic with the surrounding sea's water.

8. Blood of Sharks is hypertonic as compared to the sea water.

9. Fresh water animals are constantly facing the osmotic flooding of body fluids and loss of salts.

10. Fresh water Protozoa. Amoeba and Paramecium pump out excess water by contractile vacuoles.

11. Freshwater environment is Hypotonic. Endosmosis occurs. Therefore freshwater fishes discharge diluted urine.

12. Marine Environment is Hypertonic. Exosmosis occurs. Therefore marine Fishes drink water.

13. Kangaroo rat survives without drinking water. It is the Master or King of water Conservation. It has longest Henle's Loop. Longer is the Henle's Loop more is the concentrated urine.

14. Terrestrial animals can tolerate dehydration and it differs in various animals. This characteristic is known as anhydrobiosis. Targigrades (Tiny 1 mm long invertebrates) contain 85 % water in the hydrated state. They are dehydrated to less than 2 % water and survive in an inactive state (as dry dust) for long time. Human beings can tolerate short supply of water due to the role of ADH.

15. Water is the excretory product in the hyperosmotic environment while the salts are the excretory products in the hypertonic environment.

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16. During catabolism of Amino Acids, First of all deamination occurs. The release of amino group (– NH_2) from the amino acids is called as deamination.

    Note: The major problem for terrestrial life is the evaporation loss of water leading to dehydration.

17. Due to high level of Ammonia there is self-intoxification of plasma, Convulsions, coma and finally death.

18. Metabolism of purine and pyrimidine bases produces significant amount of nitrogenous wastes of hypoxanthine xanthine, allantoin, uric acid, urea and ammonia.

19. About 500 ml water is required to eliminate 1 g of nitrogen in the form of ammonia. Animals excreting ammonia are called as ammonotelic. Most aquatic animals including many fishes are ammonotelic.

20. Only 50 ml water is required to eliminate 1 g of nitrogen in the form of urea. Animals excreting urea are called as ureotelic, Mammals, most amphibians, sharks and some bony fishes a ureotelic.

21. Only I ml water is required to eliminate 1 g of nitrogen in the form of uric acid. Animal, excreting uric acid are called as uricotelic. Birds, insects, many reptiles and land snails are uricotelic.

22. Protonephridia is found in planaria, rotifers, some annelids, larvae of mollusks and lancelets.

23. The earthworm has tubular excretory system called as metanephridium.

24. Reabsorption occurs in Metanephridium but not in protonephridium.

25. Water ammonia and urea are principal wastes from Metanephridium.

26. Malpighian tubules are present in the Arthropods (Insects) and are involved m the excretion of uric Acid.

27. The ancestors of vertebrates, the invertebrate chordate have segmentally arranged excretory structures throughout the body like the metanephridia in earthworm.

28. In the vertebrates the basic functional unit in the kidneys IS the nephron called as vertebrate nephron.

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29. The wastes produced during the metabolism are called as metabolic wastes.

30. Most plants survive in heat stress by synthesizing Heat shock proteins.

31. In low temperature the fluidity of the cell membrane of plants is altered. Plants increase the proportion of unsaturated fatty acids. It helps the membrane to maintain structure at low temperature by preventing crystal formation.

32. Many plants of cold areas develop super cool system. As a result there is no formation of ice crystals.

33. Temperature of an animal depends upon the rate of change of body heat. It is the balance of Heat in, heat produced and heat out.

34. Poikilotherms are the animals in which body temperature fluctuates more or less with the changing air or water temperature. All invertebrates, amphibians and reptiles are present in this group.

35. Homeotherms are the animals in which body temperature is maintained in the changing air or water temperature. All birds and mammals are present in this group.

36. Deep sea fishes maintain their body temperature due to the constant natural surroundings.

37. Endotherms are the animals that generate their own body heat through heat production as byproduct during metabolism. These include birds, some fishes and flying insects.

38. Ectotherms are the animals which produce metabolic heat at low level and that is also exchanged quickly with the environment. However, absorb heat from their surroundings. Most invertebrates, fish, amphibians and reptiles are in this category.

39. Heterotherms are the animals that are capable of varying degrees of endothermic heat production hut generally do not regulate their .body temperature within a narrow range. The examples arc bats and humming bird etc.

40. Panting is structural or Morphological adaptation. It is the evaporative cooling in the respiratory tract. It can be observed in the dogs.

41. The activation of certain muscles causes plumage fluffing.

42. Because of their endothermic characteristics mammals including human maintain their high body temperature within a narrow range of about 36 – 38^{o} C.

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43. The increase in rate of heat production by increased muscle contraction by movements or shivering is called as shivering thermogenesis.

44. The hormones trigger the heat production as do thyroid hormones and are called as non-shivering thermogenesis.

45. If the body loses more heat than it is producing, the blood supply to the skin capillaries is reduced. In this case the skin capillaries are constricted. The process is called vasoconstriction.

46. In overproduction of heat more blood flows to the skin surface because the skin capillaries dilate and some heat is lost by radiation or evaporative cooling. This is vasodilation.

Note: Fever (high temperature) helps in stimulating the protective mechanisms against the pathogens.

47. Temperature in fever due to pyrogens is called pyrexia.

48. In bacterial and viral infections mainly, leukocytes increase in number. These pathogens and the blood cells produce chemicals called as pyrogens.

49. Pyrogens displace the set point of hypothalamus above the normal point of37°C.

50. Glomerular capsule: A cuplike structure that is the initial (proximal) portion of a nephron, where pressure filtration occurs.

51. Glomerulus: A capillary network within a glomerular capsule of a nephron.

52. Homeotherm: An animal (bird or mammal) that maintains a uniform body temperature independent of the environmental temperature.

53. Renal cortex: The outer layer of the kidney where nephrons arc located.

54. Renal medulla: The layer of the kidney just inside the renal cortex: where loops of Henle produce a highly concentrated interstitial fluid, important in the production of concentrated urine.

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QUESTIONS FOR PRACTISE

1. Interstitial fluid closely resembles:

(a) sea water (b) lake water

(c) pond water (d) rain water

2. Idea of Homeostasis was presented by:

(a) Bernard (b) Huxley

(c) Darwin (d) Pasteur

3. Homeostasis occurs in:

(a) all organisms to an extent (b) multicellular organisms only

(c) animals only (d) birds and mammals only

4. Osmoregulatory tissue in all animals:

(a) epithelial (b) connective tissue

(c) nervous (d) muscle

5. In the flame cell system of a planarian, materials are drained directly from the:

(a) blood (b) lymph

(c) interstitial fluid (d) coelom

6. Main function of flame cell system is to:

(a) remove N-wastes (b) remove urea

(c) osmoregulate (d) regulate pH

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7. Organisms that normally convert nitrogenous waste product ammonia into other compounds generally

(a) are plants (b) occupy an aquatic habitat

(c) are animals (d) have a terrestrial mode of life

8. In insects, Malpighian tubules drian materials directly from the:

(a) gut (b) haemocoel

(c) blood (d) lymph

9. Malpighian tubule empties urine into:

(a) gut (b) coelom

(c) ureters (d) lymph

10. Which component of feces is an excretory product?

(a) bacteria (b) bile pigments

(c) cellulose (d) undigested food

11. The excretory organs of Silkworm when adult are:

(a) metanephridia (b) malpighian tubules

(c) nephron (d) protonephridia

12. The nephridia of Neries eliminate excretory matter from the:

(a) blood (b) coelomic fluid

(c) blood and coelomic fluid (d) skin

13. Which one of the following is not normally uricotelic?

(a) insects (b) bird

(c) land snail (d) fish

14. A nephridium of an earthworm drains materials directly from the:

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(a) gut (b) coelom

(c) blood (d) lymph

15. Which one has unique and quite different plane from other animal's excretory system?

(a) man (b) earthworm

(c) grasshopper (d) planaria

16. The blood vessel supplying the Bowman's capsule is:

(a) afferent arteriole (b) efferent arteriole

(c) renal artery (d) renal vein

17. A decreased water supply to body results in increased secretion of:

(a) ADH (b) insulin

(c) sugar (d) glucagon

18. Hag fishes are:

(a) osmoconformers

(b) osmoregulators

(c) thermoregulators

(d) sometimes osmoconformers but mostly osmoregulators

19. Anhydrobiosis means:

(a) to live in excess water (b) to live in water shortage

(c) to tolerate water shortage in body (d) to live in anaerobic condition

20. A mammal having moderate supply of water excretes N in the form of:

(a) ammonia (b) urea

(c) amino acids (d) uric acid

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21. Bowman's capsule functions as:

(a) filter (b) bellows

(c) suction pump (d) sponge

22. Which is removed from Henle's loop?

(a) water (b) ammonia

(c) glucose (d) magnesium

23. One ml of water is required to eliminate one gram of nitrogen in the form of:

(a) ammonia (b) urea

(c) uric acid (d) purine

24. Well-developed Henle's Loop in:

(a) desert animals (b) all mammals

(c) fresh water animals (d) all marine animals

25. Hydra is:

(a) osmoconformers

(b) osmorcgulators

(c) thermoregulators

(d) sometimes osmoconformers but mostly osmorcgulators

26. Modern way of Kidney stone treatment is:

(a) laser therapy (b) extracarporcal therapy

(c) shock wave therapy (d)) extracarporeal shock wave lithotripsy

27. Bowman's capsule leads into:

(a) tubule (b) nephron

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(c) collecting duct (d) nephron and collecting duct

28. A lizard basks ill the sun to get heat by:

(a) conduction (b) convection

(c) Increasing aerobic respiration (d) Increasing anaerobic respiration

29. In winters, a man shivers to:

(a) increase blood pressure (b)increase body temperature

(c) increase sweating (d) increase heart beat

30. Water is stored in the stem of some desert plants, they are:

(a) hydrophytes (b) mesophytes

(c) all xerophytes (d) succulents of xerophytes

31. The animals which generate their own heat to maintain body temperature are:

(a) endotherm (b) ectotherm

(c) hetrotherm (d) both endotherm and ectotherm

32. Among vertebrates, uric acid is the chief nitrogenous waste in birds and:

(a) fishes (b) amphibians

(c) reptile (d) mammals

33. In marine bony fish there is:

(a) water drinking (b) passive loss of water

(c) active loss of water (d) passive loss of water and water drinking

34. Leaves with very small surface area are found in:

(a) hydrophytes (b) mesophytes

(c) xerophytes (d) sciophytes

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35. The layer of the kidney just inside the renal cortex; where loops of Henle produce a highly concentrated interstitial fluid, important in the production of concentrated urine is called:

(a) hilus (b) renal medulla

(c) pelvis (d) pelvis and medulla

36. Peritoneal cavity is lined by:

(a) intestine (b) thin epithelium

(c) abdominal wall (d) body fluid

37. Detoxification at body level occurs with the help of:

(a) liver (b) kidney

(c) pancreas (d) glomerular capsule

38. Hypoxanthine is formed by:

(a) purine metabolism (b) pyrimidine metabolism

(c) urea cycle functioning (d) purine and pyrimidine metabolism

39. Change in leaf color, before falling, is due to:

(a) pigmented compounds

(b) toxic materials

(c) chlorophyll out

(d) pigmented compounds and toxic materials

40. Feedback mechanism is:

(a) detection of change

(b) sending signals

(c) response of effectors

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(d) detection of change, sending signal and response of effectors

41. Extremely narrow fluctuations present in the:

(a) blood plasma (b) cell

(c) body (d) blood

42. Which compound does not take part in urea cycle?

(a) arginine (b) adenine

(c) TMO (d) adenine and TMO

43. The phenomenon that leads to the flushing of skin because of increased blood supply:

(a) vasodilation

(b) vasoconstriction

(c) fluctuations in environment

(d) vasoconstriction and fluctuations in environment

44. It is possible to live in different habitats, by regulating all body materials and Temperature etc. due to:

(a) osmoregulation (b) thermoregulation

(c) homeostasis (d) osmoregulation and thermoregulation

45. The environment in which the cell solutions are concentrated is the:

(a) hypotonic (b) hypertonic

(c) isotonic (d) interstitial fluid

46. Which part of the Cactus, during the driest season, is photosynthetic?

(a) stem (b) leaf

(c) stem and leaf (d) all non-photosynthetic

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47. Animals with acute short supply of water excrete:

(a) uric acid (b) urea

(c) urea and uric acid (d) uric acid and allanatoin

48. A protonephridium is a:

(a) network of closed tubules (b) closed tube

(c) flame cell (d) cluster of !lame cells

49. Osmotic balance of the blood is maintained by:

(a) albumin (b) fibrin

(c) prothrombin (d) prothrombin, fibrinogen and albumin

50. The primary structure for eliminating waste products:

(a) liver (b) kidneys

(c) liver and kidneys (d) liver, kidneys and skin

51. The glomerular filtrate is:

(a) corpuscles less blood

(b) urine

(c) mixture of corpuscles, water and ammonia

(d) corpuscles and plasma protein less blood

52. The function of efferent arteriole is related to nephron as it helps in:

(a) pressure filtration (b) reabsorption

(c) secretion (d) pressure filtration and Secretion

53. Heat shock proteins are produced in plants of _____ region.

(a) tropical (b) temperate

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(c) both tropical and temperate (d) tropical, temperate and boreal plants

54. Animals in which body temperature fluctuates with ambient temperature where air or water temperature are changed:

(a) poikilothcrms (b) heterotherms

(c) homeotherms (d) endotherms

55. Which of the following do not drink water?

(a) marine fishes (b) fresh water fishes

(c) both of these (d) some fresh water fishes

56. Generally leaves stores excretory material to the concentrations of crystal formation in:

(a) cytosol

(b) vacuole

(c) nucleus

(d) space between cell wall and cell membrane

57. Besides leaves, the plants also store excretory substances in:

(a) sapwood (b) heartwood

(c) phloem (d) cortex

58. Precursor for the fixation of ammonia in urea cycle is:

(a) citrulinc (b) arginine

(c) ornithine (d) arginosuccinate

59. Which is not a poikilotherm?

(a) invertebrates (b) amphibians

(c) reptiles (d) birds

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UNIT NO. 5 (HUMAN PHYSIOLOGY)

1	A	2	A	3	A	4	A	5	C	6	C	7	D	8	B	9	A	10	B
11	B	12.	C	13	D	14	B	15	C	16	A	17	A	18	A	19	C	20	B
21	A	22	A	23	C	24	A	25	A	26	D	27	A	28	A	29	B	30	D
31	A	32	C	33	D	34.	C	35	B	36	B	37	A	38	D	39	D	40	D
41	B	42	D	43	A	44	D	45	B	46	A	47	A	48	A	49	A	50	C
51	D	52	A	53	B	54	A	55	B	56.	V	57	V	58	C	59	D		

SUPPORT AND MOVEMENT

SOME MAJOR FUNCTIONS OF THE SKELETAL SYSTEM:

(i) Support and Shape:

Bones support soft tissues and serve as attachment sites for most muscles and provide shape to the body.

(ii) Protection:

Bones protect critical internal organs, such as brain, spinal cord, heart, lungs and reproductive organs.

(iii) Movement:

Skeletal muscles attached to the bones help move the body.

(iv) Mineral Homeostasis:

Bones serve as storehouse for calcium, phosphorus, sodium and potassium. Through - negative feedback mechanisms, bones can release or take up minerals to maintain homeostasis.

(v) Blood Cell Production:

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Red and white blood cells are produced in bone marrow. a connective tissue found within certain bones.

BONES AND CARTILAGES

The endoskeleton IS primarily made up of two types of tissues which are bones and cartilage. Both bones and cartilage are types of rigid connective tissue and consists of cells embedded in the matrix of protein called collagen.

1. Bone:

Bone is the most rigid form of connective tissue in which the collagen fibers are hardened by deposit of calcium phosphate.

Structure of a Bone:

Bones of arms and legs consist of two parts:

(i) Compact Bones:

It is an outer shell which is dense and strong and provides an attachment site for muscle

(ii) Spongy Bones:

Spongy bone is in the interior. It is lightrich in bloodvesselsand highly porous. The cavities of spongy bone contain bone marrow where the blood cells are formed

Cells Associated with Bone:

There are three types of cells associated with the bone:

(i) Osteoblasts: These are bone- forming cells.

(ii) Osteocytes: These are mature bone cell.

(iii) Osteoclasts: These are bone dissolving cells.

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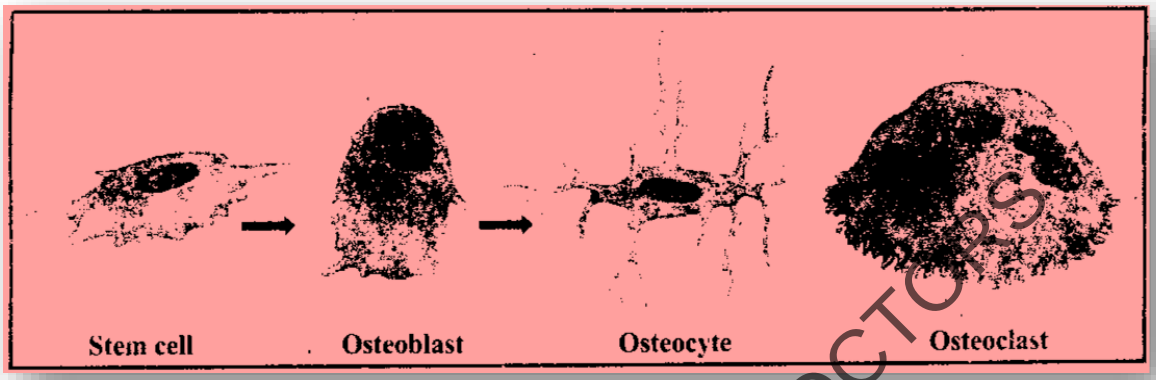

Fig. Cells of bone

Development of a Bone from Cartilage:

When a bone is replacing cartilage, the osteoclasts invade and dissolve the cartilage. Then osteoblasts replace it with bone. As bones grow, the matrix of the bone is hardened and the osteoblasts are gradually entrapped within it.

2. Cartilage:

Development of Cartilage:

Cartilage is formed of living cells called chondrocytes which secrete flexible elastic. Non-living matrix called collagen that surrounds the chondrocytes. No blood vessels penetrate into the cartilage. Cartilage is much softer than a bone. It is a form of connective tissue.

Location:

Cartilage covers the ends of the bone at the joint. It also supports the flexible portion of nose and external ears.

Types of Cartilage:

There are two main types of cartilage.

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(i) Hyaline Cartilage: It is the most abundant type in human body and is found at the moveable joints.

(ii) Fibro Cartilage: It has matrix containing bundles of collagens fibers. It forms external pinnae of ears and in the epiglottis.

HUMAN SKELETON

Human skeleton can be divided into two parts, axial skeleton and appendicular skeleton.

1. Axial Skeleton:

The axial skeleton includes:

(i) The skull

(ii) The vertebrae and

(iii) The ribs and sternum

(i) Skull:

It is made up of Cranium and Facial bones.

(a) The Cranium: The cranium consists of 8 bones, 4 unpaired and 2 paired, which protectthe brain.

Paired Bones: Parietal and temporal are paired bones.

Unpaired Bones: Frontal, occipital, sphenoid and ethmoidis unpaired bones.

(b) Facial bone: There are 14 facial bones of which 6 are paired and 2 unpaired.

Pared facial bones: the paired facial bones are maxilla, zygomatic, nasal, lacrimal palatine and inferior concha

Unpaired facial bones: the unpaired facial bones are mandible and vomer

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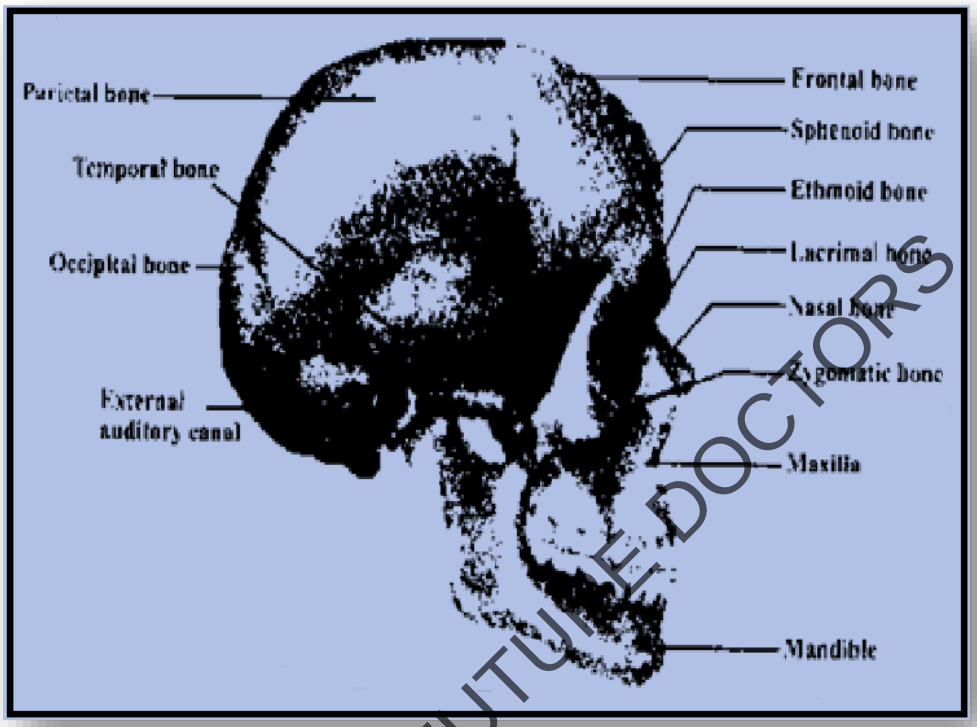

Fig. Human skull

(ii) Vertebral Column:

Vertebral column extends from skull to the pelvis to form backbone.

Advantage of Vertebral Column: Vertebral column protects the spinal cord.

Normally the vertebral column has 4 curvatures, which provide more strength than the straight column.

Vertebrae of vertebral column: The vertebral column consists of 33 vertebrae. These vertebrae are named according to their location in the body. These are cervical, thoracic, lumbar and pelvic.

(a) Cervical Vertebrae: The cervical vertebrae are seven which lie in the neck region. The first two cervical vertebrae are atlas vertebra and axis vertebra.

(b) Thoracic Vertebrae: There are twelve thoracic vertebrae located in the thoracic region.

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(c) Lumbar Vertebrae: There are five vertebrae in lumbar region.

(d) Pelvic Vertebrae: There are nine vertebrae in pelvic region which form two sets, sacrum and coccyx.

Sacrum is formed by the fusion of anterior five vertebrae.

The coccyx is formed by the fusion of four posterior vertebrae.

(iii) Rib Cage:

Rib cage is composed of twelve pairs of ribs that articulate with the thoracic vertebrae, Ten of them connect interiorly with sternum, either directly or through the costal arch, The lower two pairs of ribs are called "floating ribs" because they do not attach with the sternum. Function of the Rib Cage: The rib cage provides support for a semi-vacuum chamber called the "chest cavity".

2. Appendicular Skeleton:

The appendicular skeleton consists of:

(i) Pectoral girdle and appendages (fore limbs)

(ii) Pelvic girdle and appendages (hind limbs)

(i) Pectoral Girdle and Fore Limb:

Pectoral Girdle: Pectoral girdle consists of scapula, suprascapula and clavicle. The clavicle connects scapula with sternum.

Fore Limb: The fore limb consists of 1 humerus, 2 radius and ulna, 8 carpals, 3 metacarpals and 14 phalanges. Humerus forms ball and socket joint with scapula. Whileat distal end humcrus forms hinge joint with radius and ulna.

The radius and ulna at their distal end form multistage joint with eight wrist bones called carpals. Five metacarpals form the framework of palm of the hand. Five rows of the phalanges are attached to the metacarpals. They support the fingers.

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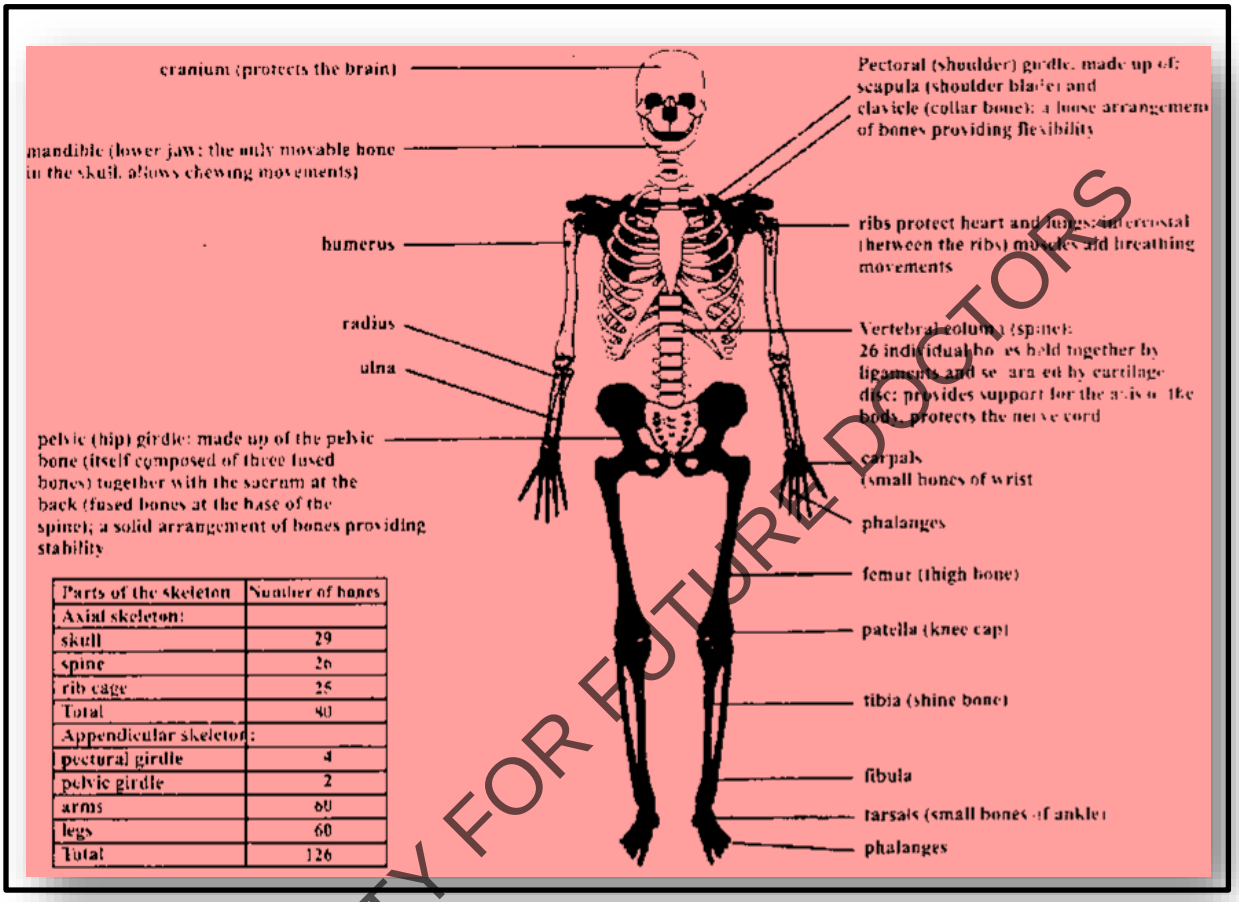

Parts of the skeleton	Number of bones
Axial skeleton:	
skull	29
spine	26
rib cage	25
Total	80
Appendicular skeleton:	
pectural girdle	4
pelvic girdle	2
arms	60
legs	60
Total	126

Fig: Human Skelton

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(ii) Pelvic Girdle and Hind Limb:

Pelvic Gridle, attaches the hind limb to the vertebral column.It consists of two coxal bones. Each is formed by the fusion of three bones ileum ischium and pubis. Function of the Pelvic Gridle: The pelvic girdle supports the pelvic region.

Hind-Limb: The hind-limb consists of 1 femur, 1 tibia and 1 fibula, 7 tarsals, 5 metatarsals and 14 phalanges. Femur is the proximal bone which forms a hip joint with the hipbone. It is a ball and socket joint.

At the distal end the femur forms knee joint with the proximal end of two parallel bones called tibia and fibula. The distal end of the tibia and fibula forms a joint with eight tarsals, which arc also distally attached with five metatarsal bones of

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ankle. Phalanges of the toes are attached with metatarsals. There are fourteen phalanges which are arranged in five rows.

JOINTS

Joints occur where bones meet.

Function: Joints not only hold our skeleton together but also give it the mobility.

1. Classification of Joints on the Basis of Movement:

There are 3 types of joints on the basis of the amount of movement allowed by them:

(i) **Immovable Joints:** Such joints are present in the skull. These joints allow no movement.

(ii) **Slightly Movable Joints:** Hyaline cartilage forms joint between growing bone & allow little movement.

(iii) **Freely Movable Joints:** The freely movable joints are of two types viz. hinge joint and ball and socket joint.

2. Classification of Joints on the Basis of Structure:

(i) **Fibrous Joints (Immovable Joints):**

These joints are held together by short fibers embedded in connective tissue. Example: Joints in the skull, and the joint which fix teeth into the jaws.

(ii) **Cartilaginous Joints (Slightly Movable Joints):**

These joints allow little or no movement. These are of two types:

(i) Hyaline cartilage formed joint between growing bones

(ii) Fibrous cartilage joints are found between vertebrae at the point where coxal bones meet in front of the pelvis.

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(iii) Synovial Joints (Freely' Movable Joints): These joints contain a cavity filled with fluid. This fluid reduces the friction between the moving joints.

The joint is surrounded by a layer of connective tissue called fibrous capsule and their inner layer the synovial membrane. Some parts of capsule are modified to form distinct ligament holding the hones together. Based onstructure and movements allowed the synovial joints can be classified further into following major types.

1. Hinge Joint:

It is the joint that allows the movements in two directions.

Examples: These are at elbow, knee and fingers.

Arrangements of Muscles: At these joints, pair of muscles arc arranged in the same plane as that of joints, One end of each muscle (the origin) is fixed to the immovable bone on one side of joint and the other end of muscles (the insertion) is attached to the far (distal) side of the joint.

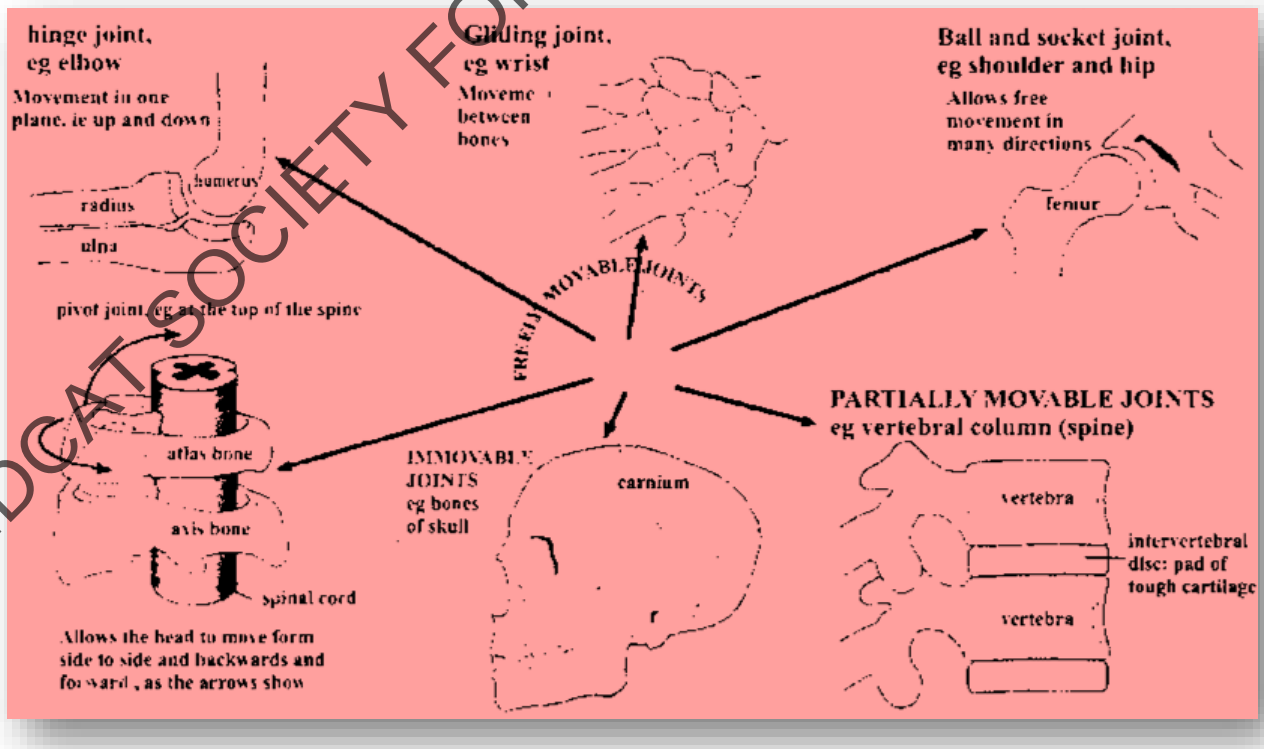

Fig: Three kinds of joints

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2. Ball and Socket Joint:

It is the joint that allows the movement in several directions.

Examples: Hip joint and shoulder joint.

Arrangements of Muscles: Such joints have at least two pairs of muscles present perpendicular to each other. They provide maximum flexibility.

DEFORMITIES OF SKELETON

Some major causes of deformation are as follows:

(i) Genetic Deformities:

(a) Cleft Palate: It is a condition in which palatine processes of maxilla and palatine fail to fuse. The persistent (constant) opening between the oral and nasal cavity interferes with sucking.

It can lead to inhalation of food into the lungs causing aspiration pneumonia:

(b) Microcepenalty: This is the condition in which the individuals have small sized skull. This is caused by some genetic defect.

(c) Arthritis: It covers over 100 different types of inflammatory or degenerative diseases that damage the joints. Osteoarthritis (O, A) is the most common chronic arthritis. It is a degenerative joint disease also caused by genetic defect.

(ii) Hormonal Deformities:

There are some hormonal deformities:

Osteoporosis: It is a group of diseases in which bone releases some depositions. As a result the bone mass is reduced but the chemical composition of the matrix remains normal, factors Causing Osteoporosis: Osteoporosis mostly occurs in aged women having decreased estrogen level.

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Other factors include insufficient exercise, smoking and diet poor in calcium and protein etc. Protection: Estrogen replacement therapy (ERT).

(iii) Nutritional Deformities:

Following are two major Nutritional deformities:

(a) Osteomalacia (Soft Bones): It includes a number of disorders in which the bones receive insufficient minerals.

Causes: In this .disease, calcium salts are not deposited and hence bones soften and weaken.

Symptoms/Effects: The main symptom is the pain when weight is put on affected bones. Weight bearing bones of legs and pelvis bend and deform.

(b) Rickets:

It is another disease in children with bowed (curved) legs and deformed pelvis.

Causes: It is caused by deficiency of calcium in diet or vitamin 'D' deficiency.

Treatment: Vitamin 'D' fortified milk and exposing skin to sunlight to cure disorder.

(iv) Deformities Due to Physical Trauma:

Following are three major deformities due to physical trauma:

(a) Disc-Slip:

Disc: Each intervertebral disc is a cushion - like pad composed of two parts.

(i) Nucleus Pulposus: It is an inner semi fluid material which acts as rubber ball to give a disc its elasticity and compressibility.

(ii) Annulus Fibrosus: It is a strong outer ring of fibrocartilage. The annulus fibrosus holds together successive vertebrae.

Functions of the Disc:

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The discs act as shock absorber during walking, jumping running and to lesser extent to bend laterally.

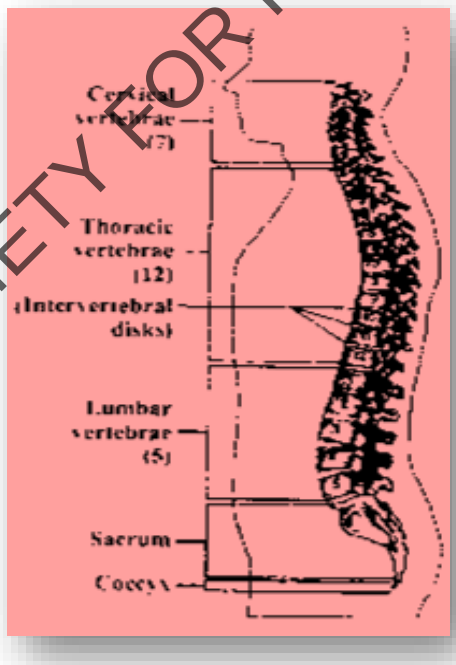
Herniation:

Severe or sudden physical trauma (shock) to spines may result in herniation of one or more discs (commonly known as slipped disc).

There is rupture of annulus fibrosus followed by protrusion of the spongy nucleus pulposus. If the protrusion (projection) presses on spinal cord or on spinal nerves (arising from cord) then severe pain is generated or even there is destruction of the nervous structure.

Treatment:

Bed rest traction and painkiller. If this fails disc may be removed surgically.



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(b) **Spondylosis:**

It is the disease, which causes immobility and fusion of vertebral joint.

(c) **Sciatica:**

It is the acute pain radiating over the course of sciatic nerve.

Causes:

It is due to:

- Injury of proximal sciatic nerve which might follow a fall.
- A herniated disc or
- Improper administration of an injection into the buttock.

Symptoms/Effects:

The effect on lower limb depends upon the course of the sciatic nerve injured. When sciatic nerve is completely transected, the legs become nearly useless. They cannot be flexed and all foot-ankle movement is lost.

Recovery:

Slow and incomplete.

(v) Arthritis:

Arthritis is inflammatory or degenerative disease that damage joints. Symptoms: Main symptoms are pain, stiffness and swelling of the joint.

(a) **Acute Arthritis:**

It is due to bacterial invasion and arc treated with antibiotics.

Symptoms:

The membrane, lining the joint thickens, fluid production is decreased. As a result friction is increased.

Treatment: It is treated with antibiotics.

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(b) **Chronic Arthritis:**

These are osteoarthritis, rheumatoid arthritis, and gouty arthritis.

REPAIR OF BROKEN BONES

CAUSES OF FRACTURE:

During youth, most fractures result from trauma that may twist or break the bones such as sports injuries, automobile accidents and falls etc.

In old age, bones become thin and weak and hence fractures occur more frequently.

Treatment:

1. Reduction and Realignment:

There are two types of reduction: closed and open reduction. Closed Reduction: In closed reduction the bone end is coaxed back to their normal position by physician's hand.

Open Reduction: In open reduction surgery is performed and the bone ends are joined together with pins or wires.

2. Cast or Traction:

After broken bone is reduced. it is immobilized by a cast or by traction to allow the healing process to begin.

REPAIR PROCESS OF A SIMPLE FRACTURE:

Healing Time:

Healing time is 8-12 weeks, however, it is much longer for large weight-bearing bones and for bones of old people (because of their poorer blood circulation),

The repair process of a simple fracture occurs in four phases:

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1. Hematoma Formation:

When a bone breaks the blood vessels in the bone itself and perhaps in surrounding is torn resulting hemorrhage.

As a result a hematoma forms at the fracture site. Hematoma is a mass of clotted blood. Soon after the bone ceils which are left without food begin to die and the tissue at the fracture site becomes swollen and therefore painful.

2. Callus Formation:

Now soft callus begins to form in 3-4 weeks. Capillaries grow into the hematoma and clear up the debris. Fibroblasts and osteoblasts migrate into the fracture site and begin to construct bone.

3. Bony Callus Formation:

Osteoblasts and osteoclasts continue to migrate inward. They multiply rapidly and gradually convert the soft callus into bony callus.

Bone formation begins 3-4 weeks after injury and continues until a firm bony union, formed within 2-3 months later.

4. Remodeling:

After several months bony callus is remodeled by the excess material on the outside of the bone.

Final structure of remodeled area resembles that of the original unbroken bone because it responds to the same set of mechanical stimuli.

MUSCLES

The bundles of cells or fibers that can be contracted and expanded to produce physical movements.

These cells contain numerous filaments of special protein called actin and myosin. Many multi-cellular animals have evolved these specialized cells for movement.

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KINDS OF MUSCLES:

The vertebrates have three kinds of muscles which are smooth muscles. skeletal muscles and cardiac muscles.

1. Smooth Muscles:

(i) **Muscle Shape:** The muscle is unstriped i.e. it has no striations.

(ii) **Cell Shape:** The cells an; long and spindle shaped with each containing a single nucleus,

(iii) **Control:** It is not under the voluntary control.

(iv) **Speed of Contraction:** Slow

(v) **Cause of Contraction:** Spontaneous, stretch, nervous system and hormones.

Examples: These muscles are found in the blood vessels, digestive tract and man) other organs.

(vi) **Earliest Form:** Smooth muscles were the earliest form of muscle to evolve and it is found throughout animal kingdom.

(vii) **Summary:** Smooth muscle tissue is visceral, non-striated and involuntary

2. Cardiac Muscles:

(i) **Muscle Shape:** Irregular stripes

(ii) **Cell Shape:** Heart muscle is composed of chains of single cell, each with its own nucleus. The cells are branched, interconnected and organized into fibers.

(iii) **Control:** It is not under the voluntary control.

(iv) **Speed of Contraction:** Immediate

(v) **Cause of Contraction:** Spontaneous

Examples: These are muscles of the heart. They constitute most of the mass of the heart walls.

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3. Skeletal Muscles:

(i) **Definition:** The muscles that are attached with the skeleton and associated with the movement of bones arc called skeletal muscles.

(ii) **Muscle Shape:** Skeletal muscles arc also called striped or striated muscle because they show alternate light and dark bands.

(iii) **Cell Shape:** Spindle or cylindrical.

(iv) **Tendons:** Generally each end of entire muscle is attached to bone b: a bundle of collagen, non-elastic fibers known as tendons.

(v) **Control:** The skeletal muscles arc consciously controlled and therefore are called voluntar, muscles.

(vi) **Speed of Contraction:** Slow to rapid

(vii) **Cause of Contraction:** Nervous system

Examples: Triceps and biceps.

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STRUCTURE OF A SKELETAL MUSCLE FIBER

Muscle: Each muscle consists of muscle bundles which arc further composed of muscle fiber or cells.

Muscle Fiber: Skeletal muscle fibers arc huge cells. Each muscle fiber is long cylindrical cell; each cell has many oval nuclei arranged just beneath its sarcolemma. Their diameter is 10 – 100 µm.

Sarcoplasm of muscle fiber is similar to the cytoplasm of other cell but it contains usually large amount of stored glycogen and a unique oxygen bonding protein called myoglobin. Myoglobin is a red pigment that stores oxygen.

Structure of a Muscle Fibre in High Magnification:

Myofibrils: Each muscle fibre contains a large number of myofibrils. Each myofibril is

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1 – 2 µm in diameter.

These myofibrils run in parallel way and extend the entire length of the cell. Bundles of these fibrils arc enclosed by the muscle cell membrane or sarcolemma. The myofibril contains myofilaments.

Ultra Structure of Myofilament:

Myofilament is made up of thick and thin filament.

(i) Thick Filament:

The thick filaments, which are about 16 nm in diameter, are composed (If myosin. structure of a thick (myosin) filament.

Each Myosia molecule has tail ending in two globular heads. The heads are sometimes called cross bridges because they link the thick and thin myofilaments together during contraction.

Myosin tail consists of two long polypepti chain coiled together.

(ii) Thin Filament:

Thin filaments are 7 - 8 nm thick and composed of chiefly actin molecule.

Structure of Thin (Actin) Filament:

The actin molecules are arranged in two chains which twist around each other like twisted double strand of pearls.

There are two strands of another protein called tropomyosin which twist around the actinchains.

Another major protein in thin filament is troponin.

It is three polypeptide complex, one binds to actin another binds to tropomysin while third binds calcium ions.

Sarcomere:

A sarcomere is the legion of a myofibril b tween two successive Z-lines and is the smallest contractile unit of muscle fibre. A myofibril has many sarcomeres.

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In each sarcomere a series of dark and light bands are evident along the length of each myofibril.

Dark Bands:

The dark bands are called A hand because they are anisotropic that is they can polarize visible light.

Each A band has it lighter stripe in its midsection called H-zone (H stands for "hele" means bright).

The H-zone is bisected by dark line called M-line.

Light Bands:

The light bands called I-band are isotropic or non-polarizing. The I-band, have mid line called |Z-line, (Z for zwish means between).

Filaments of A and I-band:

The filament extending the entire central thick length of the A-band are myosin filaments. The filaments extending across the I-band and partly into the A-band arc thin actin filaments.

Each myosin filament is surrounded by six actin filaments on each end.

Muscle Cell Appearance:

The striped appearance of the skeletal muscle cell is due to it, light and dark bands. **T-tubule, T-system and Triad:**

The sarcolemma of muscle fibre cell penetrates deep into the cell to form hollow elongated tube, the transverse tubule, T-tubule. The lumen or I-tubule is continuous with the extracellular fluid.

The thousands of T-tubules of each muscle cell are collectively called T-system. It extends and encircles the myofibril at the level of Z-line or A and l-junction.

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The T-tubule and terminal portion of the adjacent envelope of sarcoplasmic reticulum, form triads at regular interval along the length of the fibril.

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Mechanism of Muscle Contraction:

When muscle fibre contracts the thin and thick filaments undergo shining. The I-band reduces in length and I-line gets closer, to explain all these events in muscle contraction. H-Huxley, A. F. Huxley and their colleagues suggested a hypothesis in 1954. This is called "Sliding filament model" of muscle contraction.

Sliding Filament Model of Muscle Contraction:

According to this theory the thin filaments slide past the thick filaments so that actin and myosin filaments overlap to greater degree.

Thus the Z-line is brought close together. I-band shortens the H-zone disappears.

In this process of contraction the cross bridges (If thick filament become attached to binding sites on the actin filament. The cross bridges then contract to pull the actin filament towards center of sacromers.

Control of Cross Bridges:

Muscle at Rest:

When the muscle is at rest the tropomyosin covers the sites on the actin chain where the head of myosin becomes attached.

Muscle Contraction:

When the muscle is required to contract then following steps occur:

(i) Calcium ions bind with the troponin molecule and cause them to move slightly.

(ii) The tropomyosin is displaced and the sites on the actin chain where the head of myosin becomes attach are exposed.

(iii) Once the myosin head has become attached to the actin filament. ATP is hydrolyzed and the bridge goes to its cycle.

ATP is needed to break the link between the myosin bridge and the actin. This ATP is provided by the large number of mitochondria present in each muscle cell.

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RIGOR MORTIS

We know that ATP is needed to break the link between the myosin bridge and the actin. After death the amount of ATP in the body falls. Under these conditions the bridges cannot be broken and so they remain firmly bound.

As a result the body becomes stiff a condition known as rigor mortis.

Controlling the Actin-Myosin Interaction by Ca^{++} Ions:

1. Initiation of Muscle Contraction

Muscle contraction is initiated by nerve impulse arriving from the neuromuscular junction. All the fibres connected by a single motor neuron are a "Motor Unit" and contract simultaneously in response to the action potential tired by the motor neuron.

2. T-tubule and Sarcoplasmic Reticulum:

The nerve impulse is carried through the T-tubular to the adjacent sarcoplasmic reticulum (SR).

Sarcoplasmic Reticulum (S.R.) i, continued system of the sarcoplasm around each myofibril.

It is like endoplasmic reticulum but without ribosomes and shows a highly specialized repeating pattern.

3. Role of Ca^{++} Ions:

The calcium gate of SR open the calcium is released into the cytosol. Next step is the binding of calcium ions to troponin molecules of the thin filament.

The binding sites are exposed and cross bridges with myosin call form and contraction occurs.

All or None Response:

The contraction of each muscle is based on "all or none" principle i.e. all of its fibrils participate in contraction. The degree of contraction depends upon the number of fibers that participate in contraction (this is called varying degree response).

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ENERGY FOR MUSCLE CONTRACTION

Energy for muscle contraction comes from the ATP. There are different sources of ATP.

1. **Aerobic Respiration:**

Supply of ATP is maintained by the aerobic break down of glucose in muscle cell. This glucose comes from stored glycogen in the cell.

2. **Creatin Phosphate:**

When more energy is required due to high metabolism, it is provided by another energy storing substances called creatin phosphate.

3. **Anaerobic Respiration:**

Sometimes during oxygen deficiency or very high metabolism (prolong, or tough muscular activity), ATP difference is provided by anaerobic breakdown ofglucose into lactic acid.

Problem of Anaerobic Respiration:

The major problem is lactic acid accumulation which causes muscle fatigue. At rest, 1/5 lactic acid is broken aerobically and its energy is used to change remaining 4/5 lactic acid into glucose.

Effect of Exercise on Muscle:

Changes occur in the muscle according to the amount of its work. When muscles are used actively then followings changes occur:

(i) They increase in size or strength

(ii) They become more efficient and fatigue resistant.

(iii) Capillaries surrounding the muscle fibres and the mitochondria within them increase in number.

(iv) Muscle fibre synthesizes more Myoglobin.

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The result is more efficient muscle metabolism. Similarly the muscles become resistance to fatigue.

Examples: Aerobic exercise such as swimming, joggings and fast walking.

When Muscles are not used:

Complete immobilization of muscle leads to muscle weakness and severe atrophy (deterioration).

MUSCLE FATIGUE

Muscle fatigue is a state of physiological inability to contract.

Causes:

(a) Deficiency of ATP:

Muscle fatigue results from relative deficit of ATP. When no ATP is available, contractures (or states of continuous contractions) result because the cross bridges arc unable to detach.

(b) Accumulation of Lactic Acid and Ionic Imbalances:

Excess accumulation of lactic acid and ionic imbalances arc also the causes of muscle fatigue. Lactic acid is formed as a result of anaerobic breakdown of glucose.

Lactic acid drops muscle pH. As a result pain starts in the muscle, which causes extreme fatigue (tiredness).

TETANY:

Cause:

Tetany is the disease caused by low calcium in the blood.

Symptoms:

(i) It increases the excitability of neurons and results in loss of sensations.

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(ii) Muscle twitches (jerks) and convulsions occur.

(iii) If untreated the disease progresses to spasm of larynx, respiratory paralysis and ultimately death occurs.

CRAMP:

It is also known as tetanic contraction of the entire muscle.

Causes:

It is due to low blood sugar level, electrolyte depletion, dehydration and irritability of spinal cord and neurons.

Symptoms:

It lasts for just few seconds or several hours, causing the muscles to become taut (stiff) and painful. It is most common in thigh and hip muscles it usually occurs at night or after exercise.

TETANUS:

Causal Organism:

It is an acute infectious disease caused by anaerobic bacterium Clostridium tetanic.

Symptoms:

Persistent painful spasms of some skeletal muscles. It begins gradually with stiffness of jaws and neck muscles. Then it progresses to fixed rigidity of jaws (lock jaw) and spasms of trunk and limb muscles. It is usually fatal due to respiratory failure.

Mortality Rate:

The tetanus is the major killer in developing countries where the mortality rate is 40 percent. It is very rare in developed countries.

Arrangement of Skeletal Muscle for Movement of Skeleton:

The skeletal muscle moves with the help of skeleton.

Parts of a Skeletal Muscle:

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Skeletal muscle has three parts:

(i) **Origin:** It is the end of muscle which remains fixed when contracts muscle.

(ii) **Insertion:** It is the end of muscle that moves the bone.

(iii) **Belly:** It is thick part between origin and insertion, which contract.

Bone to bone and muscle to bone attachment by connective tissue, a connective tissue binds other tissue and helps to maintain body form by holding the various organs together. Connective tissue fibrils have two specialized kinds.

(i) **Ligaments:** These connective tissue fibrils attach bone to bone and are slightly elastic.

(ii) **Tendons:** These connective tissue fibrils attach muscles to bones and are non-elastic.

MOVEMENT OF BONES

The majority of muscle tissue in our body is skeletal muscle.

Movement of Skeletal Muscles:

The skeletal muscles produce movements by pulling on tendons through cords of connective tissues that attach muscle to the bones. The tendons then pull on bones.

Attachment of a Skeletal Muscle:

Most muscles pass across a joint and are attached to the bones that form joints. When such muscle contracts it draws one bone towards or away from "the bone with which it articulates.

Movement of Antagonistic Muscles:

There are 650 muscles in human body, most of which occurs in pairs. At joint these muscles work against each other by contraction. This relationship is called antagonistic.

Movement of Elbow Joint:

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The best example is the movement of elbow joint by biceps and triceps the biceps bend the arm at the elbow joint and triceps straightens it.

(i) Bending of Arm:

It is by three muscles:

(a) The biceps brachii muscle arises from the two heads of scapula and is inserted into the medial surface of the radius bone.

The other two muscles (brachialis and brachioradilus) lie below the biceps brachii.

(b) The brachialis arises from the anterior surface of the lower $3/5^{th}$ of the humerus and inserted in to the ulna.

(c) The brachioradilus arises from the lateral side of the lower end of the humerus and inserted in the radius.

When these muscles contract they lift radius and ulna and bend the arm at the elbow.

(ii) Straightening of Arm:

When triceps contracts it straightens arm at elbow.

In the antagonistic pairs one muscle reverses the effect of the other but do not contract simultaneously.

LOCOMOTION IN PROCTOCTISTA

LOCOMOTION IN EUGLENA

Locomotary Structure:

Euglena moves with the help of flagellum.

Mechanism of Locomotion:

Locomotary flagellum is at its anterior end of the body. As the flagellum is whipped backward, the organism is pulled forward. However, when the f1agellum moves forward the Euglena doe, not move backward.

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Wave, of activity are generated which pass in spiral fashion from its base to its tip. The activity of the f1agellum caused the body of Euglena to rotate forward about its axis.

Euglena changes its direction by the active contractile myonemes which run along the length of its body.

When they contract the shape of the body is changed as well as its direction.

First body becomes short and wider at the anterior end then in the middle and later at the posterior end. This characteristic movement is called eualenoid movement.

LOCOMOTION IN PARAMECIUM:

Locomotary Organs:

Paramecium moves with the help of cilia. This is called ciliary movement.

Structure of Cilia:

Cilia are short, fine thread-like extensions of the cell membrane.

The length of cilia ranges from many microns to many hundred microns and the diameter varies in from 0.1 to 0.5 μ. A cilium consists of nine peripheral double fibrils giving the appearance of 8-shape figure and two central smaller fibrils. All these fibrils run longitudinally through the cilium. These are covered with the extensions of membrane.

Mechanism of Ciliary Movement:

All the cilia do not move simultaneously. A bunch of cilia move in a progressive wave like manner at a time. The wave starts at the anterior end and progresses in the backward. The exact mechanism of movement of cilia is not known. In 1955 Bradford suggested that movement of cilia is due to simultaneous contraction or sliding of double fibrils in two groups one after the other.

(i) Effective Stroke:

Five out of nine (5/9) double fibrils contract or slide simultaneously and the cilium bends or shortens. It is called effective stroke.

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(ii) Recovery Stroke:

The four out of nine (4/9) double fibril contract and the cilium becomes straight. It is called recovery stroke.

As a result of bending and recovery strokes the paramecium swims against water.

The energy for the movement of cilia is provided from the A TP. The enzyme present in the cilia breaks up ATP to release energy.

The action of the cilia is coordinated and all the cilia beat together in a sequence to propel the animal in one direction.

LOCOMOTION IN AMOEBA:

Organ of Locomotion:

In amoeba movement takes place by means of pseudopodia.

Mechanism of Amoeboid Movement:

The pseudopodia are finger-like projections thrown m the direction of movement in which the cytoplasm flows and body moves in that direction.

LOCOMOTION IN THE INVERTEBRATES

(i) Locomotion in jelly Fish:

Body: Jellyfish has an umbrella-like body called bell.

Locomotary Organs:

The muscular processes of the cells are involved in locomotion.

Mechanism of Locomotion:

First of all water enters in the bell then the bell contracts, the water is forced out like a jet and the animal moves forward. This movement is known as jet propulsion.

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(ii) Locomotion in Earthworm:

Organs and Type of Locomotion:

Earthworm show s accordion like movement peristalsis in which setae hydrostatic skeleton and muscles are involved.

(iii) Locomotion in Cockroach:

Mode of Locomotion:

The mode of locomotion in cockroach is swift walking by leg, (3+ 3) and flight by wings. Out of the two pairs, the posterior pair of wings is involved in the flight.

(iv) Locomotion in Snail:

Snails and mussels are mollusks. These crawl or move very slowly by "foot".

(also called Ventral Muscular foot).

(v) Locomotion in Star Fish:

Organs of Locomotion: Starfish moves with the help of tube feet. The tube feet are present on both sides of radial canal that extends upto the tip of ann. Arms of the starfish also help in swimming.

LOCOMOTION AND SKELETON IN THE VERTEBRATES

In the vertebrates, skeletal muscles and skeleton help in locomotion. Different classes of the vertebrates move in different ways:

Swimming in Fishes:

Following are adaptations in fishes for swimming:

Adaptations of fishes for moving efficiently through the water.

(i) Streamlined Body:

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Most fishes have streamlined body which is tapered at both ends.As a result the water flows over the body surface and drag is reduced to a minimum.

(ii) Fins:

Fins are present for efficient swimming. The dorsal and ventral, unpaired fins help to stabilize the fish. The paired pectoral and pelvic fins are used for steering and balancing the animals.

The caudal or tail fin in coordination with paired fins provide forward movement of fish through water.

(iii) Body without Projections:

Apart from the fins no other structures project from the body of fish. It is clear that faster the fish the more perfect is the streamlined.

(iv) Moist Surface:

The dermal denticles of cartilaginous fish and the scales of bony fishes are kept moist by slimy exudation from mucus or oil glands.

This also reduces the friction between the fish and water.

(v) Swim Bladder:

Buoyancy in the water is maintained by a specialized structure in bony fish called swim bladder.

Locomotion in Amphibian:

The general body structure of amphibians is fish-like. These have two means of locomotion.

(a) They wriggle along their belly on the ground with the help of segmentally arranged muscles. It seems they "swims on land" with legs hardly touching the ground when moving purposely.

A few types rise up their body on the legs which propel them asmoveable levers.

(These arc two main types of locomotion)

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(b) In the anurans the entire skeleton and muscular system is specialized for peculiar swimming and jumping methods of locomotion. it is b) means of extensor thrusts of both kinds of limbs acting together.Frogs and toads also walk and hop on land due to their strong hind limbs.

Locomotion in Reptiles:

For locomotion, reptiles have following adaptations in their life style.

(i) Better than Amphibians:

The general form of the reptilian skeleton is like ancient amphibians. However, they move better than amphibians due to the evolution of skeleton.

(ii) Method of Locomotion:

The reptile uses method of walking and running.

(iii) Skeleton Highly Ossified:

The skeleton is highly ossified to provide greater support.

(iv) Cervical Vertebrae:

Reptiles have cervical vertebrae.

The first two cervical vertebrae (atlas and axis) provide greater freedom of movement for head. The axis is modified for rotational movement.

(v) The Ribs of Reptiles:

The ribs of reptiles may be highly modified. The ribs of snakes have muscular connections to large belly scales to aid locomotion.

(vi) Bipedal Locomotion:

Many primitive reptiles were bipedal (walked on hind limbs). They had a narrow pelvis and heavy out stretched tail for balance. Bipedal locomotion freed the front appendages which were used for prey capture or night in some animals.

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Locomotion in Air:

Flight has evolved in three types of vertebrates namely in pterodactyls birds and bats. More muscular effort is required in flying than swimming, walking or running. Wings are required to generate sufficient lift to remain in air. Birds have developed different adaptations for flight. Most adaptations are in skeleton.

(a) **Hollow Bones:**

The bones are with large air spaces which make them lighter.

(b) **Evolution of Wings:**

The fore limbs evolved into Wings with very strong pectoral muscles which pull the wings up and down.

(c) **Feathers:**

The body is covered by feathers. The feathers give the wing a large surface area which helps to keep the birds in air. Feathers also keep their bodies warm. Therefore they can produce enough energy to fly.

(d) **Stream Lined Body:**

The body is stream lined to cut clearly through the air. The feathers lie smoothly against its body. so that the air can easily flow over them.

(e) **Modification of Sternum:**

The sternum is modified to form keel. The keel is needed for the attachment of muscles.

(f) The enlargements of the pectoral girdle.

(g) The pectoral muscles provide power for the upward stroke.

(i) The lifting action is possible because the tendon of the supra-coracoid muscles passes through an opening the foramen triosseum formed between the scapula, coracoid and clavicle hones and is attached to the upper surface of the humerus.

(j) The number of bones is reduced as compared to those in the limbs of other vertebrates and many bones are fused together to increase strength.

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(h) The shape of the wings influences the speed and the type of flight. For example long narrow wings are ideal for gliding into wind as in the gulls and other sea birds. Short broad wings arc effective for slow happing light as in many garden birds. Bats have different arrangement of wing hones but adaptation for flight is parallel in range.

TYPES OF FLIGHT:

A bird can fly either passively by gliding or actively by flapping its wings.

1. Passive Flight:

When the birds glidetin, wings act as aero foils. Aerofoilsis any smooth surface which moves through the air at an angle to the airstream.

The air flows over the wing in such a way that the bird is given lift. The amount of lift depends on the angle at which the wing is held relative to the air-stream.

2. Active Flight / Flapping Flight:

As the birds move through the air, the air flows more quickly over the curved upper surface than over the lower surface. This reduces the air pressure on the top of the wing as compared to the air pressure below the wing. There is therefore a net upward pressure which lifts the bird.

MAMMALS:

The most efficient way of supporting the body is seen in the mammals. The limbs of the mammals have modifications to produce the following modes of locomotion:

1. Plantigrade:

In this type of locomotion the mammals walk on their soles with palm, wrist and digits all land to rest more or less on ground.

Examples: Monkeys, apes, man and hear etc.

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2. Digitigrade:

In this type or locomotion the mammals walk on their digits only. They run faster than plantigrade animals. In these mammals first digit usually reduces or completely lost as in rabbit rodents etc.

3. Unguligrades:

In this type of locomotion the mammals walk on the tips or toes, modified into hoof (As deer, goat etc.) It is the swiftest type of locomotion.

Evolutionary Changes In The Arrangement Of Bones And The Methods Of Locomotion In The Major Groups Of Vertebrates

All vertebrates have a common body plan and have skeleton formed or the same' basic parts. However there are many differences. Some differences arc related to the changes in habitat. For example the requirements for support and locomotion in sea are different from those needed on land or in the air.

1. Fishes (Aquatic):

Most fishes are propelled forward by means of muscle contraction which passes along the body from anterior to posterior. As a result a characteristic S-band locomotion is produced.

Alternate contractions on both sides produce lashing movement which drives the fish like dogfish and sharks. This type of motion is seen in cartilaginous fish like dogfish and sharks.

2. Tetrapods (Land vertebrates):

Most land vertebrates are tetrapods. In four footed amphibians and reptiles the legs emerged from the sides of the body and the S-wriggles is retained as a part of the body.

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Pelvic Girdle of the Tetrapods:

Girdles and limbs of tetrapods show homologies in fundamental structure. The tetrapod pelvic girdle is united firmly to the sacral region of the vertebral column. It is composed of three cartilaginous bones ilium, ischium and pubis on each side. At the point of junction of three bones a depression is present called the acetabulum. Here joint is formed with femur.

The Limbs of the Tetrapods:

The limbs of tetrapods are primitively pentudactyle. Reduction and fusion produce many variations in the primitive skeleton.

ADDITIONAL RELATED READINGS

1. Both plants and animals need support against gravity. Movement is required to get food, shelter and to escape from danger. Movement is mostly required for reproduction.
2. The collenchymatous cells in plants give support to the baby plants and sclerenchymatous cells to the adult plants.

   Note: Parencymatous cells provide support by Turgor pressure.
3. In the stem, the function of support is provided by turgorpressure, vascular bundles and several types of cells.
4. The pressure exerted by the swelling protoplast against the cell wall is called turgor pressure.
5. The membrane that bounds vacuole is called tonoplast.
6. The vascular bundles arc strengthened by additional sclerenchyma fibers which form bundle cap.
7. Collenchyma cells have protoplasts and usually lack secondary walls.

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8. Young stems often have a cylinder of collenchyma just below their surface. Collcnchyma cells provide support to young herbaceous parts of the plant. Sclerenchyma Cells are mostly dead. They have thick secondary cell walls usually impregnated with lignin.

9. Pits are formed from Plasmodesmata. Pits are of two types: Simple and Branched. An increase in plant girth due to the activity of vascular cambium is called secondary growth.

11. Secondary growth occurs due to ccli division in:

    (i) Vascular Cambium

    (ii) Cork Cambium

12. Vascular cambium first appears as a cylinder of actively dividing cells between primary xylem and primary phloem.

13. The layers of secondary xylem which are visible as rings are known as annual rings.

14. The outer region of secondary xylem of tree trunks which is the active portion is called sapwood. '1 he inactive non-conducting wood is called heartwood.

    Cork + phloem = bark

    A Callus is a soft parenchymatous tissue which is rapidly formed on or below the damaged surface of stems and roots.

16. Autonomic movements are spontaneous movements due to internal causes.

17. The movement in response to stimulus of chemicals is called chemotactic movements.

18. In phototactic movements, the light intensity and direction both affect the intracellular distribution of chloroplast.

19. Turgor movement is due to differential changes in turgor and size of cells as a result of gain or loss of water.

20. Sleeping movements aredue to daily changes in turgor pressure in the Pulvinus.

21. Pulvinus is swollen portion of the petiole composed of parenchymatous cells with relatively large inter cellular spaces and central strand of vascular tissues.

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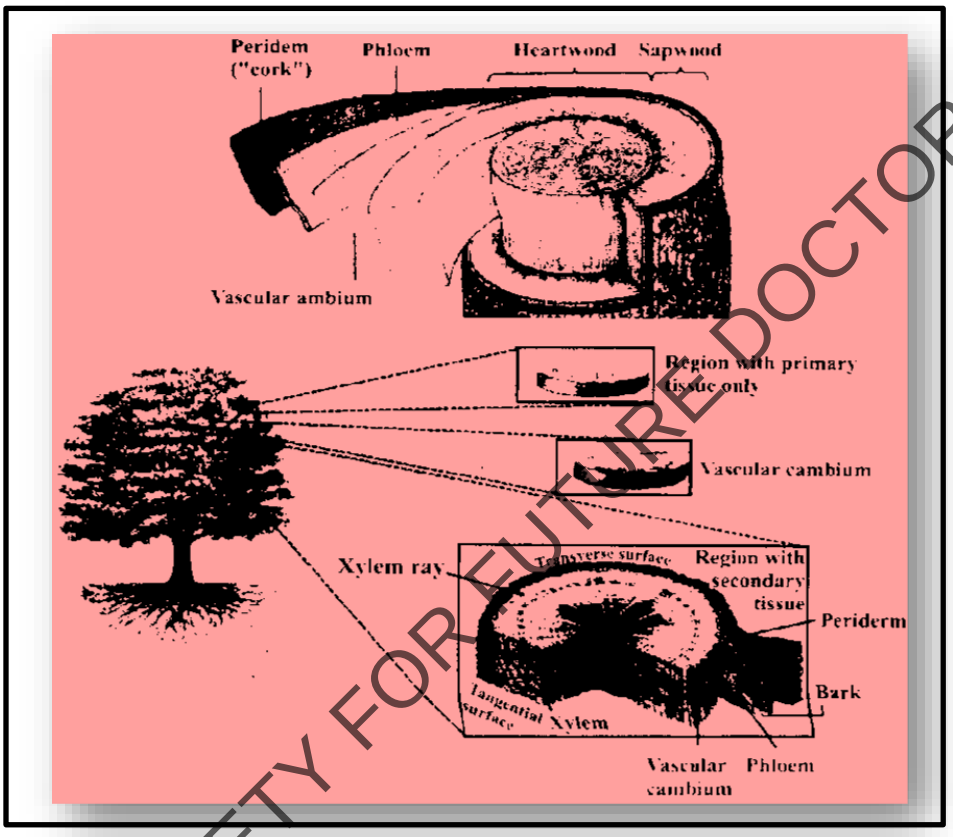
22. Growth movements are due to unequal growth on two sides of plant organs like stem, root, tendrils, buds etc. There are three types of growth movements. Lpinasty, Hyponasty and Nutation.



23. In Epinasty the upper surface of leaf in bud condition shows more growth as compared with the lower surface. This leads to opening of buds. It is shown by leaves and petals etc. Epinasty is due to auxins.

24. In Hyponasty the growth in the lower surface of the leaf in bud condition is more than that of the upper surface. Now the bud will remain closed. It is shown by leaves and petals etc. Hyponasty is due to gibberellins.

25. In Nutation the growing tip of young stem moves in zigzag fashion due to alternate changes in growth on opposite side of the apex.

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26. The word tropic is derived from Greek word Tropos meaning turn. Tropic movement is the movement in curvature of whole organ towards or away from stimuli such as light, gravity and touch.

27. Nastic movements are non-directional movements of parts of plant in response to external stimuli. These are of two types: In Nyctinasty Non directional but growth occurs, in haptonasty there is non-growth and non-directional movements.

28. Auxins inhibit the growth of root cells at higher concentration.

29. Nastic movements are due to some balance or ratio between growth inhibitors (abscisins) and growth stimulators (gihberellins).

30. Callus: Repaired tissue (fibrous or bony) formed at fracture site.

31. Cartilage: The flexible connective tissue.

32. Chitin: Nitrogen containing heterosaccharide molecule.

33. Collenchyma: A specialized type of parenchyma usually located just beneath the epidermis, function as supporting tissue.

34. Cutin: A group of substances chemically related to fatty acids forming continuous layer.

35. Cytokinin: A plant hormone that promotes cell division, fruit growth and the sprouting oflateral buds and prevents the aging of plant parts especially leaves.

36. Ecdysone: A steroid hormone produced by arthropoda that induces moulting and metamorphosis.

37. Gravitropism: Growth with respect to the direction of gravity.

38. Hydrostatic skeleton: The skeleton composed of fluid held under pressure in close body compartment.

39. Myoglobin: A red pigment that stores oxygen within the muscle cell.

40. Phloem: The vascular tissue that conducts organic solutes in plants: it contains sieve-tubecells and companion cells.

41. Sarocoplasm: The cytoplasm of the muscle cell that contains large amount of stored glycogen and myoglobin.

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42. Sclerenchyma: The main supporting tissue in the plants, made up of cells with heavily thickened walls and empty lumen.

43. Synovial joint: The point in which articulating bones are separated by a fluid containing joint cavity.

44. Stem cell: Relatively undifferentiated cell that can continue dividing indefinitely gives daughter cells that differentiate into particular cell types.

45. Taxis: An innate behavior that is a directed movement of an organism towards or away from a stimulus such as heat, light or gravity.

46. Tendon: A type of fibrous connective tissue that attaches muscle to bone.

QUESTIONS FOR PRACTISE

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1. Which statement is true about osteoporosis?

(a) bone deposition out paces hone re-absorption

(b) high level of estrogen in females promote this condition

(c) chemical composition of the hone changed

(d) other factor may contribute like insufficient exercise or diet poor in Ca

2. When the muscle is required to contract, calcium ions hind with which molecule and cause them to move slightly:

(a) tropomyosin (b) troponin

(c) actin (d) myosin

3. During contraction of a skeletal muscle the degree of contraction depend upon:

(a) the type of scleral muscle

(b) number of sarcomeres involved

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(c) number of muscle fibers participate in contraction

(d) size of the muscle

4. Which one is multinucleate?

(a) osteocyte (b) osteoblast

(c) osteoclast (d) stem cell

5. Thin myofilaments consist of:

(a) actin, myosin,troponin (b) actin, tropomyosin, troponin

(c) actin, tropomyosin, fibrin (d) Actin, myoglobin,troponin

6. Which of the following changes occur when skeletal muscle contracts?

(a) the A-hands sshorten (b) thc I-bands shortcn

(c) the Z- lines move further apart (d) the H-zone becomes more visible

7. The flexion at the elbow joint of man is produced by the muscles called:

a) bicep, brachii, barachialis and brachioradialis

(b) barachialis, biceps brachii

(c) brachioradialis, biceps brachii

(d) triceps brachii and barachialis

8. In arthropoda all the changes of moulting are controlled by the nervous system and the hormone:

(a) serotonin (b) epincphrine

(c) ecdysone (d) melanin

9. All the fibers innervated by a single motor neuron called as:

(a) motor box (b) neuro-unit

(c) muscle unit (d) motor-unit

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10. Any smooth surface which moves through the air at an angle to the air-stream is:

(a) curvature (b) aerofoil

(c) tail plane (d) membranous

11. An inflammatory or degenerative disease that damage joints is:

(a) arthritis (b) osteoporosis

(c) spondylosis (d) meningitis

12. At the distal end the femur forms knee joint with the proximal end of two parallel bones called:

(a) tibia and fibula (b) radius and ulna

(c) carpals and metacarpals (d) tarsal and metatarsal

13. A condition in which palatine processes of maxilla and palatine fail to fuse is:

(a) cleft palate (b) microcephally

(c) cretinism (d) osteoporosis

14. The fusion of four posterior vertebrae present in the pelvic region form:

(a) sacrum (b) coccyx

(c) lumbar (d) chest cage

15. Each A band has a lighter stripe in its midsection called:

(a) A-zone (b) M-line

(c) H-zone (d) Z-line

16. In Plantigrade mode of locomotion, the mammals used to walk on their:

(a) digits (b) tips to toes

(c) soles (d) belly

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17. Bone to bone attachment is by:

(a) tendon (b) smooth muscles

(c) ligament (d) skeletal muscles

18. Osteomalacia includes a number of disorders in which the bones receive inadequate:

(a) water (b) O_2

(c) blood (d) minerals

19. Rib Cage is composed of twelve pairs of ribs that articulate with the:

(a) cervical vertebrae (b) thoracic vertebrae

(c) sacral vertebrae (d) lumbar vertebrae

20. Sclerenchyma has thick secondary cell walls usually impregnated with:

(a) pectin (b) silica

(c) lignin (d) chitin

21. The cranium consists of eight bones, in which:

(a) 1 paired and 4 unpaired (b) 2 paired and 4 unpaired

(c) 4 paired and 2 unpaired (d) 3 paired and 2 unpaired

22. The first two cervical vertebrae are:

(a) atlas and sacrum (b) lumbar and sacrum

(c) atlas and axis (d) lumbar and coccyx

23. The joint that allows the movements in two directions is called:

(a) hinge joint (b) shoulder joint

(c) hip joint (d) both hip joint and shoulder joint

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24. The radius and ulna at their distal end form multistage joint with eight wrist bones called:

(a) tarsal (b) metacarpals

(c) radioulna (d) carpals

25. In man the number of facial bones is:

(a) 10 (b) 14

(c) 16 (d) 20

26. Elasticity of intervertebral disc is due to:

(a) nucleus fibrosus (b) annulus pulposus

(c) Nucleus pulposus (d)nucleus fibrosus and annulus pulposus

27· During evolution, the muscles not evolved first:

(a) cardiac (b) skeletal

(c) smooth (d) both cardiac and skeletal

28. The wings for Gliding should be:

(a) short and narrow (b) short and broad

(c) long and narrow (d) long and broad

29. Pelvic region has:

(a) sacrum (b) coccyx

(c) femur (d) both sacrum and coccyx

30. The anurans have:

(a) peculiar swimming (b) jumping

(c) bipedal (d) peculiar swimming and jumping

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31. Change in turgor in plants is due to:

(a) K (b) Ca

(c) Mg (d) Ca + K + N

32. The sclerenchyma cells present in Walnut shell are:

(a) trachieds (b) sclereids

(c) vessels (d) fibrers

33. Exposure of skin to sunlight can cure:

(a) osteomalacia (b) rickets

(c) osteoporosis (d) osteoarthritis

34. The fungal hyphae are:

(a) phototropic (b) thigmotropic

(c) hydrotropic (d) chemotropic

35. Axial skeleton does not include:

(a) skull (b) vertebral column

(c) ribs (d) pelvic gridle

36. Framework of palm of hand is formed by:

(a) carpals (b) metacarpals

(c) tarsal (d) metatarsals

37. A sarcomere is the region between two:

(a) A-bands (b) H-bands

(c) Z-lines (d) I-bands

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38. If the muscles were deprived of A TP, which of the following would not be affected:

(a) Na pump of muscle membrane (b) Ca pump of sarcoplasmic reticulum

(c) length of myosin filament (d) velocity of shortening

39. Non-surgical reduction of bone is called:

(a) closed reduction (b) open reduction

(c) vertical reduction (d) horizontal reduction

40. Sarcoplasm refers to a specific kind of:

(a) cytoplasm (b) nucleoplasm

(c) protoplasm (d) muscle cell

41. Hypothesis about ciliary movement is proposed by:

(a) H. Huxley (b) A.F. Huxley

(c) Bradford (d) Huxley and Bradford

42. The primary source of energy in muscle cell is:

(a) glucose (b) ATP

(c) creating phosphate (d) glycogen

43. The most primitive fishes were the:

(a) lobe-finned fish (b) jawless fish

(c) bony fish (d) dipnoi

44. The fins that help to stabilize fish during swimming are:

(a) ventral (b) dorsal

(c) caudal (d) both ventral and dorsal

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45. Which is not correct for pectoral muscle?

(a) striated muscle (b) striped muscle

(c) skeletal muscle (d) involuntary muscle

46. Amount of lactic acid restored to glycogen during rest is:

(a) $1/5^{th}$ (b) $4/5^{th}$

(c) $1/4^{th}$ (d) $3/4^{th}$

47. Sarcoplasm has more:

(a) myoglobin (b) glycogen

(c) myoglobin (d) water in the cytosol

48. A tendon is a:

(a) fibrous tissue (b) connecting tissue

(c) non-elastic fibrous connective tissue (d) non-fibrous tissues

49. Which is not a genetic defect?

(a) cleft palate (b) microcephaly

(c) osteoarthritis (d) osteoporosis

50. Which is not an unguligrade?

(a) deer (b) goat

(c) rabbit (d) horse

51. Tube feet are locomotary organs of:

(a) jelly fish (b) snail

(c) cuttlefish (d) starfish

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52. Which of the following is plantigrade?

(a)rabbit (b) monkey

(c) horse (d) cow

53. The mammals which walk only on the tips of their toes are called:

(a) plantigrade (b) unguligradee

(c) digitigrade (d) brachigrade

54. A common digitigrade animal is the:

(a) monkey (b) goat

(c) horse (d) dog

55. The brachialis muscle on the contraction lifts the:

(a) radius (b) humerus

(c) ulna (d) fibula

56. Bicep muscle is:

(a) flexar (b) extensor

(c) involved in locomotion (d) helping in sitting

57. Muscles with no branched fibres and multinucleate:

(a) smooth

(b) cardiac

(c) skeletal

(d) some smooth muscles at earlier stages of development

58. Muscles get fatigued:

(a) smooth (b) cardiac

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(c) skeletal (d) cardiac muscles during development

59. Muscle fatigue is due to:

(a) deprivation of ATP and deposition of lactic acid

(b) deposition of ATP and lack of lactic acid

(c) lack of ATP and lack lactic acid

(d) deposition of ATP and deposition of lactic acid

60. An oxygen debt develops during:

(a) an aerobic work (b) aerobic work

(c) tetany (d) tetanus

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UNIT NO. 5 (HUMAN PHYSIOLOGY)

1	D	2	B	3	C	4	C	5	B	6	B	7	A	8	C	9	D	10	B
11	A	12.	A	13	A	14	B	15	C	16	C	17	C	18	D	19	B	20	C
21	B	22	C	23	A	24	D	25	B	26	C	27	D	28	C	29	D	30	D
31	A	32	B	33	B	34.	D	35	D	36	B	37	C	38	C	39	A	40	A
41	C	42	B	43	B	44	D	45	D	46	B	47	C	48	C	49	D	50	C
51	D	52	B	53	B	54	D	55	C	56.	A	57	C	58	C	59	A	60	A

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NERVOUS SYSTEM

Introduction:

In nervous coordination specialized cells or neurons are linked together directly or via the central nervous system, to form network that connects receptors and effectors. Receptors are the cells or organs which receive stimuli while the effectors are those which carry out actions or responses.

The neuron has the capacity to generate and conduct impulses which travel across the synapse and pass from the receptors to the effectors. The neuron brings about the nervous co-ordination.

The elements of nervous system which help in co-ordination are:

1. Receptors
2. Neurons
3. Effectors

1. Recpetors:

The receptor may be a cell, or neuron ending or a receptor organ. Receptors detect changes in the external and internal environment of the animal,receptor are classified as follows:

(i) **Chemo receptors:** These are for smell (nose), taste (tongue) and for blood CO_2, oxygen, blood glucose. amino acids and fatty acids (receptors in the hypothalamus).

(ii) **Mechanoreceptors:** These detect stimuli of touch (free nerve endings + expanded tip ending + stray edgiest) pressure, hearing and equilibrium.

(iii) **Photoreceptors:** (Electromagnetic receptors), these respond to stimuli of light for example in eyes. r ids and cones.

(iv) **Thermo receptors:** Show response to cold and warmth.

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(v) Nociceptors: (Undifferentiated endings) which produce the sensation of pain. Modalities of Sensation:

Each principal sensation is modality (like pain, touch, sight, sound etc.)

Sensory Receptors of the Skin:

The receptors in the skin are concerned with at least five different senses which are touch, pressure, heat, cold and pain. These sensations are detected by 3 different types of modified sensory neurons haying naked nerve endings or specialized cellular capsules (pressure, hot and cold receptors).

(a) Naked or Free Nerve Endings: These are touch and pain receptors (for example situated at the base of hairs).

(b) Meissner's Corpuscles: These are touch receptors. These are encapsulated neuron endings. These lie in papillae which extend into the ridges of the fingertips. The corpuscle consists of spiral and much-twisted endings, each of which ends in a knob.

(c) Pacinian Corpuscles: These receive deep pressure stimulus. These are also encapsulated neuron endings. These are present quite deep in the body. The receptors present in the limbs detect vibration sense. The receptors present. in the joints of terrestrial vertebrates also detect the vibrations of the ground.

Note: Free Nerve Ending: On some receptor neurons, a finely branched ending that responds to touch and pressure, to heat and cold, or to pain; produces the sensations of itching and tickling.

Number and Kinds of Receptors: Pain receptors are nearly 27 times more abundant than cold receptors.The cold receptors are nearly 10 times more abundant than heat or temperature receptors.The receptors are not distributed evenly. For example touch receptors are more numerous in the finger tips than in the skin of the back.

2. Neurons:

The chief structural and functional unit of the nervous system is neurons. Neuroglia are the cells that playa vital role in the nutrition of neurons and their protection by myelin sheath. These are present in the higher animals and in humans and make up as much as half of the nervous system.

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There are three functional types of neurons in mammals:

The sensory neurons

The associative (intermediate/relay) neurons

The motor neurons

Structure of a Neuron:

A neuron has two main parts which are cell body and fibres.

(i) The Cell Body:

The neuron has a cell body or soma containing nucleus and various organelles embedded in the cytoplasm. The cell body is the main nutritional part of the cell and is concerned with the biosynthesis of materials necessary for the growth and maintenance of the neuron. Nissl's granules are present in the cell body. Nissl's granules are groups of ribosomes associated with rough E.R, and Golgi apparatus. If the cell body of the neuron remains intact, it can regenerate axons and dandrite fibres. A mature neuron cannot divide further.

(ii) The Fibres:

The fibres are the protoplasmic processes arising from the cell body.

There are two main types of cytoplasmic processes or fibres:

(a) Dendrites: These carry impulse towards cell body. If it is a single fibre then it is called dendron but if smaller fibres then they are called dendrites (singular: dendrite).

(b) Axons: The processes conducting impulses away from cell body are called axons.These may be more than a meter long in some neurons. Microtubules, neurofibrils, rough endoplasmic recticulum and mitochondria are present throughout the axoplasm (cytoplasm of axon) of the neuron.

3. Effectors:

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These are the structures which respond when they are stimulated by impulse coming via motor neuron. The principal effectors are muscles and glands. The muscles respond by contracting while gland responds by secreting.

REFLEX ARC

Flow of impulse through the nervous system involves receptor, neurons, and effectors. Reflex arc is the path way of passage of impulse during a reflex action. Reflex action is a type of involuntary action. The direction of stimulus is from receptors to sensory neuron to associative t association / relay) neuron and then through motor neuron to the effectors.

Reflexes may be monosynaptic or polysynaptic.

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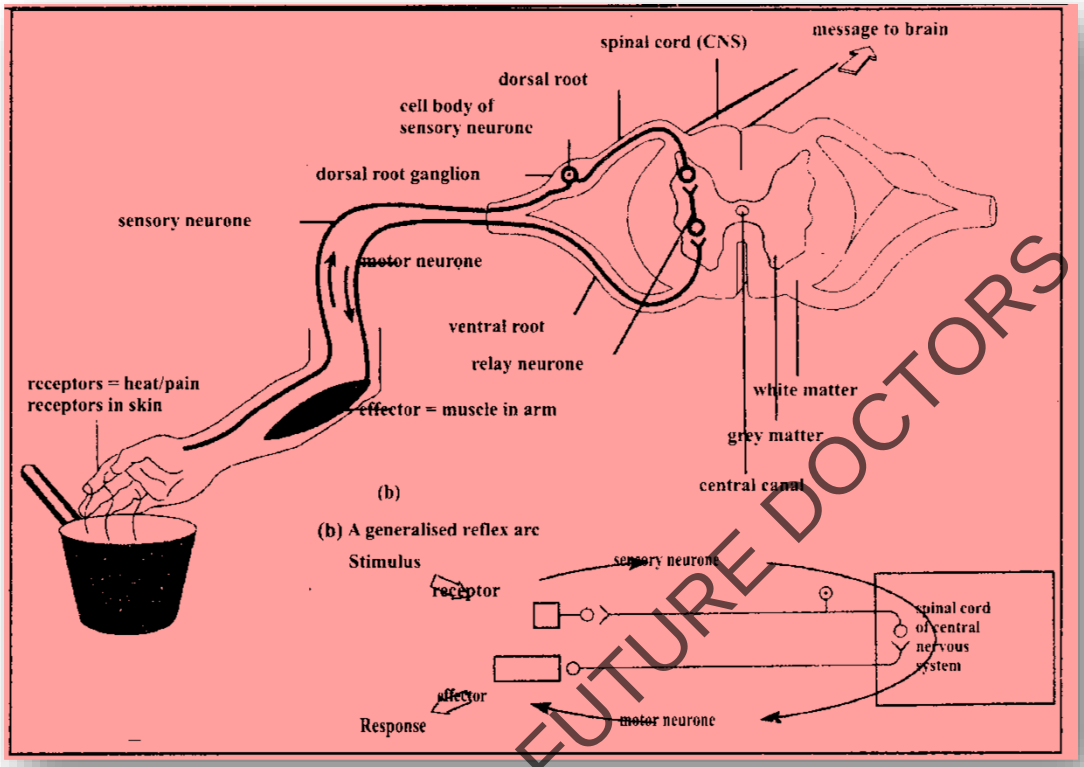

Fig: Reflex action

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NERVE IMPLUSE

Nerve impulse is a wave of electrochemical changes, which travels along the length of the neuron involving chemical reactions and movement of ions across the cellmembrane.

Electrical Potential: Electrical potential is a measure of the capacity to do electrical work. It represents stored energy which is due to separation of charges across a barrier.

In the case of neuron, the charges are positive and negative ions, and the charge separating barrier is the plasma membrane.

Membrane Potential: The electrical potential that exists across a cell membrane IS known as membrane potential.

Resting Membrane Potential: A typical neuron at rest is more positive electrically outside than inside the cell membrane. This net difference in charge between the inner and outer surface of a non-conducting neuron is called the **resting membrane potential.**

Factors Involved in Resting Membrane Potential: The major factors which are involved in resting membrane potential aresodium ions are tenfold higher in concentration outside than inside the membrane surface. The potassium ions are twenty times more concentrated inside than outside. This is due to Na^+ / K^+ pumping system.

The large negative organic ions (such as proteins, organic acids etc.) are much more inside the membrane than outside, where they are only in negligible concentration. This makesthe inside of neuron membrane more negative. So inside becomes more negative than the outside of the cell membrane of neuron.

The membrane potential is of approximately -70 m V. A nerve impulse is initiated by an appropriate stimulus (called threshold stimulus) applied at one end of the neuron and it results in a localized change in the resting membrane potential.Resting membrane potential disappears for a brief instant and is replaced by a new potential called **active membrane potential,** which is in the form of impulse. Now pumping offNa^+rushes in and the inner membrane surface becomes more positive than the outside. This is Active membrane potential which is 0.05 volts (– 50mv).

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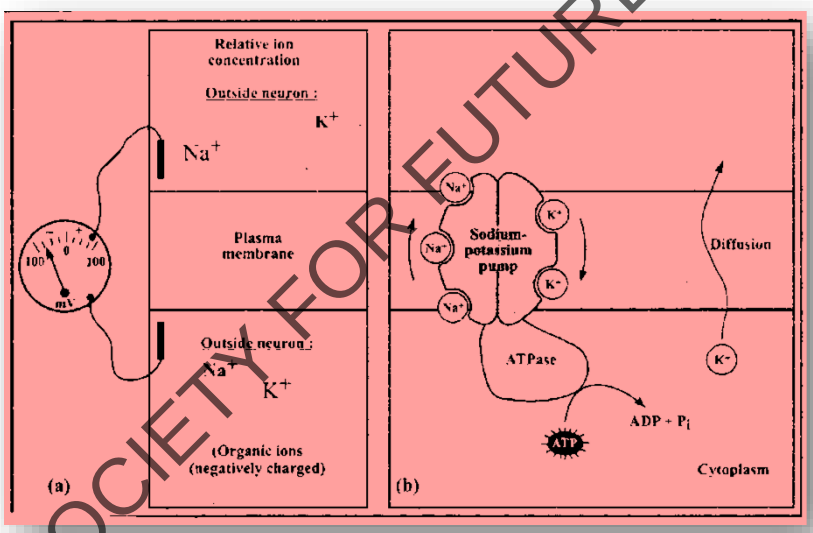
This change is so brief (for perhaps a millisecond) that only a portion of the neuron is inside active membrane potential state. The neuron conducts this impulse in the form .of nerve impulse.

Soon after passage of the impulse, the resting membrane potential is restored by the movement of a small number of ions especially K+ moving out. This neuron now is ready to conduct another impulse.

In myelinated neurons the impulse jumps from node to node (node of Ranvier). This is lolled **Saltatory impulse.**

The normal speed of nerve impulse in humans is 100 meters per second but In myelinated neurons **maximum speed is 120 meters per second.**



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SYNAPSE

The axon endings of the neuron are connected to the dendrites of the next neuron. There is no cytoplasmic connection between the two neurons and microscopic gaps are left between them. Each of these contact points is known as synapse. A nerve impulse is passed from one neuron to the other through the synapse.

However a single impulse does not necessarily pass the synapse. It may take two or three impulses arriving in rapid series or perhaps simultaneously from two or more fibres to start an impulse in the next neuron.

The action potential c~nnot jump from one neuron to the next in line, however,the message is transmitted across the synapse in the form of chemical messenger called neurotransmitters.

When an impulse reaches a synaptic knob, synaptic vesicles within fuse with the presynaptic membrane, the neurotransmitter molecules are released into the synaptic cleft. The neurotransmitter molecules bind to the receptors on the post-synaptic membrane Nerve impulse starts in this neuron. Neurotransmitters are chemicals, which are released at the axon ending of t neurons, at synapse. These are: acetylcholine, adrenaline, nor-epinephrine, serotonin and dopamine.

Acetylcholine is the main transmitter for synapses that lie outside the cent nervous system. Others are mostly involved in synaptic transmission within the brain and spit cord.

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HUMAN NERVOUS SYSTEM

Human nervous system is a type of centralized nervous system.

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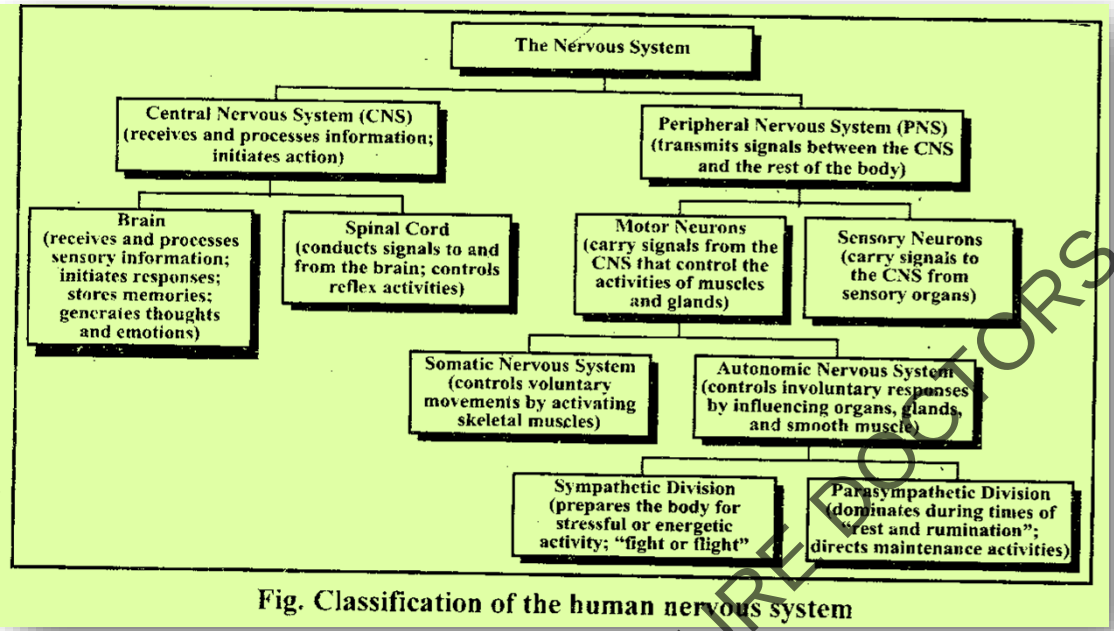

Fig. Classification of the human nervous system

Fig. Classification of the human nervous system

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Protection of Central Nervous System (CNS):

The CNS consists of brain and spinal cord, which are both protected in three ways.

(i) **Cranium:** It is the part of skull which protects the brain

(ii) **Vertebral Column:** The neural arches of the vertebrae of vertebral column protect the spinal cord

(iii) **Meninges:** Beneath the cranium (and vertebral column), the brain and spinal cord are protected by triple layer of meninges.

Cerebrospinal fluid (CSF): Between the layers of meninges, the cerebrospinal fluid (CSF) is present. It is similar in composition to blood plasma. It bathes the neurons of brain and spinal cord. It cushions against the bumps and jolts. Both brain and spinal cord are hollow. The spinal cord has central canal and brain has many cavities (ventricles) filled by CSF.

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Parts of Central Nervous System (CNS):

These are brain & spinal cord.

Parts of Human Brain:

The human brain 'weighs about 1.5 kilograms and is 85 per cent water. Brain is the major part of CNS and is well protected in the cranium of skull. The brain can be divided into forebrain, mid brain and hind brain.

FOREBRAIN

It is further divided into three functional parts, the thalamus, the limbic system and the cerebrum.

1. Thalamus:

The thalamus is a relay center and carries sensory information to the limbic system and cerebrum.

The information is taken by sensory neurons from auditory and visual pathways, from the skin and from within the body.

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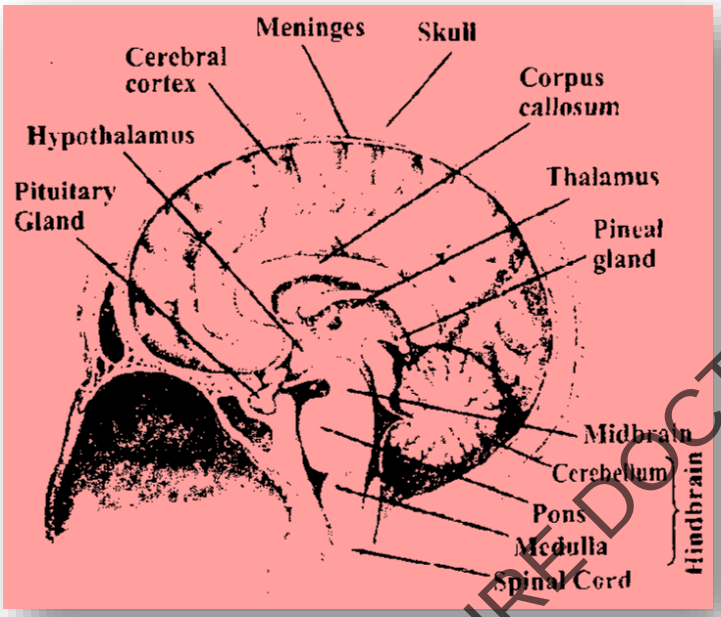

Fig: The human brain

The Limbic System:

The limbic system is located in an arc between the thalamus and cerebrum. The limbic system extends through several brain regions, limbic system work together to produce our most basic and primitive emotions, drives, and behaviours. It is the center of most unconscious emotional behaviors such as love, hates, hunger, sexual responses, fear, rage, tranquility, thirst, pleasure, sexual response & the formation of memories

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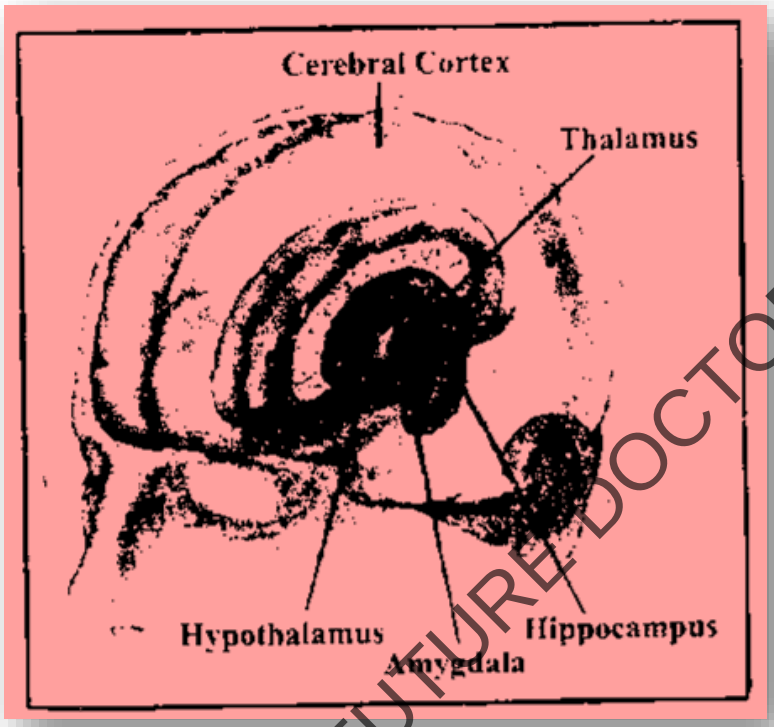

Fig. The limbic system and thalamus

Parts of Limbic System:

The limbic system consists of hypothalamus, the amygdala, and hippocampus and nearby regions of cerebrum.

(i) **The Hypothalamus:** The hypothalamus is a key area. It receives a huge amount of internal and external sensory information and acts as a coordinate center between the nervous system and the endocrine (hormonal) system.

The hypothalamus is responsible for sensations such as hunger andthirst.It also helps control the autonomic nervous system since it regulates body temperature and the balance of water and salts in the blood.It is linked directly to the pituitary gland by means of blood vessels and nerves.

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Generally the hypothalamus controls the release ofhormones from the pituitary including the antidiuretic hormone (which controls water reabsorption in the kidneys) growth hormone and some reproductive hormones.

(ii) **Amygdala**: Amygdala in the amygdala, cluster of neurons produce sensation (feeling) of (pleasure, punishment, love, hate or sexual arousal) when stimulated.

It is also involved in the feelings of fear and rage.

(iii) **Hippocampus:** Hippocampus plays an important role in the formation of long-term memory and thus us required for learning.

3. Cerebrum:

Cerebrum is the largest part of the brain and is divided into two halvescalled cerebral hemispheres. The left cerebral hemisphere controls the right side of the body and right cerebral hemisphere controls the left side of the body.

Corpus Callosum:

These halves communicate with each other by means of a large band of axons called corpus callosum. Tens of billions of neurons are packed into this part, the outer region the cerebral cortex, forms folds called convolutions which greatly increase its surface area.

Functions of Cerebral Cortex:

(i) It receives sensory information, processes it and stores some in memory for future use. This is also involved in intelligence, reasoning and judgment.

(ii) It is also responsible for poorly understood process that we call thinking.

(iii) The cerebral cortex contains primary sensory areas. Here the signals from sensory organs such as eyesandears are received and converted into subjective impressions such as light and sound. Nearby association areas interpret this information.

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(iv) It also contains sensory area of touch. This area receives and interprets sensations of touch from all parts of the body.

(v) It is also involved in speech.

(vi) It is also a center for sending impulses to voluntary muscles, controlling voluntary movements.

MIDBRAIN:

It is reduced in humans and has following functions:

1. **Relay Centre**:

Hindbrain containsreticular formation, which is a relay centerconnecting hindbrain withthe forebrain.Reticular formation is very important inscreening the input information before they reach higher brain centers.

It also contains auditory relay center.

2. **Reflex Movements**:

It controls reflex movement of eyes**.**

HINDBRAIN:

It includes the medulla, pons and cerebellum.

1. **Medulla**:It controls several automatic functions such as breathing, heart rate, blood pressure andswallowing.

2. **Pons**: It is located above the medulla. Its functions are as follows:

(i) Certain neurons in pons influence transitions between sleep and wakefulness

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(ii) It is also involved in the rate and pattern of breathing

3. The Cerebellum:

It co-ordinates body movements and maintain body position. Therefore smooth and accurate motions are possible. The cerebellum is also involved in the learning and memory storage for behaviours. It is best developed in birds, which engage in the complex activity of flight.

SPINAL CORD:

Medulla oblongata narrows down into the spinal cord. Structure and Composition:

Structure and Composition:

It is an oval shaped hollow cylinder, running through the vertebral column. It is made up of a very large number of neurons, the cell-fibers and cell bodies. These are arranged in a definite pattern. In a cross section, the spinal cord shows two portions:

(i) **Inner Portion:**It is butterfly shaped grey matter containing a central canal. Gray matter consists of cellbodies and non-myelinated nerve fibers or tracts.

(ii) **Outer Portion:**It is composed of white matter. White matter is made lip of myelinated nerve fibers or tracts.

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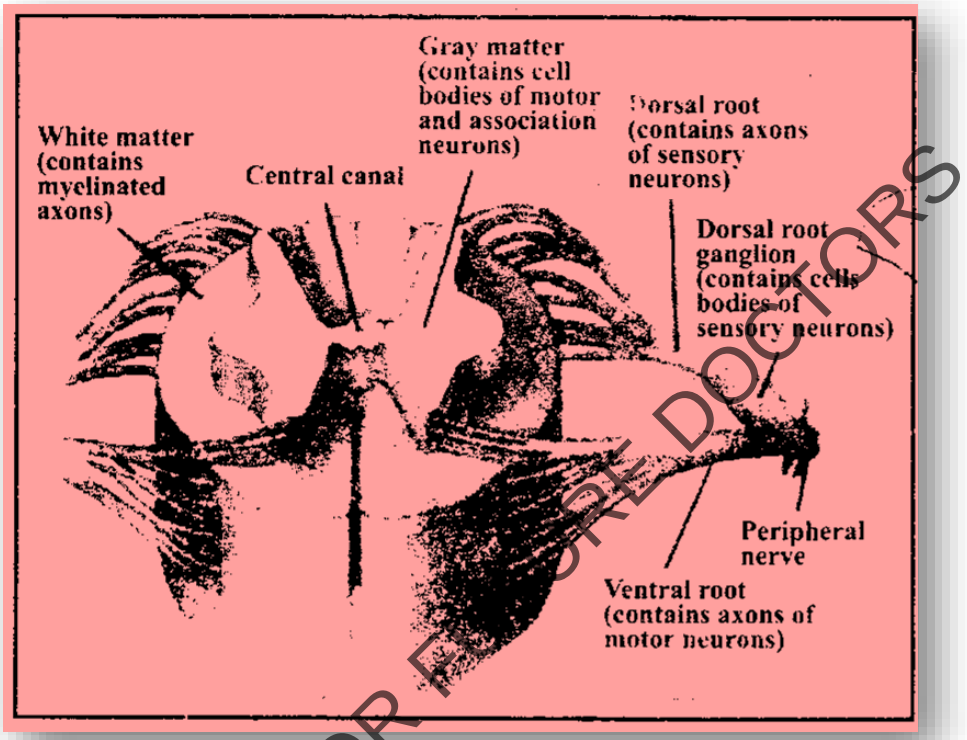

Fig. The spinal cord

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Functions:

(i) The spinal cord is the centre for a large number of reflexes.

(ii) It is a pathway for conduction of impulses to and from different parts of the body and brain.

Peripheral Nervous System (PNS): It consists of sensory neurons and motor neurons, which may form ganglia and the Nerves.

Ganglia: These are the concentrations of cell bodies of neurons.

Nerves: The nerves are the bundles ofaxons or dendrites, bounded-by connective tissue.

Type of Nerves on the Basis of Conduction of Impulse:

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The nerves may be sensory, motor or mixed depending upon the direction of impulse they conduct.

Types of Nerves on the Basis of Link with Brain or Spinal Cord:

These are of two types:

(i) Cranial Nerves: In humans, there are 12 pairs of nerves, which arise from the brain, or lead to the brain. These nerves are called cerebral or cranial nerves. Some of these nerves are sensory, some motor and some are mixed.

(ii) Spinal Nerves: From the spinal cord 31 pairs of spinal nerves arise or lead to spinal cord. All these nerves are mixed having fibres of both sensory and motor neurons. Sensory neurons carry signals to the CNS' from sensory organs. The motor neurons carry signals from the CNS that controls the activities of muscles and glands.

Nervous Systems Formed by the Motor Neurons:

Motor neurons form two types of nervous systems:

(i) Somatic Nervous System: It controls voluntary movements. These movements are under the conscious control of the body. Skeletal muscles are involved in these movements.

(ii) Autonomic Nervous System: It controls involuntary responses by influencing organs, glands and smooth muscles.

Types of Autonomic Nervous System:

The motor neurons of autonomic nervous system are divided into sympathetic nervous system and parasympathetic nervous system.Both of these systems function automatically and innervate all internal organs. These systems utilize two neurons and one ganglion for each impulse.

(i) Sympathetic System:

Most ganglia of the sympathetic system arise from the middle portion of the spinal cord and almost terminate in the ganglia that lie near the cord.

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Functions:

(a) This system is important during emergency situations and is associated with "fight or flight".

(b) This system accelerates the heartbeat, dilates the pupil and inhabits the digestion of food etc.

(ii) Parasympathetic System:

A few cranial nerves including the vagus nerve together with the nerves from the bottom portion of the spinal cord, form the parasympathetic nervous system.

Functions:

It promotes all the internal responses which are associated with the relaxed state (maintenance activities). Some examples are contraction of the pupils promotes digestion of food & retards heartbeat.

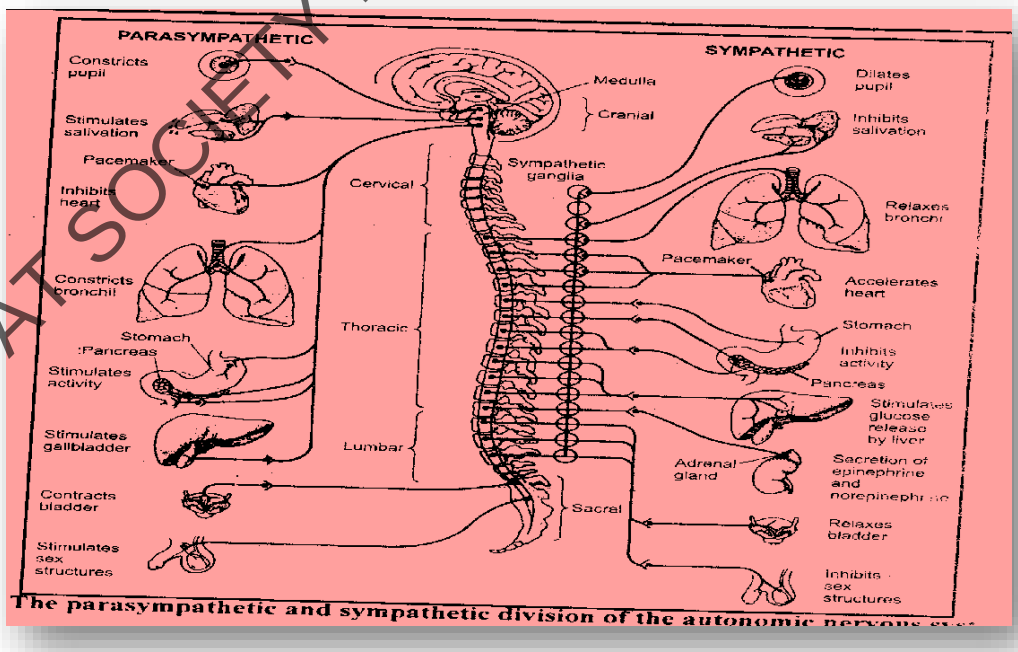

Fig: The parasympathetic and sympathetic division of the autonomic nervous system

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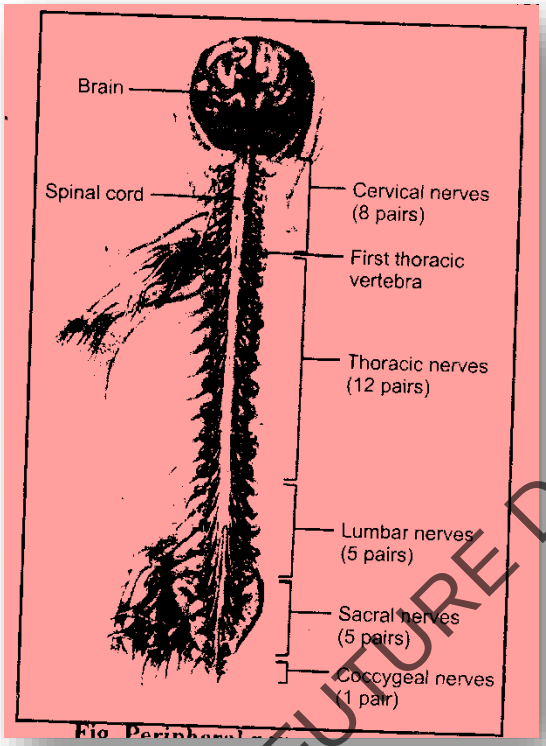

Fig: Peripheral Nervous system

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NERVOUS DISORDERS

Following are some of the common disorders of nervous system in humans:

1. Parkinson's Disease (Paralysis Agitans):

(i) Symptoms: It is a nervous disorder characterized by involuntary tremors reduced motor power and rigidity poor balance and speech problems. The mental faculties are not affected.

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(ii) Causes.

Parkinson's disease is a disease in which the death of a small number of cells in the basal ganglia leads to an inability to select and initiate patterns of movement, onset of disease usually in 50's and 60's.

The disease is slowly progressive. Therefore the patient may live for many years. The disease may result by head trauma.

Treatment:

Effective drugs are available (such as L-dopa also called Levodopa).

In carefully selected patients, surgical destruction of the portions of globus pallidus or the ventrolateral nucleus of thalamus has proved highly beneficial. A naturally occurring protein called glial cell-line derived neurotrophic factor (G DNF) boosts uptake or dopamine when delivered to lab rats and monkeys.

2. Epilepsy:

Symptoms:

(ii) Primary Changes:

Sudden transient alterations in brain function associated with excessive rapid electric discharge in the gray matter.

(ii) Secondary Changes:

It is a convulsive disorder of nerves. It is characterized by sudden and transient symptoms of motor sensory, psychic or autonomic nature, associated with changes in consciousness.

Causes:

The start of epilepsy is usually before age 30. Later age start suggests organic disease. In some patients, emotional disturbances playa significant “trigger" role.

Diagnosis:

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Electroencephalography (EEG) is most important test in the study of epilepsy.

Treatment:

Anticonvulsant drugs are used. Alcohol aggravates epilepsy. Therefore persons suffering from epilepsy should avoid alcohol.

3. Alzheimer's disease:

Alzheimer's disease was first described by alois Alzheimer in 1907.

Symptoms:

There is decline in the brain function (especially with age). Its symptoms are similar to those diseases that cause dementia (mammary loss).

Causes:

There is a genetic predisposition (tendency) to the disease in some people. So it runs in families.There is also evidence that high levels of aluminum may contribute to the onset of this disease.

CHEMICAL COORDINATION

In animals chemical coordination is by endocrine system. It consists of endocrine glands which are present in different parts of the body. These glands secrete hormones.

ENDOCRINE GLANDS:

The endocrine or ductless glands are (with a few exceptions) discrete group of cells which make specific chemical compounds called hormones (In Greek hormone mean) exciting or setting in motion).

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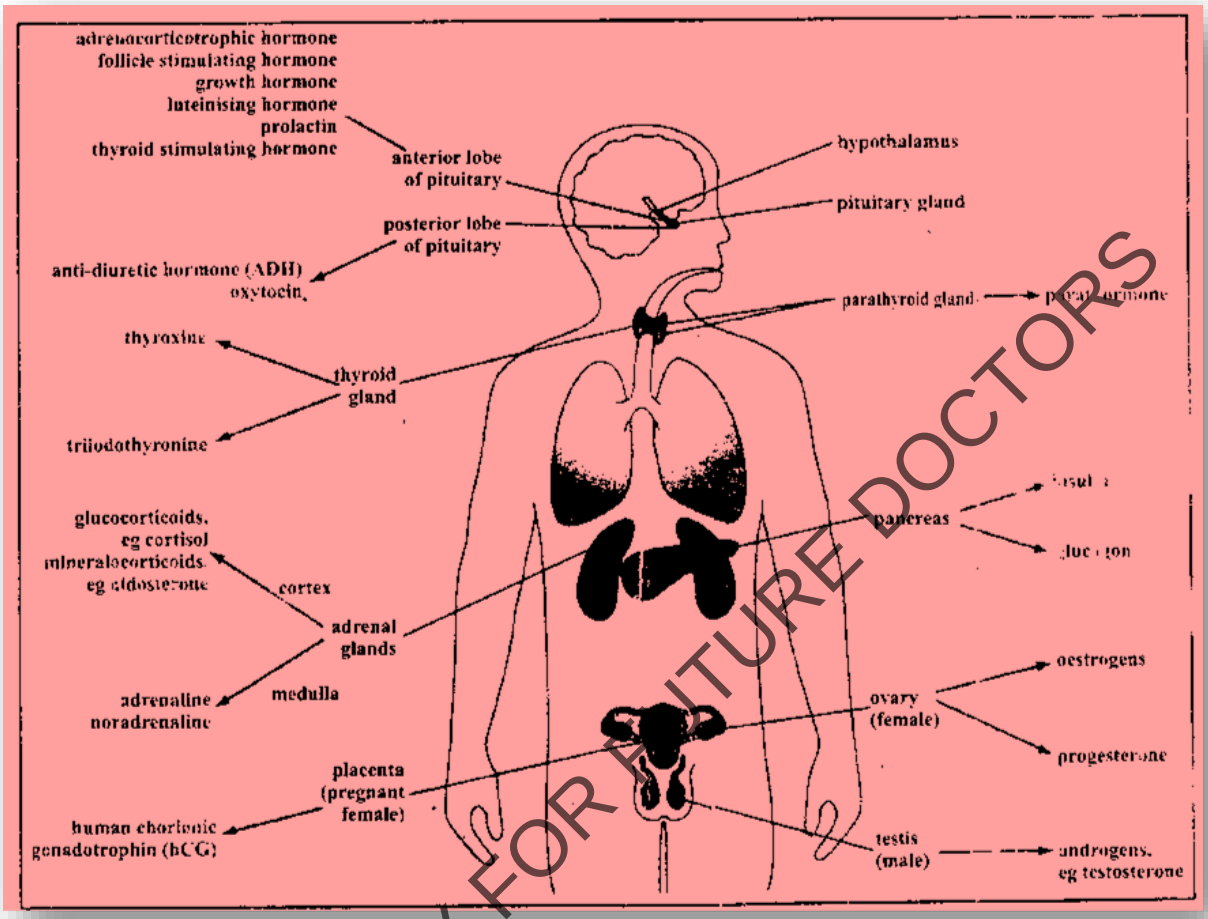

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Hormones:

Hormones are organic compounds of varying structural complexity. They are poured directly and are transported by blood to respective target tissues.

Function:

The hormones affect the target cells. To affect the target cells they work in the following. They do not initiate new biochemical reactions. However they regulate enzymatic and other chemical reactions, already present. They may either stimulate or inhibit a function. Hormones may also control some long term changes. For example rate of growth, ate of metabolic activity and sexual maturity.

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Chemical Nature of Hormones:

Chemically hormones may be of following four types:

(i) Proteins (e.g. insulin and glucagon.)

(ii) Amino acids & derivatives (e.g. Thyroxin, epinephrine and norepinephrine)

(iii) Polypeptides (e.g. vasopressin or anti-diuretic hormone and oxytocin)and Steroids (e.g. Oestrogens, testosterone and cortisone)

Role of Hypothalamus in Endocrine System:

It is part of the fore brain. Here many of the sensory stimuli of the nervous system are converted into hormonal responses.

Nerve cells in the hypothalamus produce and secrete a variety of hormones. One of the nerve clusters synthesizes oxytocin and antidiuretic hormone (ADH)vasopressin.These hormones travel down and are stored in the nerve endings located in the posterior pituitary. Upon proper stimulation from the hypothalamus, oxytocin and vasopressin are released into the blood supply of the posterior pituitary.

Other nerve clusters in the hypothalamus produce and secrete a battery of releasing and inhibiting hormones. These hormones are carried by the blood to the anterior pituitary. There they regulate the secretion u various tropic hormones, growth hormone, and Prolactin manufactured by the anterior pituitary cells.

The Pituitary Gland:

In the pituitary gland (hypophysis cerebri) is an ovoid structure. It is about 0.5 gm in the adult and is connected to brain through a short stalk (the infundibulum).It has three lobes which are anterior,median and posterior

ANTERIOR LOBE

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The anterior lobe is also called as the master gland. This is because that in addition to producing primary hormones it produces the tropic hormones which control the secretion of hormones of other endocrine glands.Anterior lobe of pituitary secretes the following hormones:

1. Somatotrophin (STH):

Release:

Somatotrophin releasing factor (SRF) is secreted from hypothalamus through nut the life.

Functions:

The main function is growth. When growth has mostly ceased after adolescence, the hormone continues to promote protein synthesis throughout the body.

Disorders:

(i) If this hormone is produced in excess during early life, it leads to Gigantism as a result there is abnormal development of hands, feet, jawetc. (known as Acromegaly).

(ii) If there is under-secretion,. **Dwarfism** results in addition to other symptoms associated with lack of thyroid and adrenal hormone.

2. Thyroid Stimulating Hormone:

Release:

Release ofthryotrophin releasing factor from the hypothalamus is controlled by the levels of thyroxin in the blood. In the presence of low levels of thyroxin, there is increasing production ofTSH and viceversa.

Functions:

It is secreted throughout life but particularly reaches high levels during the periods of rapid growth and development. It acts directly on the cells of the thyroid gland increasing both their numbers and their secretary activity.

3. Adrenocorticotrophic Hormone (ACTH):

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Release:

Release of corticotrophin releasing factor from the hypothalamus is controlled by steroid levels in the blood and by direct nervous stimulation of the hypothalamus as a result of stress e.g. cold, heat, pain, fright and infections.

Functions:

Excess and deficiency results as for disturbance of normal adrenal functions.

4. Gonadotrophic Hormones:

These are of three types:

(i) Follicle stimulating hormone (FSH)

(ii) Luteinising Hormone (LH) it is also called interstitial cell stimulating hormone (ICSH) in the male

(iii) Prolactin: It is sometimes inappropriately (improperly) called luteotrophic hormone (LTH)

Release:

A common hypothalamic releasing factor is involved in the secretion of FSH and LH/ICSH.Prolactin is continuously produced from the pituitary and is inhibited by prolactin inhibiting factor (PIH) from the hypothalamus.

Functions of FSH:

In females FSH stimulates follicle development and secretion of oestrogens from the ovaries.

In males, FSH stimulates development of the germinal epithelium of the testis and sperm production.

Functions of LH:

LH works with FSH to stimulate oestrogen secretion and rupture of mature follicles to release egg or ovum.LH also causes the lutenisation (lit. "turning yellow") of the ruptured follicle and work with prolactin to maintain the corpus luteum (and hence it secretes progesterone).

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ICSH in the male stimulates the interstitial cells of the testis to secrete testosterone.

Functions of Prolactin:

Prolactin stimulates milk production (and acts with LH as described above).

MEDIAN LOBE

Median lobe secretes the following hormone:

Melanophore Stimulating Hormone:

Release: External light governs its secretion,more secretion in pregnancy.

Inhibition: Its inhibition of secretion is controlled by hypothalamus.

Functions: Stimulates melanocytes in skin to produce brown pigment, melanin which darkens the skin.

Disorder: Excess MSH is secreted in Addison's disease. One of the symptoms of which is darkening ofthe skin.

POSTERIOR LOBE

The posterior lobe of the pituitary gland secretes the following hormones:

1. Antidiuretic Hormone (ADH) or Vasopressin:

Release: Secretions caused by decrease in blood pressure, blood volume, and osmotic pressure of the blood which is detected by osmoreceptors in the hypothalamus.External sensory stimuli also influence hypothalamic neurosecretory cells.

Functions: Increased levels cause increased water reabsorption in distal parts of kidney.

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Disorder: Lack of this hormone produces **Diabetes insipidus.**As a result there is the production of large quantities of dilute urine and great thirst. **Oxytocin:**

Release: Its release is stimulated by distension of cervix, decrease in progesterone level in blood and neural stimuli during parturition and suckling.

Functions:

Primary action is on smooth muscles, particularly in the uterus during childbirth and also causes milk ejection from mammary glands.

THYROID GLAND

Location: In mammals thyroid gland consist of two lobes situated below the larynx. In mammals the thyroid gland consists of two lobes.

Hormones: It produces:

(i) Thyroxin (or tetraiodo-thryonine: T4), tri-iodothyronine or T3 (which has a structure similar to thyroxin with 3 iodine atoms and not 4).

(ii) Calcitonin hormone.

Functions:

The thyroid is active continuously but produces higher levels of secretions during periods of rapid growth and sexual maturation and in stress situations such as cold and hunger.

(i) Functions of Thyroxin and Tri-iodothyronine: These two hormones act in the same way:

(a) They act on the basal metabolic rate by stimulating the breakdown of glucose and release of heat and generation of ATP.

(b) They also act in combination with somatotropin in bringing about growth, and act directly on brain cells causing them to differentiate.

(c) In amphibians, they affect the process of metamorphosis. If secretion of thyroid is deficient, tadpole larvae of frog does not metamorphose to develop into frog, but instead grow to a large sized tadpole.

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(ii) **Effects of Over Secretion (Grave's Disease):** Excess thyroxin produces a condition called Grave's disease, with exophthalmic goiter and increase in the basal metabolic rate.

This can lead to cardiac failure if prolonged. The cause of Graves' disease is the production of an abnormal body protein. This protein continuously stimulates the thyroid for excessive secretion.

Effects of Under Secretion:

(i) **Cretinism:** If congenitally 'deficient, the lack of thyroxin causes cretinism, where the individual fails to develop normally. They are small, have coarse scanty hair, thick yellowish scaly skin and mentally retarded they also fail to develop sexually.

(ii) **Goiter / Myxoedema (Occurs Later in Life):** Individuals with iodine-deficient diets may have goiter, a condition in which the thyroid becomes greatly enlarged.

It produces a swelling of the neck (goiter) and may lead to lying down of excess fat and. weight is increased. The condition is known as myxoedema. In the myxoedema, the puffiness of hands and skin is produced. Reduced metabolism, body temperature and puls.e rate results. All bodily and mental processes are retarded. Table salt with iodine is recommended so that there is no deficiency of iodine andthus of thyroxin in the body.

Functions of Calcitonin: High Ca^{++} ions concentration in the blood causes stimulation of the synthesis and release of calcitonin. Low levels of Ca^{++} ions suppress its manufacture.

Functions: Its function is antagonistic to parathormone (from the parathyroid glands) and prevents removal of Ca^{++} ions from the bones.

Oversecretion / Undersecretion: Excess or deficiency leads to a disturbance of calcium metabolism. Disturbance in calcium metabolism seriously affects nerves; skeleton, muscle and blood etc.

PARATHYROIDS:

Location: In man the glands are found embedded in the posterior part of the lateral lobes of the thyroid.

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Hormone: These produce a hormone called Parathormone.

Functions: Low levels of blood Ca^{++} ions stimulate the parathyroid directly to increase parathormone production. The high levels of Ca^{++} ions suppress its release.

Undersecretion /Oversecretion: Under-activity causes a drop in blood Ca + ions which in turn leads to muscular tetany. Over-activity would lead to a progressive demineralization of the bones similar to rickets. Similarly there is the formation of massive kidney stones. Both conditions may be fatal.

ISLETS OF LANGERHANS (PANCREAS)

Location: These are present in the pancreas.

Control: These are under the control of pituitary trophic hormones STH and ACTH and responds circtly to the level of blood glucose.

Cell Types: The islets contain two types of cells:

(i) **β-cells:**These are larger in number and secrete insulin.

(ii) **α-cells:** These are smaller in number and secrete glucagon.

Functions of Insulin: Insulin decreases blood glucose levels in many ways which include:

- Increasing glycogen synthesis.
- Increasing cell utilization of glucose.
- Conversion of glucose into lipid and protein.
- Insulin inhibits the hydrolysis of glycogen in the liver and the muscles.

Disorders Due to Undersecretion or Oversecretion of Insulin:

Diabetes Mellitus: Failure to produce insulin leads to a condition called diabetes mellitus.

Symptoms:

(a) High level of blood sugar

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(b) Sugar in the urine,

(c) A disturbance of the body's osmotic equilibrium

(d) derangement of the nervous system.

(e) Toxic metabolites from fat (which need 'glucose energy' for their oxidation) also accumulate and are only lost from the kidney with valuable metal cations.

(f) The body becomes dehydrated.

Hypoglycaemia: If excess insulin is produced, the utilization of sugar is too great and its level falls in the blood (hypoglycaemia) which upsets nerve and muscle functioning.

Functions of Glucagon: Glucagon is antagonistic to insulin and increases the blood glucose levels. It does this mainly by promoting breakdown of glycogen to glucose in the liver and muscles.

It also increases the rate of breakdown of fats.

Disorders: Glucagon abnormalities are rare as endocrine disorders. Tumors on the a-cells will cause excess glucagon secretions. The result is high hlood glucose levels. This in turn damages the a-cells.

ADRENALS

Location: A pair of adrenals is present, one on the top of each kidney.

Structure: Its outer layer is called as **adrenal cortex** while the inner layer is called as **adrenal medulla.**

The Hormones of Adrenal Medulla: The medulla produces the hormones adrenaline and noradrenaline.

Release: Both adrenaline and noradrenaline are secreted in stress situations. In rats whose adrenal medulla has been removed surgically the ability to withstand any stress situation (such as cold) is reduced.

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Functions: Adrenaline: It dilates blood vessels In certain parts of the body (such as the skeletal muscles) and increases the heart's output.

Noradrenaline: It constricts blood vessels in certain areas (such as the gut).

Combined Effects:

(i) Both hormones are involved in raising blood pressure

(ii) Both promote the release of glucose from liver glycogen

(iii) They also reinforce the effects of the sympathetic system

Cortical Hormones: The adrenal cortex secretes Cortisol, Corticosterone and aldosterone hormones. ACTH from the pituitary stimulates secretion of these hormones.The adrenal cortex is active at all times but especially active in a shock or stress situations and infections.

Functions: Cortisol: It increases blood glucose level mainly by its production from protein and b) antagonizing the action of insulin.

Corticosterone: It increases blood glucose levels and regulates mineral ion balance. Therefore it is both a glucocorticoid and a mineralocorticoid.

Aldosterone: The adrenal cortex mainly secretes aldosterone. It conserves the level of N a + ions in the body by preventing their loss from the kidney tubules.

Disorders:

(i) **Under Secretions:** The destruction of the adrenal cortex (such as occurs in Addison's disease) will lead to general metabolic disturbance. In this case there will be weakness of muscle action and loss of salts.

Stress situationsuch as cold which would normally be overcome lead to collapse and death.

(ii) **Over Secretions:** The reverse of this is found in Cushing's disease where too much cortical hormone is produced. Symptoms are an excessive protein breakdown resulting muscular and bone weakness. The high blood sugar disturbs the metabolism as in diabetes.

Androgens (e.g. Testosterone): Very small amounts of androgens are secreted in both male and female by adrenal glands. Androgens cause development of the secondary male characteristics.

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Disorder: A tumor on the inner part of the adrenal cortex in a female can cause excess of androgens to be produced. As a result there is the development of certain male characteristics. However such cases are very rare.

GUT

Many parts of the gut function as endocrine tissue. The important hormones produced are Gastrin and secretin:

(i) **Gastrin:** It is the hormone produced by mucosa of the pyloric region of the stomach. It stimulates the secretion of gastric juice.

(ii) **Functions:** It is produced' under the influence of protein food in the stomach after it is partially digested.

(iii) **Secretin:** It is produced from the duodenum when acid food touches its lining.

Functions: It affects the pancreas to produce and release pancreatic juice. It also affects the rate of bile production in the liver.

GONADS

These are ovaries and testes. The ovaries are inside the body while the testes are outside

OVARY:

Following hormones are secreted by the ovary:

Oestrogens: Oestrogens are secreted by ripening follicles (and, in many species. by interstitial cells the ovary). The development of the follicle was initiated by FSH from the pituitary.

Functions:

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(i) Oestrogens bring about the development of the secondary sexual characters in the female.

(ii) Cause thickening of the uterine wall and

(iii) At a point during the oestrous or menstrual cycle, Oestrogens exert a positive feedback

As a result there is a sharp rise in LH output by the pituitary

(iv) It also aids in healing and repair of uterine wall after menstruation

(v) Under the influence of oestrogens, some of cells of uterine wall become glandular and start secreting proteinacious secretions which are taken up by the embryowhen in its early stages of development.

Undersecretion: Deficiency of the sex hormones leads in the young to failure to mature sexually and sterility in the adult.

Progesterone:

Release: Progesterone is produced by the ruptured follicle in response to LH from the pituitary.

Functions:

(i) Progesterone inhibits further FSH secretion from the pituitary. In this way it prevents any more follicles from ripening.

(ii) It also affects the uterus, causing further thickening and vascularization of its wall, and other areas of the female body, preparing it for the maintaining state of pregnancy.

(iii) It suppresses ovulation. That is why it is a major component of birth control pill.

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TESTES

Structure: The testes consist of many coiled seminiferous tubules. Here the spermatozoa developsbetween the tubules are the regions of interstitial cells.

Hormones: The interstitial cells produce gonadal hormones called testosterone and 17 β-Hydroxytestosterone.

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Release of Hormones: After the initiation of the sex organs in the foetus, the level rises fairly consistently until puberty. After puberty the supply of LH, and therefore the level of testosterone, remains constant.

Functions:

(i) In the foetus it initiates the development of the sex organs

(ii) At puberty it brings about development of the male secondary characteristics and promotes the sex drive

(iii) The castrated male fails to develop secondary sexual characteristics and his body is morelike an immature female.

FEEDBACK MECHANISM

It is a type of interaction in which a controlling mechanism is itself controlled by the products of reactions it is controlling.

Explanation: For proper body functions two opposing systems are needed, if there are accelerators, there must be inhibitors.If one hormone in the body promotes or stimulates a reaction, another will check it. This occurs due to feedback mechanism.
Let us take an example:

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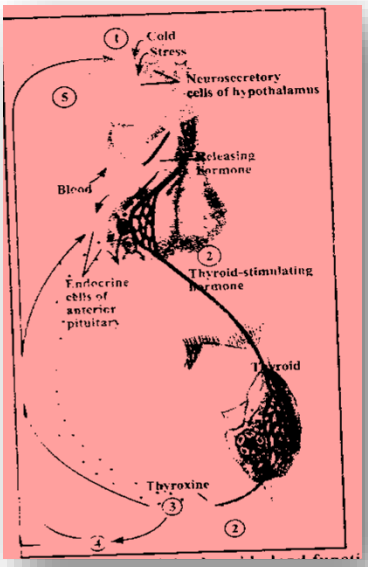

Feedback in Thyroid Gland Function:

(i) Low body temperature (or stress) stimulates neurosecretory cells of the hypothalamus. These cells release hormones.

(ii) These hormones activate the release of thyroid-stimulating hormone (TSH) in the anterior pituitary.

(iii) The TSH then stimulates the thyroid gland to release thyroxine.

(iv) Thyroxine causes an increase in the metabolic activity of most body cells, generating A TP energy and heat.

(v) Both the raised body temperature and higher thyroxine levels in the blood inhibit the releasing-hormone cells and the TSH-producing cells.

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TABLE: Human endocrine glands and their principal secretions.			
Glands	**Hormone**	**Chemical Structure**	**Effect**
Posterior lobe	Anti-diuretic hormone (ADH)	Peptide	Reduces amount of water lost In urine Raises blood pressure by constricting arterioles.
	Oxytocin	Peptide	Contraction of smooth muscle during childbirth. Stimulates secretion of milk from mammary glands.
Anterior lobe	Adrenocorticotrophic hormone (ACTH)	Peptide	Stimulates production and release of hormones from adrenal cortex.
	Follicle stimulatin hormone(FSH) also called ICSH in males	Glycoprotein	Controls the development of follicles in the ovary, and sperm cells in the testis.
	Growth hormone	Protein	Promotes growth (especially of skeleton and muscles). Affects bodymetabolism.
	Luteinising hormone (LH)	Glycoprotein	Stimulates ovulation and formationof the corpus luteum (stimulatestestosterone production in males).
	Prolactin	Protein	Stimulates milk productionand release during pregnancy.
	Thyroid stimulating hormone (TSH)	Glycoprotein	Stimulates growth of thyroidsglandsynthesis and production of thyroid hormones.
Thyroid	Thyroxin + Tri-iodothyronine	IodineContainingAmino acids	Thyroxin Increases rateof cellmetabolism,controls aspects of growth and development and controls basal metabolic rate (BMR)
Parathyroid	Parathormone	Peptide	Raises blood calcium levels by stimulating release of calcium frombone
Pancreas (Islets of Langerhans)	Insulin (Produced bythe β-cells)	Protein	Lowers blood glucose levels by making cell membranes more permeable to glucose increase glycogen storage in liver.
	Glucagon (Produced by the a cells)	Peptide	Raises blood sugar levels by stimulating glycogen breakdown inthe liver

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Adrenal Cortex	Glucocorticoid e.g. cortisol	Steriods	In response to stress, raises blood glucose.
	Mineralocorticoids, e.g., aldosterone	Steriods	Concerned with water retention.Increases reabsorption of sodium chloride in kidneys, so important incontrol of blood volume and pressure

Adrenal medulla	**Adrenaline**	**Modified amino acid**	**Fear, flight and flight reactions Prepares the body for heightenedactivity. Mimics effects of the autonomic nervous system**
	Noradrenaline	Modified amino acid	As adrenaline
Gonads Ovary (follicle)	Oestrogens	Steroids	Female sex characteristicrebuildingof uterus lining after menstruation, inhibits FSH
Ovary (corpus)	Progesterone	Steroids	Stimulates maturation of uterus lining, maintains pregnancy inhibits FSH.
Testis	Androgens e.g testosterone	Steroids	Support sperm production important the development ofmad in secondary sexual characteristics
Placenta	Human Chorionic Gonadotrophin (HCG)	Sterioid	Causes corpus luteum to secrete thusmaintainingprogesterone.Pregnancy

BIOLOGICAL CLOCKS AND CIRCADIAN RHYTHMS

- In living things the behaviour activities occur at regular intervals which are called asbiological clocks or biological rhythms or biorhythms.
- All plants and animals have endogenous cycles that, in response to an outside rhythm will cue various actions.
- For example, bears know they must hibernate flowering plants know they must flower and humans know they need sleep.
- In the example of plants the vegetative/flower cycle is synchronized with a day length cycle that has longer hours of darkness, resulting in a chemical reaction that releases florigen and signals to the plants to flower.

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- Similarly, a chemical reaction takes place in humans with their sleep/wake cycle.There are two types of biorhythms:

    1. **Circadian Rhythms:** If the biorhythms occur daily (about 24-hours) these are called circadian (Latin circa = about. dies = day) or diurnal rhythms.

    2. **Circannual Rhythms:** If the biorhythms are less than or about 365 days these rhythms In activity are called circannual.

    Biorhythms may be the result of the following:

    (i) Some biorhythms are due to changes in the external (exogenous) stimuli.

    (ii) Some biorhythms are due to changes in the internal (endogenous) stimuli.

Normally the internal rhythm works in synchronicity (coordination) with the exogenous time period (a 24 hour or a 365 day period). The organism's behaviour develops on the basis of these two rhythms.Many organisms maintain internal clock (rhythm). By this clock they can predict and prepare for the periodic changes that are cyclical in nature. For example days tides, and seasons etc.The basic period of the clock is innate. It means that the rhythms are in one's genes but the environment influences the rhythms to some extent. The behaviour is due to the combination of effects of rhythmical internal processes and the environment.

ADDITIONAL / RELATED READING

1. The organization, regulation, integration and control in the composition andfunctions of the complex multicellular animals is called coordination.
2. Integration means unity out of diversity.
3. Principle of coordination is S-R (Stimulus - Response).
4. To the unicellular organisms coordination exists between various cellular processes
5. Plants are rarely passive.
6. In plants the control is by the plant hormones. In animals the control is by hormones and by nervoussystem.
7. Locomotion ismovement of organism as a whole.

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8. There are two kinds of plant movements: turgor movements and growth movements.

9. If plants are grown without light, they become extremely long and fail to form chlorophyll. They are said to be etiolated.

10. In the absence of carbon dioxide, the process of photorespiration may start in the plants. As a result net productivity is reduced.

11. If plants are wounded, they often develop calluses. A callus is a mass of amorphous material with very poor differentiation.

12. Plant cancers may arise and spread throughout the plant as an amorphous invasion of surrounding well differentiated tissue.

13. Galls are growth on a plant that are induced by parasites.

14. Highly organized growth galls are tumors induced by bacteria. They are usually less differentiated than other types of galls

15. Phytohormone/plant hormone is a substance that has a specific effect on plant growth and that produces this effect when present in very low concentrations.

16. Auxins are indole acetic acid (IAA) or their variants. These are synthesized in the shoot apex.

17. In the root, auxins promote growth at very low concentrations.

18. Auxins inhibit abscission (controlled shedding ofleaf, fruit or flower).

19. Auxins cause delay in leaf senescence (aging) in a few species

20. 2,4-D (2,4 Dichtorophenoxy acetic acid) Selective weed killer: Kills broad leaved species (dicots).

21. Gibberellin are produced commercially from fungal cultures (Gibberella fujikuroi). The first Gibberellin isolated was GA_3.

22. Cytokinins are also called as kinins. Primarily involved in cell division.

23. Cytokinins delay aging of fresh leaf crops, such as cabbage and lettuce (delay of senescence) as well as keeping flowers fresh.

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24. The controlled shedding of a part, such as leaf, fruit or flower by a plant is called as abscission.

25. Abscisic acid Promotes closing of stomata under conditions of water stress (wilting).

26. Ethene is a gaseous hydrocarbon that is produced in small quantities by many plants and act as phytohormone.

27. Ethene induces flowering in pineapple

28. When an impulse reaches a synaptic knob, synaptic vesicles within fuse with the pre-synaptic membrane.The neuro-transmitter molecules are released into the synaptic cleft.

29. The neuro-transmitter molecules bind to the receptors on the post-synaptic membrane. An action potential is generated in the post-synaptic neuron, by causing changes in its permeability to certain ions.

30. Acetylcholine is the main transmitter for synapses that lie outside the central nervous system.

31. Behaviour is defined as a change in response to stimulus or the sum of everythingthat animals do. Study of Behaviour is called ethology.

32. Responses are due to Nervous system and the nervous system is inherited.

33. Smaller is the animal more inherited behvaviour lesser / slower is the learning ability.

34. Larger' is the animal lesser is inherited behvaviour-more is learning ability.

35. Walking, moving, running and eating etc is due to Instinctive behaviour.

36. By instinctive behaviour an animal has specific response to a particular stimulus.

37. Kineses is a behaviour in which an organism changes the speed of random movements which help them to survive in the environment.

38. A taxis is a directed movement either toward (positive taxis) or away from (negativetaxis) a stimulus.

39. Modification through experience is called learning.

40. Thorpe classified learning behaviour into six types

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41. Imprinting is Irreversible form of learning. Other five types are reversible form of learning.

42. Imprinting is a form of learning which is best known in birds such as geese, ducks, and chickens.

43. Habituation is the simplest form of learning while Insight learning is the most complex form of learning.

44. Thorpe defined latent learning as the association of indifferent stimuli or situations without patent reward.

45. Insight learning is an extreme case of behavioural modification involving the application of insight or reasoning to a novel situation

46. Epinephrine: A hormone, secreted by the adrenal medulla, that is released in response to stress and that stimulates a variety of responses, including the release of glucose formskeletal muscle and an increase in heart rate.

47. Ethology: The study of animal behavior in natural or near-natural conditions.

48. **Ethylene:** A plant hormone that promotes the ripening of fruits and the dropping of leaves and fruits.

49. **Gibberellin:** A plant hormone that stimulates seed germination, fruit development and cell division and elongation.

50. **Glial cell:** A cell of the nervous system that provides support and insulation for neurons.

51. **Habituation:** Simple learning characterized by a decline in response to a harmless, repeated stimulus.

52. **Hormone:** A molecule usually a peptide or steroid that is produced in one part of an organism and triggers a specific cellular reaction in target tissues and organs somedistance away.

53. **Imprinting:** The process of learning by which an animal forms an association with another .animal or object in the environment during a sensitive period of development, usually shortly after birth; or being hatched.

54. **Insight learning:** A complex form of learning that requires the manipulation of mental concepts to arrive at adaptive behavior.

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55. **Melanocyte-stimulating hormone:** A hormone, released by the anterior pituitary that regulates the activity of skin pigments in some vertebrates.

56. **Melatonin:** A hormone, secreted by the pineal gland that is involved in the regulation of circadian cycles.

57. **Melanotonin:** A Hormone that is secreted by the pineal gland and that reverses the darkening effect of melanocyte-stimulating hormone by causing aggregation of the melanin granules in the melanocytes.

58. Meninges: Three layers of connective tissue that surrounds the brain and spinal cord

59. **Neuromuscular junction:** The sysnapse formed between a motor neuron and a musclefiber.

60. **Neurosecretory cell:** A specialized nerve cell that synthesizes and releases hormones.

61. **Photoperiodism:** Response of an organism to the relative duration of day and night.

62. **Progesterone:** A hormone, produced by the corpus luteum that promotes the development of the uterine lining in females.

63. **Steroid hormone:** A class of hormone whose chemical structure (four fused carbon rings with various functional groups) resemble cholesterol; steroids, which are lipids, are secreted by the ovaries and placenta, the testes, and the adrenal-cortex.

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QUESTIONS FOR PRACTICE

1. The essentially automatic movement of an animal toward or away from stimulus is:

(a)taxis (b)kinesis (c)reflex (d)orientation

2. Concept of imprinting was developed by:

(a)Darwin (b)Pavlov (c) Lorenz (d)Mendel

3. Male stickleback attack the object with:

(a)red underside (b)three spines (c)silver top side (d)elongated body

4. Central nervous system is mainly composed of:

(a) sensory neurons (c) intermediate neurons (b) motor neurons (d) CSF

5. Inwater logged and saline conditions of the soil, stem and root growth is inhibited by:

(a) abscisic acid (b) gibberellic acid (c) indole acetic acid (d) ethane

6. One term that does not belong with others is:

(a) exophthalmia (b) cretinism (c) myxedema (d)Addison's disease

7. Axon is long in:

(a)sensory neuron (b)associative neuron (c)motor neuron (d)none of them

8. Schwann cell is associated with:

(a) muscle cell (b)gland cell (c)nerve cell (d)muscle and gland cells

9. At the time of impulse, the inner side of the membrane is more positive due to:

(a) more K^+ ions (b)more Na^+ ions

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(c)more cations (d)movement of organic anions to outside

10. Synaptic vesicles are present:

(a)within the presynaptic knob (b)within the postsynaptic knob

(c) in the synaptic cleft (d)in the dendrite port of neuron

11. GDNF is:

(a)protein (b)lipid (c)carbohydrate (d)lipo-protein

12. Cerebrospinal fluid bathes the neurons of:

(a)CNS (b)somatic nervous system

(c) autonomic nervous system (d) both SNS and ANS

13. Vagus nerve is involved in the formation of:

(a)somatic nervous system (b) sympathetic nervous system

(c) parasympathetic nervous system (d) complete ANS

14. Oxytocin is chemically:

(a)polypeptide (b)polynucleotide (c)protein (d) nucleic acid

15. Luteotrophic hormone refers to:

(a)prolactin (b) LH (c)FSH (d)ICSH

16. Insulin maintains blood glucose level by:

(a)conversion of excessive glucose to glycogen (b)conversion of excessive glucose into lipids

(c) inhibiting hydrolysis of glycogen in liver (d)all of these

17. Ripening of more follicles is prevented by:

(a)oestrogen (b) progesterone (c) androgens (d) LTH

18. Which is a different learning behaviour?

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(a) operant conditioning (b) conditioned reflex type II

(c) trial and error learning (d)insight learning

19. Sometimes may substitute for red light.

(a)auxin (b) gibberellins (c)cytokinins (d)abscisic acid

20. Cellular functions of neurons are by:

(a) soma (b) axon (c) dendrite (d) synaptic knob

21. Adrenaline is also called:

(a) oxytocin (b) epinephrine (c) nor epinephrine (d) ICSH

22. Metamorphosis in tadpole requires:

(a) thyroxin (b) parathorrnone (c) calcitonin (d)both b & c

23. As cells become more specialized, they become more:

(a) independent (b) dependent (c) motile (d) elastic

24. Part of hind brain responsible for hand-eye coordination:

(a) pons (b) medulla oblongata (c) cerebellum (d) both pons and medulla oblongata

25. Of the total brain, the cerebral cortex is:

(a) 30 (b) 50 (c) 65 (d) 80

26. The behaviour which does not involve acquisition of new responses but loss of old ones is:

(a) habituation (b) imprinting (c) latent learning (d) insight learning

27. The hormone calcitonin is secreted by:

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(a) thyroid (b) parathyroid (c) hypothalamus (d) pancreas

28. A conditioned reflex is:

(a) inborn (b) unlearnt (c) acquired (d) inherited

29. Components of S-R Model:

(a) 1 (b) 2 (c) 3 (d) 4

30. First hormone isolated was:

(a) secretin (b) thyroxin (c) FSH (d) ICSH

31. In which organisms is a nerve impulse least likely to travel in a definite pathway?

(a) hydra (b) earthworm (c) planaria (d) human

32. Cell bodies of sensory neurons constitute:

(a) dorsal root ganglion (b) ventral root ganglion

(c) dorsal root (d) posterior root ganglion

33. What would be the result of a reduction in the activity of the thyroid gland?

(a) a decrease in the metabolic rate (b) a decrease in glucose level in the blood

(c) an increase in glucose in the urine (d) an increase in blood pressure

34. The base of biological clock is:

(a) inhale (b) environmental (c) both innate and environmental (d)variable

35. Thyrotrophin releasing factor (TRF) is produced by:

(a)anterior lobe of PG (b)median lobe of PG

(c)hypothalamus (d)thalamus

36. The information about CO_2 is received by:

(a)mechanoreceptors (b)nociceptors

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(c)thermoreceptors (d) chemoreceptors

37. Which of the following is common to all neurones?

(a) a cell body which contains a nucleus

(b) a thick myelin sheath

(c) presence of nodes of ranvier

(d) presence of schwann cells

38. The microscopic gap between the axon endings of one neuron and the dendrites of the other Neuron is:

(a) synapsis (b) synaptic cleft (c) synapse (d) impulse

39. The receptor cells of Planaria are sensitive to:

(a) light and pressure (b) light pressure and touch

(c) light, pressure, touch and chemicals (d) touch pressure and chemicals

40. The plants are said to be etiolated, if they fail to form chlorophyll in the absence of:

(a) water (b) Mg^{+} (c) light (d) nitrogen

41. The chief morphological and physiological unit of the nervous system is the:

(a) ganglion (b) neuron (c) reflex (d) synapse

42. The groups of ribosomes present in the cell body of the neuron, which are associated with rough endoplasmic reticulum, are called:

(a) Meissner's corpuscles (b) Pacinian corpuscles

(c) Nissl's granules (d) lysosome granules

43. A nerve impulse is a wave of electrochemical change traveling along the length of the neuron involving chemical reactions and movement of ions across the:

(a) synapse (b) cell wall (c) cell membrane (d) axon

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44. The mammalian forebrain is differentiated into the thalamus, limbic system and the:

(a) cerebellum (b) cerebrum (c) hippocampus (d) hypothalamus

45. The limbic system of forebrain of man consists of hypothalamus, hippocampus and:

(a) thalamus (b) amygdala (c) cerebrum (d) meninges

46. A nerve is a:

(a) concentration of cell bodies of neurons

(b) collection of naked neurons

(c) bundle of Dendron's

(d) bundle ofaxons or dendrites, bounded by connective tissue

47. The number of human cerebral nerves is:

(a) twelve (b) twenty four (c) thirty one (d) sixty two

48. The number of human spinal nerves is:

(a) 24 (b) 50 (c) 62 (d) 64

49. A convulsive disorder of nerves associated with rapid electric discharges in the gray matter of the brain is called:

(a) Parkinson's disease (b) Alzheimer's disease

(c) epilepsy (d) Cushing's disease

50. Dwarfism in human being is caused due to under-secretion of:

(a) somatotrophin (b) corticotrophin (c) thyrotrophin (d) prolactin

51. When a neuron is stimulated, the cell membrane at the point of stimulation undergoes a mometory reversal in charge called:

(a) impulse (b) potential (c) resting potential (d) action potential

52. Aldosterone conserves the level of sodium ions in the bod)' by preventing their loss from the:

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(a) liver (b) kidney tubules (c) pancreas d) lungs

53. The scientists who study animal behaviour are known as:

(a) psychologists (b) ethnologists (c) ethologists (d) gerontologists

54. The pattern of behaviour, which is hereditary, is called:

(a) instinctive (b) learning (c) adaptive (d) selective

55. Learning by trial and error was demonstrated and studied by:

(a) Thorpe (b) Pavlov and carpenter

(c) Thorndike and skinner (d) Allen and Thorpe

56. The highest form of learning is:

(a) conditioned reflex (b) imprinting (c) insight learning (d) latent learning

57. Biological rhythm in drosophila was studied by:

(a) Ervin Bunning (b) Darwin (c) Thrope (d) Pavlov

58. Which hormone serves both as a weedicide and retards abscission of fruits?

(a) indole acetic acid (b) 2,4 dichlorophenoxyy acetic acid

(c) naphthalene acetic acid (d) indole propionic acid

59. Nerve endings in the branchial vessels of fishes serve as:

(a) chemoreceptors (b) mechanoreceptors (c) photoreceptors (d) nociceptors

60. Neurotransmitters are released by:

(a) axon ending (b) Dendron ending (c) cell body (d) synaptic cleft

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UNIT NO. 5 (HUMAN PHYSIOLOGY)

1	A	2	C	3	A	4	C	5	A	6	D	7	C	8	C	9	B	10	A
11	A	12.	A	13	C	14	A	15	A	16	D	17	B	18	D	19	B	20	A
21	B	22	A	23	B	24	C	25	D	26	A	27	A	28	C	29	C	30	A
31	A	32	A	33	A	34.	A	35	C	36	D	37	A	38	B	39	B	40	C
41	B	42	C	43	C	44	B	45	B	46	D	47	B	48	C	49	C	50	A
51	D	52	B	53	C	54	A	55	C	56.	C	57	A	58	B	59	B	60	A

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REPRODUCTION

Reproduction is a process through which organisms produce young ones of their own kind to maintain their species. Reproduction is of two types, asexual reproduction and sexual reproduction.

ASEXUAL REPRODUCTION:

It is a kind of reproduction in which a single organism gives rise to offspring by mitotic cell division, during which the total number of chromosomes is exactly replicated and passed on to the daughter cells, so that the offspring are genetically identical to the parent.

Advantages:

(i) The offspring are genetically identical to the parent.

(ii) Increase in number is very rapid.

(iii) Tissue culturing in plants and cloning in animals are very easy.

Disadvantages:

(i) It is not good for survival of a species.

(ii) In the cloning there is rapid aging and low resistance to environmental stress and diseases. Similarly cloning is still not being accepted socially and morally in general.

SEXUAL REPRODUCTION:

It is a kind of reproduction in which usually two parents are involved and a fertilized egg is produced through the union of meiotically produced specialized sex cells (egg and sperm)from each parents.

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Advantage:

Meiosis or reduction division gives rise to spores (sporogenesis) or gametes (gametogenesis). As a result the chromosome number is halved (haploid). Similarly reshuffling of genes also occur which lead to new recombination of genes.

This not only maintains the chromosome number in a species but also produce genetic variations. It is an important factor in the survival of a species or a population.

Asexual Reproduction	Sexual Reproduction (Omitting Bacteria)
One parent only	Usually two parents
Offspring produced by mitotic cell division.	A fertilized egg is produced by the union of meiotically produced specialized sex cells (egg andsperm) from each parents. From this fertilized egg.an organisms is produced by the process of mitosis
No gametes are produced	Gametes are produced. These are haploid and nuclei of two gametes fuse (fertilization) to form a diploid zygote
Meiosis absent and the complete number of chromosomes is exactly replicated and passed on to the next generation	Meiosis present at some stage in life cycle. Meiosis or reduction division gives rise to gametes (gametogenesis) III which not only the chromosome number is halved (haploid). In this way the chromosome doubling in every generation is prevented
Offspring genetically identical to the parent	Offspring show genetic variation which is an) important factor in the survival and adaptation of species or a population

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Commonly occurs In plants, less differentiated animals and micro-organisms Absent In more differentiated animals	Occurs in the majority of plant and animal species
Often results in rapid production of large numbersof offspring	Less rapid increase in numbers.
Methods of asexual reproduction are fission, sporulation, budding, vegetative propagation, artificial propagation, parthenogenesis and apomixes etc. The layering, grafting, budding etcare the artificial asexual methods of reproduction in plants	

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Evolution of Sexual Reproduction:

Asexual method of reproduction is a primitive form of reproduction. Later on a mechanism was evolved leading to the production and union of gametes. First isogamy & then Heterogamy was evolved.

Evolution of sexual reproduction also leads to the differentiation of sexes (male or female). Fertilization is the process which leads to union of gametes. Fertilization may occur outside the body (external fertilization) or inside the body of the female (internal fertilization). In terrestrial conditions fertilization is internal. Sperms are lodged in the female body where fertilization occurs.

After internal fertilization sometimes there is external development as in reptiles and birds. They lay shelled eggs to protect the developing embryo from harsh terrestrial conditions. Such animals are called oviparous,

In mammals, internal fertilization leads to internal development and development of embryo occurs inside the female body, which give birth to young one such animals are called **viviparous.**

In some mammals like Duckbill platypus (Echidna), internal fertilization leads to internal development of the young one in a shelled egg and when development is completed shelled egg is laid which hatches the offspring. This is called **ovoviviparous** condition. Viviparous and ovoviviparous animals provide more protection to their young one during development.

REPRODUCTION IN MAN

Male and female have separate reproductive systems.

Male Reproductive System:

Male reproductive system consists of external genitalia which consist of: (i) A pair of testes.

(ii) Male reproductive organ which IS used to transfer the sperms into the female reproductive tract.

(iii) Various glands

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Testes:

Location: Testes lie outside the body in the sac like scrotum.

Seminiferous Tubules: Each testis consists of a highly complex duct system called seminiferous tubules.

Sperm Production: In the seminiferous tubules repeated division by the cells of the germinal epithelium produce spermatogonia. These increase in size and differentiate into primary spermatocytes. Meiosis occurs in the primary spermatocytes to form secondary spermatocytes and spermatids. Finally the spermatids differentiate into mature sperms.

Hormone Production: Between the seminiferous tubules are interstitial cells which secrete testosterone. This hormone is essential for the successful production of sperms and also controls the development of male secondary sexual characteristics during puberty.

Sperm Storage: Fluid secreted by sertoli cells provides liquid medium, protection and nourishment to sperms while they are in the tubules. The sperms are then transferred to the main duct of the male reproductive tract, the vas deferens which forms highly convoluted epididymis. The sperms then pass through the urinogenital duct and are discharged out.

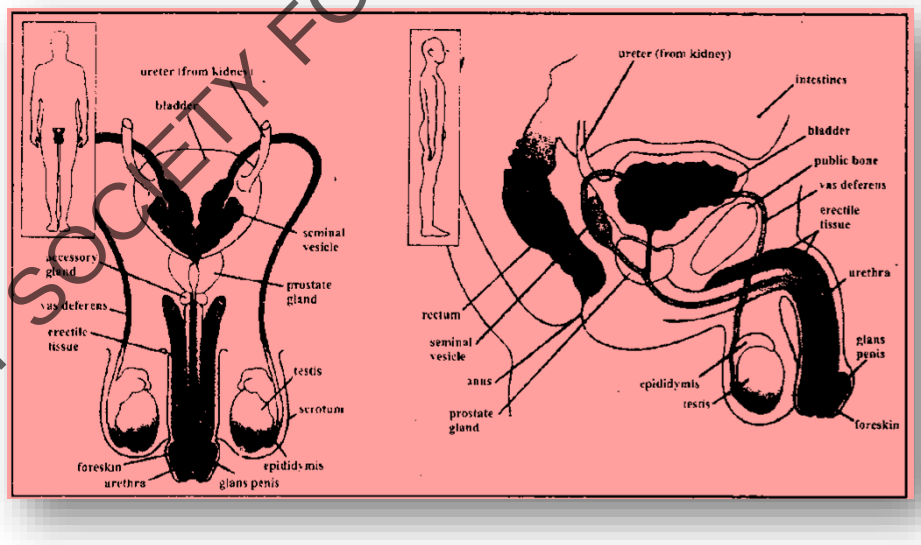

Fig. The male reproductive system cosmists of two testes that produce sperms, ducts that carry the sperms, and various glands.

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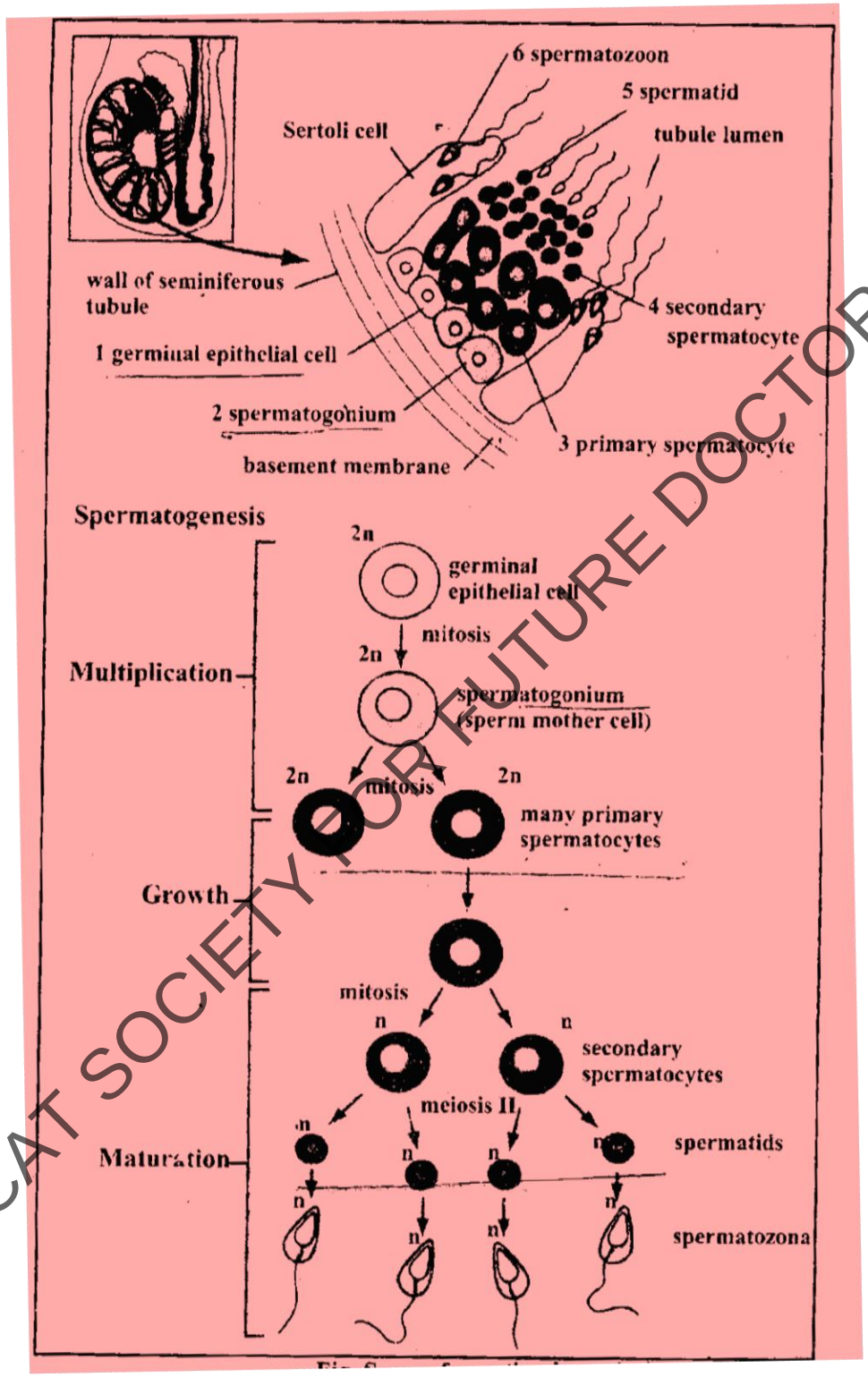

Fig. Sperm formation by meiosis

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2. Female Reproductive System:

The female reproductive system consists of

(i) the ovaries (ii) the oviducts

(iii) uterus and (iv) the external genitalia

(i) Ovaries: A pair of ovaries lies within the body cavity of the female

Egg Production: Germ cells in the ovary produce many oogonia which divide by mitosis to from primary oocytes. These are enclosed in groups of follicle cells. The primary oocyte divides meiotically into the haploid secondary oocyte and first polar body. Second meiotic division in the ooccyte proceeds as far as metaphase but is no completed until the oocyte is fertilized by the sperm.

Ovulation: Discharge of ovum from the ovary is called ovulation. In human only on, ovum is usually discharged from the ovary at one time.

(ii) Oviduct / Fallopian Tube: The ovum is then transferred to the oviduct generally called fallopian tube or uterine tube. The fertilization of the ovum takes place in the proximal part of the oviduct.

(iii) Uterus: The uterine tube opens into the uterus. The fertilized ovum (zygote) enters the uterus where it is implanted (conceived) and undergoes further development. A placenta is established between the uterine and foetal tissues for the exchange oxygen, carbon dioxide, waste, nutrients and other materials.

(iv) External Genetalia: Uterus opens into the vagina through cervix. Urethera and vagina has independen openings to the exterior.

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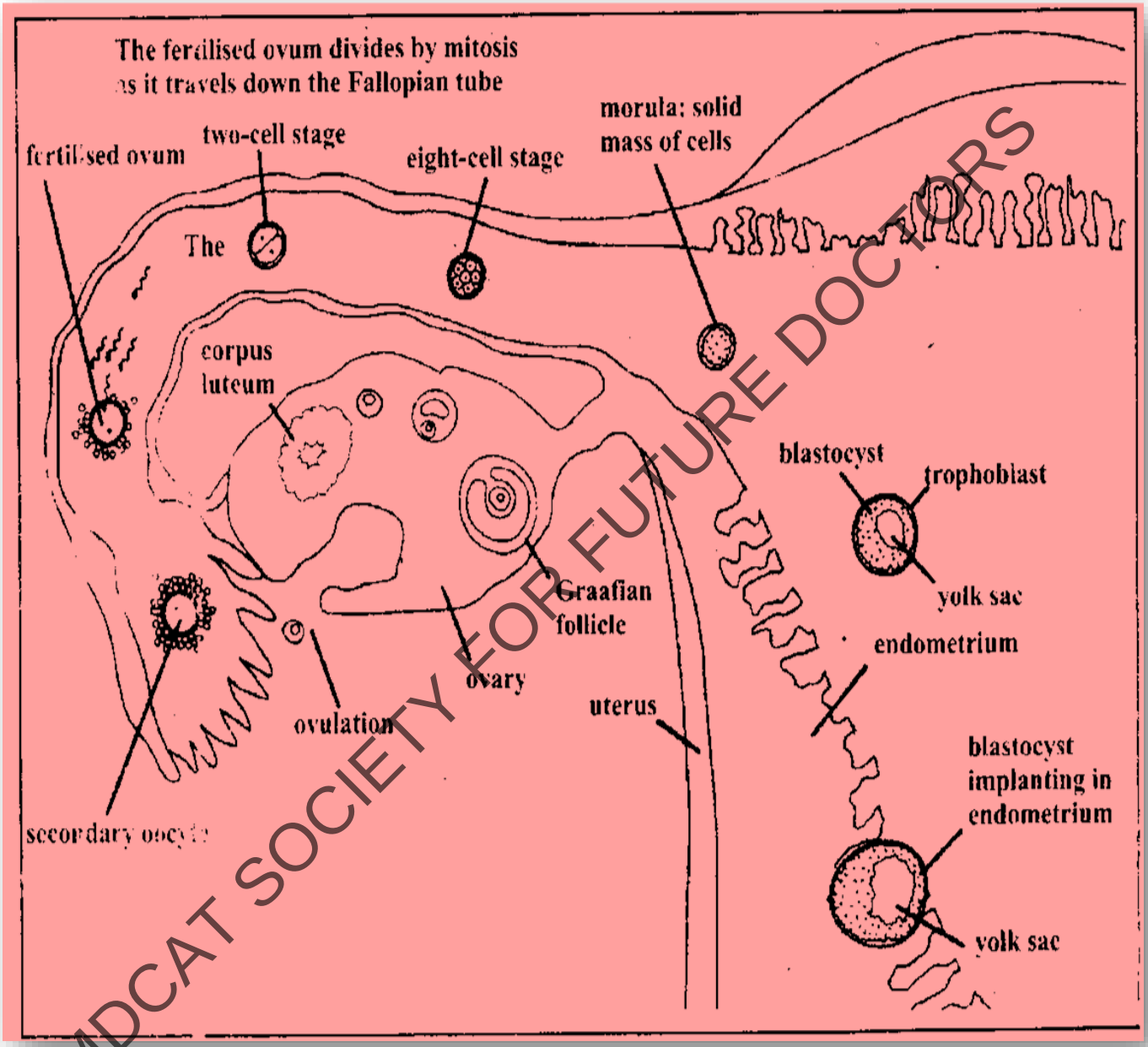

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Fig. The human female reproductive system

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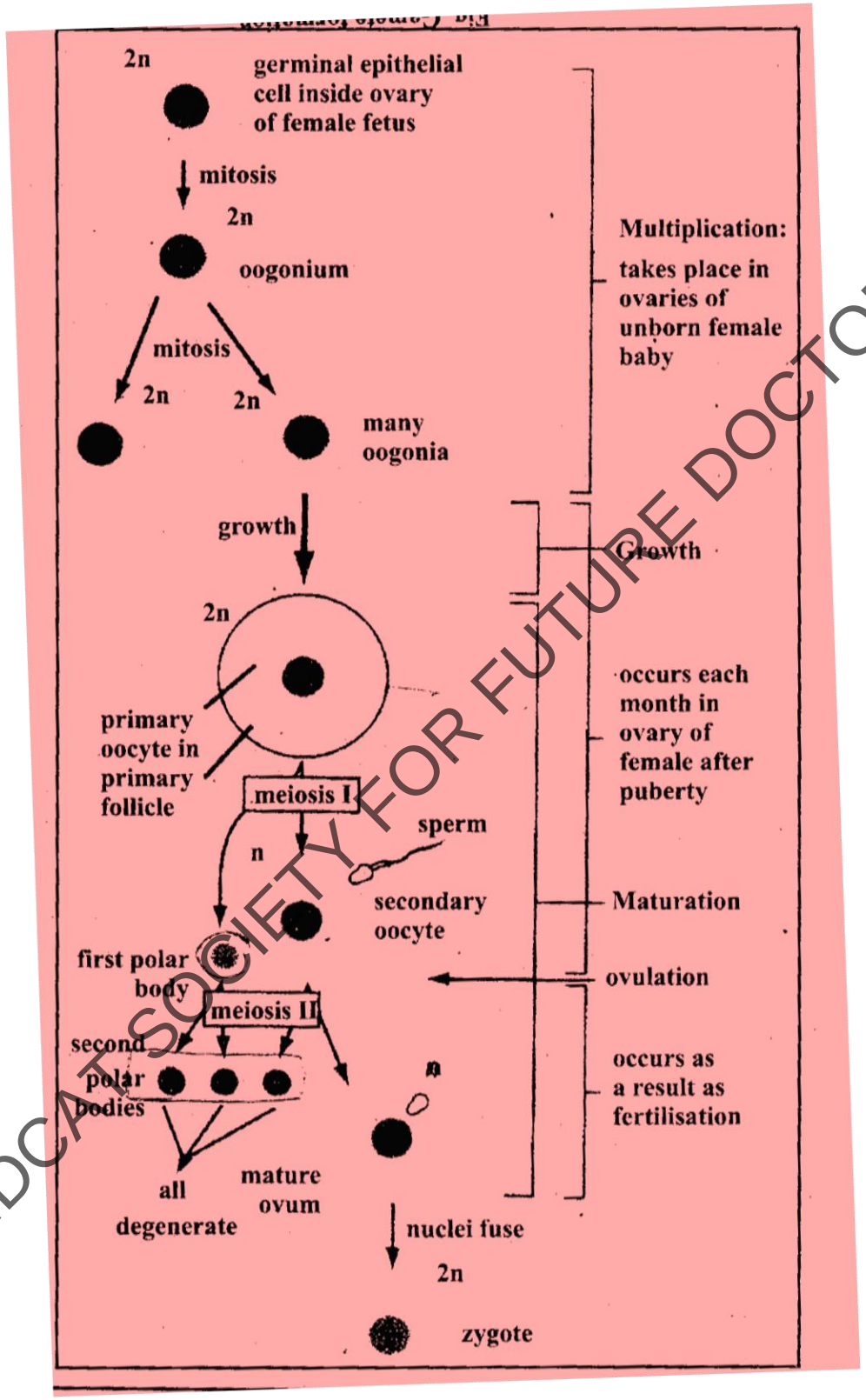

Fig:Gamete Formation

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FEMALE REPRODUCTIVE CYCLE:

- In females production of egg is a cyclic activity. However in males, the gamete production and release is a continuous process beginning at puberty and lasting throughout life.

- The 28 days periodic reproductive cycle in which structural and physiological changes occur in the whole reproductive system ofthe female is called menstrual cycle.

- The cycle is divided into four phases. The events of the menstrual cycle involve the ovaries cycle and the uterus (uterine cycle) and these are regulated by pituitary gonadotropinsin female reproductive cycles are:

1. **Role of FSH:The pituitary** gland on the start of puberty, releases follicle stimulating hormone (FSH).This hormone stimulates the development of several primary follicles. Only one of these follicles continues to grow with its primary oocytes while the rest break down by a degenerative process known as follicle atresia.

2. **Role of Estrogen:**The ovary under the stimulus of FSH, also produce estrogen hormone. It has following functions:

   (i) It stimulates the endometerium (internal lining of the uterus wall) and vascularize it.

   (ii) It inhabits the secretion of FSH from pituitary gland.

3. **Role of LH:** Decrease of FSH and increase of estrogen, causes the pituitary gland to secrete luteinizing hormone (LH) which induces ovulation.The release ovum from the follicle is called ovulationif release of a secondary oocyte (ovulation) is coincided with the thickening of .if the uterus.

4. **Role of Progesterone:**The following cells after release of the egg are modified to form a special structure called corpus loteum. The yellowish glandular structure starts secreting a hormone called progesterone. It has following functions.

   This hormone develops the endometrium and makes it receptive for the implantationof the zygote (placenta formation).The uterine cycle in humans involves the preparation of the uterine wall to receive the embryo if fertilization occurs. Knowing how these two cycles are correlated, it is possible to determine when pregnancy is most likely to occur.

   If fertilization does not occur, the corpus luteum starts degenerating. The progesteroneerection reduces and its effect on the spongy endometrium is reduced, which suffers abreakdown, this cause the discharge of blood and cell debris known as

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menstruation. This stage usually lasts for 3 – 7 days. The cycle is thus completed and the uterus is ready to enter into the next cycle.

Period of Menstrual Cycle: The human menstrual cycle generally repeats every 28 days although there is variation in different individuals or even within the same individual at different times of her age.

The end or complete stop of the menstrual cycle is called menopause after which the female stops producing the ova.Malnourishment and emotional stresses, effect the female reproductive cycle, which may be disturbed. The cycle is not completed in its normal 28 days.

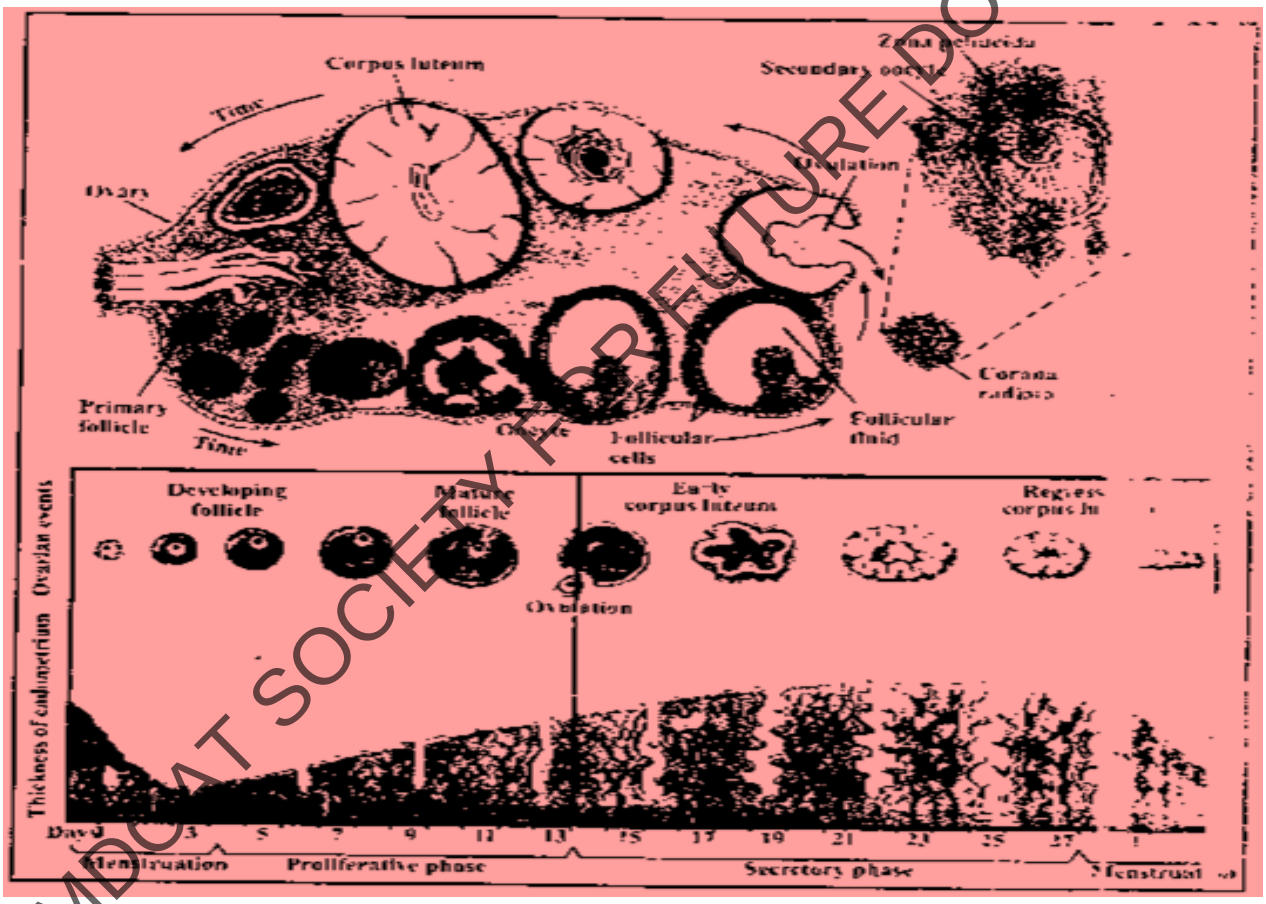

Fig. The ovarian and uterine cycles in human female

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OESTROUS CYCLE

Introduction: Oestrous cycle is a reproductive cycle found in all female mammals except human being

Definition: The cyclic structural and physiological changes which occur in the female re productive tract from one period of estrous to the next is called oestrous cycle.

Explanation: In this cycle, the estrogen production prepares the uterus for conception partly and also follicle develops ova. At this stage, female needs a physical stimulus of mating for ovulation. She exhibits the desire for mating or is said to be on **"beat".**

BIRTH:

Gestation Period: The total gestation period (pregnancy) is usually about 280 days.

Secretion of Progesterone: Once the placenta is established, it starts secreting the progesterone hormone which maintains the pregnancy.

Premature Births or Miscarriage: Any disturbance in the secretion of progesterone may lead to premature births or miscarriage. Human embryo is enclosed in amniotic sac filled with amniotic fluid (protective and shock absorptive).

Placenta: It is a structure which develops between the developing child and the uterus. It develops partly from tissue of the uterus and partly from the extra embryonic membrane of the developing child. The embryonic blood vessels that supply nutrients to the developing child and remove metabolic wastes are separated from the blood vessels of the mother. Because of this separation, the placenta can selectively filter different materials andmicro-organisms.

Secretion of LTH and Placental Lactogen: During this period pituitary gland produce luteotropic hormone (LTH). Placenta also secretes human placental lactogen. Both these hormones stimulate mammary development in preparation for **lactation.**

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Fetus Formation: From beginning of the 3rd month of pregnancy the human embryo is referred to as the fetus. Most of the major organs are formed by the 12thweek of pregnancy and the remainder of the gestation period is taken up by growth.

Onset of Birth: It was thought that hormonal activities within the mother i.e., decrease in progesteronelevel onset the birth. But recent evidence suggests that there is a high degree of fetal involvement in the timing of birth.

The initial stage of birth is the result of the stimuli from the fetal pituitary. The ACTH released from fetal pituitary stimulates the fetal adrenal gland to release corticosteroids which cross the placental barrier and enter the maternal blood circulation causing adecrease in progesterone production.

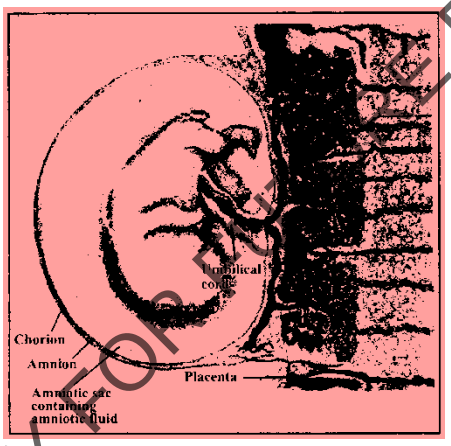

Fig. Placentia structure

The embryonic blood vessels that supply the developing child with nutrients and remove the metabolic wastes are separated from the blood vessels of the mother. Because of this separation, the placenta can selectively filter many types of incoming materials and micro-organisms.

Oxytocin and Labour:

The reduction of progesterone level stimulates the pituitary gland to produce oxytocin hormone. This induces labour pains i.e. contraction of the uterus wall.

The release of oxytocin occurs in "waves" during labour and provides the force to expel the fetus from the uterus.

Delivery:

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The cervix dilates and the uterine contractions spread down over the uterus and arc strongest from top to bottom, thus, pushing the baby downward leading to the delivery of the baby. The umbilical cord is ligated and baby is released from the mother.

Release of After Birth:

Within 10-45 minutes after birth the uterus contracts and separate the placenta form the wall of the uterus and placenta then passes out through the vagina. This is called after birth.

Bleeding During Delivery:

Bleeding, throughout this period, is controlled by the contraction of smooth muscle fibers which completely surround all uterine blood vessels supplying the placenta. Average loss of blood is about 350 cm.

Test Tube Babies:

If some physiological and physical abnormalities in reproductive system in any of the two parents then test tube baby is possible.

Parental sperm and ovum is fertilized in vitro outside the female body and then the zygote is implanted back into the mother uterus, placenta establishes and remaining development takes place in the body of the mother leading to normal birth.

SEXUALLY TRANSMITTED DISEASES (STD):

Unhealthy attitudes and low moral values sometime lead to serious complication. The carrier may transmit this disease to their healthy partners.

1. Gonorrhoea:

Causal Organism: It is caused by a gram positive bacteria Neisseria gonorrhoeae.

Effects: It mainly affects the mucous membrane of urinogenital tract. New born infants may acquire serious eye infections if they pass through the infected birth canal.

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Transmission: It is highly contagious through sexual contacts.

2. Syphilis:

Causal Organism: It is caused by a spirochete, Treponemapallidum.

Symptoms: It damages the reproductive organs, eyes bones joints, central nervous system, heart and skin.

Transmission: Sexual contact is the major source of its spreading.

Genital Herpes:

Causal Organisms: It is caused by it herpes simplex type 2 virus (HSV-2)

Symptoms: It produces genital soreness and ulcers in the infected areas

Transmission: It is most frequently transmitted by sexual contact causing infection of the genitalia. In infected pregnant woman, virus can be transmitted to infant during birth, causing damage to eyes and CNS of the infant.

3. AIDS (Acquired Immune Deficiency Syndrome):

Causal Organism: It is caused by HIV (Human Immunodeficiency)

Symptoms: Patient loses his power of immunity.

Transmission: Sexual contact is a major source of its spread.

Control: It is by avoiding sexual contacts with.

Control of Sexually Transmitted Diseases (STD):

The above sexual diseases can be controlled and prevented by avoiding sexual contacts with carrier or diseased person and adopting the hygienic conditions.

The treatment involves medication for a long period except AIDS.

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QUESTION FOR PRACTICE

1. A structure established between the uterine and foetal tissues for the exchange of oxygen, carbon dioxide, waste, nutrients and other materials is:

(a) amnion (b) placenta (c) endometrium (d) uterus

2. During delivery in humans, the average loss of blood is about:

(a) 150 cm^3 (b) 250 cm^3 (c) 350 cm^3 (d) 450 em^3

3. Between the seminiferous tubules are interstitial cells, which secrete:

(a) ICSH (b) testosterone (c) semen (d) FSH

4. Biennial and perennial plants are stimulated to flower by exposure to low temperature. This is called:

(a) photoperiodism (b) florigenation (c) thermostimulation (d) vernalization

5. Corpus luteum secretes a hormone called:

(a) oestrogen (b) testosterone (c) progesterone (d) oxytocin

6. Decrease of FSH and increase of oestrogen, cause the pituitary gland to secrete:

(a) luteotropic hormonone (b) luteinizing hormone

(c) vasopressin (d) oxytocin

7. Luteinizing hormone induces:

(a) menstruation (b) ovulation (c) oogenesis (d) menopause

8. Effect of photoperiodism was first studied in 1920 by:

(a) garner and allard (b) darwin and francis

(c) linnaeus and lamarck (d) watson and crick

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9. External genitalia of human male consist of a pair of testes, which lie outside the body, in the sac like:

(a) peritestum (b) marsupium (c) scrotum (d) pouch

10. Henbane, snapdragon, cabbage, spring wheat, spring barley are examples of:

(a) short day plants (b) long day plants (c) day-neutral plants (d) none of them

11. In nature P 730 to P 660 conversion occurs in the:

(a) day (b) evening (c) dark (d) dawn

12. In seminiferous tubules repeated division of the cells of the germinal epithelium produce:

(a) oogonia (b) sperms (c) eggs (d) spermatogonia

13. Most of the major organs of foetus are formed by the:

(a) 10^{th}week of pregnancy (b) 14^{th}week of pregnancy

(c) 12^{th}week of pregnancy (d) 18^{th} week of pregnancy

14. Reptiles and birds are:

(a) oviparous (d) viviparous (c) ovoviviparous (d) euviparous

15. Some mammals like Duckbill platypus are:

(a) oviparous (b) viviparous (c) ovoviviparous (d) euviparous

16. Syphilis is caused by a spirochete:

(a) staphylococcus aureus (b) rhizobium

(c) E. Coli (d) treponema pallidum

17. Temperature around 4°C stimulates the production of "Vemalin" hormone, which induces:

(a) vernalisation (b) fruit ripening (c) embryonic induction (d) flowering

18. The ACTH released from foetal pituitary stimulates the foetal adrenal gland to release:

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(a) steroids (b) vasopressin (c) corticosteroid (d) oxytocin

19. The biological clock once stimulated causes production of florigen hormone in leaves, which travel through phloem to the floral buds, initiating:

(a) fruit ripening (b) leafformation (c) leaf shedding (d) flowering

20. The end or complete stop of the menstrual cycle is called:

(a) menstruation (b) genopause (c) menopause (d) after birth

21. The follicle cells, after release of the egg, are modified to form a special structure called:

(a) corpus luteum (b) follicle atresia (c) corpus callosum (d) placenta

22. The ovary, under the stimulus of FSH, also produces:

(a) progesterone (b) LH (c) lactogen (d) oestrogen

23. The pituitary gland, on the onset of puberty, releases follicle-stimulating hormone (FSH), which stimulates the development of several:

(a) primary oocyte (b) primary follicles (c) secondary sexual characteristics (d) primary ova

24. After birth the uterus contracts and separates the placenta from the wall of theuterus within:

(a) 10 – 35 minutes (b) 10 – 25 minutes (c) 10 – 45 minutes (d) 15 – 45 minutes

25. Which light was effective in preventing flowering in cocklebur?

(a) red light (b) blue light (c) ultra violet light (d) far red light

26. Genetic variations "in the daughter generation arises by:

(a) asexual reproduction (b) sexual reproduction

(c) asexual reproduction if mutations(d) sexual reproduction and asexual reproduction if mutations

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27. Pollen tube stimulates the secretion of hormones by the:

(a) stigma (b) style (c) ovary (d) both style and ovary

28. Interruption in dark period would cause flowering in:

(a) long day plants (b) short day plants (c) day neutral plants (d) all kinds of plants

29. At the time of final discharge, the sperms pass through:

(a) seminiferous tubules (c) epididymis (b) vas deferens (d) urethra

30. All the following methods are involved in sexual reproduction except:

(a) spermatogenesis (b) oogenesis (c) gametogenesis (d) parthenogenesis

31. Embryo is fetus at the beginning of:

(a) 3rd month (b) 4th month (c) 5th month (d) 7th month

32. Offsprings are not identical to the parents in:

(a) parthenogenesis (b) budding (c) sexual reproduction (d) binary fission

33. Which process is not significantly affected by aging in humans?

(a) oogenesis (b) spermatogenesis (c) estrogen secretion (d) progesterone secretion

34. Animals which exhibit viviparity include:

(a) bony fiches (b) turtles (c) birds (d) whales

35. Which one is not spermatophyte?

(a) gymnosperm (b) angiosperm (c) bryophyte (d) both gymnosperms and angiosperms

36. The sperms are produced in:

(a) vas deference (b) epididymis (c) seminiferous tubules (d) urethra

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37. Testes in rabbit are present outside the abdominal cavity because:

(a) there is no space in abdominal cavity

(b) maturation of sperms need low temperature

(c) testes in abdon cavity will obstruct release of urine

(d) maturation of sperms need surrounding temperature

38. Which one in the testes of rabbit secretes male hormone?

(a) sertoli cells (b) binary fission (c) spermatocytes (d) budding

39. In hydra reproduction is by:

(a) binary fission (b) multiple fission (c) budding (d) regeneration

40. In viviparity the unfertilized egg is:

(a) very small in size

(b) very large in size

(c) surrounded by extraembryonic membranes and is very large in size

(d) motile

41. The sperm carrying away vessel (from testes) is:

(a) vas deference (b) epididymis (c) seminiferous tubules (d) testes

42. Estrogen, the female hormone is _____ in nature.

(a)protein (b)steroid (c)amino acids (d)glycoprotein

43. The luteal phase is followed by:

(a) menstruation (b) ovulation (c) follicular phase (d) proliferating phase

44. The luteotrophic hormone is produced by:

(a) corpus luteum (b) ovary (c) pituitary (d) follicles

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45. The right sequence of stages during menstrual cycle:

(a) follicular stage → luteal stage → ovulation → menstrual

(b) follicular → ovulation → menstrual → luteal

(c) follicular → ovulation → luteal → menstruation

(d) menstrual → luteal → ovulation → follicular

46. Fetal hormone, which cresses the placental barrier to decrease the progesterone secretion:

(a) ACTH (b) corticosteroid (c) testosterone (d) aldosterone

47. syphilis damages:

(a) reproductive organs (b) bone joints (c) CNS (d) all of these

48. Which hormone stimulates the development of several primary follicles?

(a) LH (b) LTB (c) FSH (d) ACTH

49. Which of the following is hermaphrodite?

(a) ANT (b) earthworm (c) aphid (d) trout

50. External fertilization occurs almost exclusively in habitats that are:

(a) tropical (b) moist (c) warm (d) crowded

51. How many mature eggs are typically produced by each ovary of a non-pregnant woman each year?

(a) 6 (b) 12 (c) 24 (d) 52

52. What structure serves as a lung, digestive tract and kidney for the developing embryo?

(a)liver (b)amnion (c)placenta (d)endometrium

53. An anther produces:

(a)haploid gametes (b)diploid gametes (c)haploid spores (d) diploid spores

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54. in asexual reproduction:

(a)two parents (b)sometimes one parent

(c) usually two parents (d) one parent

55. Sporogenesis means:

(a) germination of spores (b)formation of spores

(c)dormancy of spores (d)regeneration of spores

56. New generations are produced and species is maintained by:

(a)reproduction (b) development (c)mitosis (d)fertilization

57. Leaf unrolling is promoted by red light in:

(a)monocots (b)dicots (c)gymnosperms (d)all plants

58. The sequence for the discharge of sperms is:

(a)seminiferous tubules, vas deferens, epididymis, urethra

(b) vas deferens, seminiferous tubules, epididymis, urethra

(c) seminiferous tubules, epididymis, vas deferens, urethra

(d) vas deferens, seminiferous tubules, urethra, epididymis

59. Which cell of the ovary undergoes meiosis during the development of egg?

(a) germ cells (b) oognia (c) primary oocytes (d) follicle cells

60. The genital duct which opens on the body surface in human female is:

(a) urethra (b) vagina (c) oviduct (d) uterus

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UNIT NO. 6 (BIOENERGETICS)

1	B	2	C	3	B	4	D	5	C	6	B	7	B	8	A	9	C	10	B
11	C	12.	D	13	C	14	A	15	C	16	D	17	A	18	C	19	D	20	C
21	A	22	D	23	B	24	C	25	A	26	D	27	D	28	A	29	D	30	D
31	A	32	C	33	B	34.	D	35	C	36	C	37	B	38	B	39	C	40	A
41	A	42	B	43	A	44	C	45	C	46	B	47	D	48	C	49	B	50	B
51	A	52	C	53	C	54	D	55	B	56.	A	57	A	58	C	59	C	60	B

GROWTH AND DEVELOPMENT

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1. A plant has a growth pattern called open growth. In this pattern the plant growth continue throughout life.

2. Plant growth rate: At the beginning, the growth is slow, but gradually it becomes rapid, attains a maximum and then gradually slows down.

3. Growth point in lower plants (Bryophytes/non-vascular plants) any cell.. Growth point in higher plants (TracheophytesNascular plants) is limited site which is Meristem.

4. Meristems are young tissues or group of cells that retain the potential to divide.

5. The apical meristems are found at the tips of roots and shoot and are primarily concerned with the extension of plant body. These are perpetual (Permanent) growth zones.

6. Intercalary Meristenis are situated at the bases of internodes in many plants. These are temporary. They produce leaves and flowers.

7. Lateral meristems are cylinders of dividing cells. They are present in discots and gymnosperms. Vascular and cork cambium are the example of lateral meristem. They increase the diameter of stem and root. Therefore they play an important role in the secondary growth.

8. A determinate growth is upto a certain size and then stop. For example leaves flowers and fruits.

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9. An indeterminate growth is by meristems that remain youthful, for example vegetative root and stem.

   Note: Growth is irreversible process in which there is increase in No. and size of cells by increase in dry mass and uptake of water.

10. Growth is of two types on the basis of primary and secondary growth: Primary growth occurs by the apical meristem. Secondary growth occurs by the intercalary orvascular cambium leading to increase in thickness.

11. Growth of a multicellular plant is divided into four phases, cell division, elongation, maturation and differentiation.

12. Zone of cell division at the tip of root and shoot.

13. A little distance from apex of root and shoot is the zone of elongation. It is only of few millimeters in length. During elongation the cell volume increases upto 150 fold due to uptake of water.

    Note: Developments the programmed and progressive series of stages/changes from simple to complex which are undergone before an organism acquires its adult form. Growth is a stage ofdevelopment.

15. When the cell enlargement ceases the process of differentiation starts.

16. In Higher plants growth and differentiation occurs in five stages: The formation embryo; apical meristems; cambium formation: Primordial formation and finally f developed tissues (e.g. Xylem. phloem)

17. Temperature influences the rate of growth within a certain range (0 – 35^{o}C)

18. For maximum growth, the optimum temperature is 25 – 30^{o}C and it is least at 5 – 10^{o} C.

19. However at a very high temperature (35 – 40^{o}C) the rate of growth stops and the plant may dies.

20. The increase in intensity of light increases the number of cell divisions.The red light favours elongation of cells and blue light enhances cell division but ret cell enlargement. Ultraviolet rays also retard cell elongation.

21. Very high supply of oxygen inhibits growth due to photo respiration.

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22. A very high concentration of Carbon dioxide retard growth because Stomata elm

23. Influence exerted by a terminal bud in suppressing the growth of lateral buds is called an apical dominance.

24. A very important Growth correlation is inhibitory correlation. It is also called Apical Dominance.

25. The auxin of the termmal bud is responsible for inhibiting the growth of lan buds by a phenomenon known as apical dominance.

26. Thimann and Skoog in 1934 showed that apical dominance was caused by auxin.

27. The removal of apex releases the lateral buds from apical dominance. It is called compensatory effects.

28. Those plants that have dense growth of lateral branches have very little apical dominance.

29. By applying synthetic auxin in potato tuber, the sprouting of lateral buds (eyes) inhibited.

30. In incubating eggs artificially. the incubators are usually regulated at tempera: between 36 – 38^{o}C. At this temperature the chick completes development and is hate on the twenty first day.

31. Immediately after fertilization the egg undergoes a series of mitotic divisions called cleavage.

32. In bird's egg the process of cell division is confined to the small disc of protoplasmlying on the surface of the yolk at the animal pole. This type of cleavage is called discoi cleavage.

33. In cleavage there is increase in No. but Not increase in size of cells. Cleavage is upto Blastula.

34. The fluid filled space below the blastocoel is sub-germinal space.

35. The discoidal cap of cells above the blastocoele is called blastoderm.

36. The marginal area of the blastoderm in which the cells remain undetached from the yolk and closely adherent to it is called the zone of junction.

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37. During gastrulation initially the blastoderm splits into two layer's Epiblast and Hypoblast.

38. The yolkier cells at the edge of blastoderm merge with the multinucleate cells of zone of Junction to form Area Opaca.

39. The central cells of blastoderm can be separated from the yolk. Under these central cells a pool of fluid develops raising them off the yolk and giving the area a translucent appearance the area pellucida.

40. The cells in area pellucida will develop into embryo (Ectoderm, Mesoderm and Endoderm). The cells in

area Opaca or pass the area opaca and go toward the yolkwill develop extra embryonic layers (Amnion. chorion. yolk sac and allantois).

Note: The yolkier cells at the edge ofblastoderm mergewiththemultinucleate cells of zone ofjunction to form area opaca.

41. In the chick the mesodermal cells do not invaginate as in amphibians. However the) migrate medially and caudally from both sides and create a mid-line thickening called primitive streak.

42. Primitive streak of chick embryo is equal to the dorsal and both lateral lips of blastopore.

43. Epiblast develops into ecto and Mesoderm.

44. Notochord and Semites develop from Hensen's node.

45. Ectodermal cells+ Mesodermal cells + Endodermal cells after passing Area opaca and are on the peripheral part of yolk = Germ wall (It forms Extra embryonic layers).

46. The cavity between the yolk and the endoderm which is initially called gastrocoele develops into primitive gut.

47. The lateral plate mesoderm is splatted into two sheets like layers which arc somatic mesoderm and splanchnic mesoderm. The cavity formed between somatic and splanchnic mesoderm is coelom.

48. Nervous system develops from ectoderm.

49. Zygote contains complete information in the form of genome

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50. During cleavage zygote divides into many cells. Each cell has full chromosomes and gets complete instructions from the parents differentiation however some genes remain active while others switch off.

51. Delayed nucleation experiments were performed by Spemann.

52. In deuterostomes, during development up to 16 cell stage all cells are similar, single cell is separated, it contains a complete set of genes and forms a com embryo. Later on differentiation starts. But this differentiation is only due specific cytoplasm. For example Gray crescent which is the pigment free area that appears at the time of fertilization in some Amphibians. It means that for development both Nucleus and Cytoplasm are necessary.

53. Clear cytoplasm. It produces larval epidermis.

54. Yellow cytoplasm. It gives rise to muscle cells.

55. Gray vegetal cytoplasm. It gives rise to gut.

56. Grey equatorial cytoplasm. It produces notochord and neural tube

57. Acetabularia mediterranea, which has regular shaped cap. A crenulata, which has irregular shaped cap,both are unicellular (5 – 8 cm) green Algae. It consists of' rhizoid, which is attached to the ground, from which arises a long stalk with an umbrella shaped cap at its top.

58. Nucleus contains all the genes, which determine the characteristics of the individual, while cytoplasmplays the role of selection of genes.

59. Different cytoplasmic components have morphogenetic determinants that control the functioning of a specific cell type.

Note: The cytoplasmic molecules due to which some genes remain active while others switch off are called determinative molecules.

60. Spemann proved that mesoderm had some effect on the ectoderm to stimulate the ectodermal cells to form nervous system.

60. Spemann designated that dorsal lip area the primary organizer because it was the only tissue capable of inducing development of secondary embryo in the host.

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Note: The dorsallip area which corresponds to the presumptive area of notochord somite's and precordial plates is the primary organizer.

Note: The cytoplasmic components that are responsible for the formation ai shapes or structures are called Morphogenetic determinants.

62. The process of development by primary organizer is called primary induction.

63. An embryo developed by the primary organizer of the host is called primary embryo.

64. An embryo developed by the primary organizer implanted from other embryo into the Host is called Seondary embryo

65. The process of getting old OR The regressive or degenerative changes leading to the general weakness and decrease in body's ability to cope with stress is called aging or Negative physiological changes in our body.

66. The study of aging is called gerontology.

67. Changes in intracellular substances take place during aging. For example in collagen there is increased cross linkages in its protein molecules. Elastic tissues lose their elasticity with the passage of time. There is also hardening and loss of resilience (flexibility) in dense connective tissue and cartilage.

68. Simpler are the animals, more embryo cells and more regeneration.

69. In starfish, embryonic cells are very close to the Mouth.

70. In the mammals the regeneration is restricted to healing of wounds.

71. In plants, regeneration is the basis of plant propagation.

72. The branch of biology which deals with the abnormal developments and the causes for such developments is called Teratology.

73. Chromosomal abnormalities result when one of the sex chromosomes (x or y) is missingor extra and these abnormalities lead to syndromes.

74. Klinefelter's Syndrome (xxy) is an example of trisomy of the sex chromosome.

75. Turner's syndrome (xo) is the condition in which one of the sex chromosomes is missing.

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76. xyy (Jacob's syndromes) leads to tallness, aggressiveness, mental defect andantisocial behavior.

77. Environmental factors causing or contributing to abnormal development are grouped together as teratogens.

78. Ionizing radiations (e.g. x rays) are well known for their teratogenic action, Because they often have their effect on the developing ovum or spermatozoan causing damage or changes (mutations) in the genes.

79. In microcephaly, the individuals are born with small skull.

80. Individuals with cleft palate have their upper lip folded or the individual has harelip.

81. **Animal pole:** The region of a fertilized egg where meiosis is completed. I: contains less yolk and is more metabolically active than the opposite vegetal pole.

82. **Blastocoel:** The fluid filled cavity of blastula.

83. **Blastocyst:** An early stage of embryonic development consisting of a hollow ball of cells.

84. **Blastoderm**: A small disc of cells at the animal end of a reptile or bird embryo that results from early cleavages.

85. **Blastomeres**: Any of the cells produced by cleavage of a zygote.

86. **Blastopore**: The point of invagination at which cells on the surface of the blastula move to the interior of the embryo during gastrulation.

87. **Blastula:** An early stage in the development of an embryo. It consists of a sphere of cells enclosing a fluid-filled cavity (blastocoel).

88. **Development:** Series of stages by which a zygote becomes [in organism or by which an organism changes during its life span; includes puberty and aging for example.

89. **Embryology:** Study of animal development from fertilized egg to formation of all major organs.

90. **Epiblast:** An outer layer of cells in the embryo of an amniote that forms from the proliferation and movement of cells of the blastoderm.

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91. **Gastrulation**: The embryological process that results in the formation of the gastrula. It eventually results in the formation of the embryonic gut (endoderm), ectoderm and mesoderm.

92. **Gray-crescent:** A dark, arching band that forms on the surface of the amphibian zygote opposite the point of sperm penetration (forms in the region where gastrulation will occur).

93. **Homeotic gene:** One of a series of "master switch" genes that determine the form of segments developing in the embryo.

94. **Morula:** A stage in the embryonic development of some animals that consists of soild ball of cells (blastomeres).

95. **Mutagen:** An agent that induces changes in DNA; includes physical agents that damage DNA and chemicals that alter DNA bases.

EXERCISE NO. 1

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1. Cyclic nature of periods of dormancy and acute growth are best seen on:

(a) wood (b) cambium (c) parenchyma (d) storage tissue

2. Which type of meristems is found in stem in plants?

(a) apical meristem (b) lateral and intercalary

(c) apical and lateral (d) apical, lateral and intercalary

3. The human fetus is surrounded by:

(a) liquid (b) air (c) fertilization membrane (d) solid cells

4. Ectoderm is influenced by:

(a) endoderm (b) mesoderm (c) ectoderm (d) coelom

5. Which of the following organs develops first?

(a) liver (b) heart (c) notochord (d) kidneys

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6. Regular cap is found in:

(a) acetabularia mediterranea (b) A. crenulata

(c) growing a. mediterranea (d) growing A. crenulata

7. If fore limb of frog is cut, it will:

(a) regenerate (b) not regenerate

(c) change into gills (d) regenerate very slowly and incomplete

8. During primary growth, a plant cell elongates by:

(a)producing more cytoplasm (b)producing more nucleoplasm

(c)taking up water (d)producing more cytoplasm and taking up water

9. Archentron is present in stage:

(a)morula (b)gastrula (c)blastula (d)growth

10. Animals having more undifferentiated cells show more:

(a) aging (b) metamorphosis (c) regeneration (d) growth

11. Hare lip condition is also known as:

(a)brachydactyly (b) polydactyly(c) cleft palate (d) microcephaly

12. Generally all cells in our body can undergo mitosis for:

(a)indefinite number of times (b)definite number of times

(c)once only (d) twice only

13. As blastula changes into gastrula its blastocoele gradually:

(a)reappears (b) disappears (c)develops (d)changes into a permanent cavity

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14. Which of following is correct?

(a)morula follows blastula (b) blastula following gastrula

(c) gastrula follows neurula (d) gastrula follows blastula

15. Ectodermis develops not into:

(a) skin (b) nervous system (c)hair and nails (d) blood vessels in skin

16. In multicellular organisms which is involved in development?

(a) cytoplasm (b) genes (c) both cytoplasm and genes (d) whole protoplast

17. The leaves are produced from:

(a) apical meristem (b) intercalary meristem (c) lateral meristem (d) shoot apex

18. Exposure of plant to red light:

(a) increase in cell size (b) cell division

(c) inhibit cell division (d) starts meiosis

19. Which is a short lived stage during the development of chick embryo?

(a) morula (b) blastula (c) gastrula (d) neurula

20. In triploblastic orgaisms germinal layers are organized during formation of:

(a) blastula (b) gastrula (c) organogenesis (d) adult

21. Head can be regenerated by the:

(a) lizard (b) frog (c) salamander (d) earthworm

22. The branch of biology which deals with abnormal development and its causes is:

(a) gerontology (b) teratology (c) embryology (d) cytology

23. In planarians, the cells involve in regeneration are:

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(a) neoblasts (b) osteoblasts (c) erythroblasts (d) chondroblasts

24. The mesodermal cells of the chick embryo migrate medially and caudally from both sides of epiblast and create a midline thickening called:

(a) hensen's node (b) primitive streak (c) epiblast (d) hypoblast

25. The negative physiological changes in our body are called:

(a) degeneration (b) abnormalities (c) aging (d) regeneration

26. The epiblast and hypoblast are formed by the splitting of:

(a) blastodisc (b) blastoderm (c) area pellucida (d)area opaca

27. Delayed nucleation experiment was performed by:

(a) Spemann (b) haemmerling (c) spemann and hilde mangold (d)hilde mangold

28. In aging there are:

(a)physiological changes (b)negative physiological changes

(c) only morphological changes (d) negative morphological changes

29. Neurulation occurs after:

(a) blastulation (b) gastrulation (c) cleavage (d) morulation

30. Primary tissue is added by:

(a) apical meristem (b) cork cambium (c) vascular cambium (d) both vascular and cork cambium

31. In 18 hours of chick, neural plate was seen as a:

(a) longitudinal folding (b) flat, thickened area of ectoderm

(c) neural fold (d) neural groove

32. The temperature at which plant growth is maximum:

(a) 0 – 35°C (b) 20 – 2°C (c) 25 – 30° C (d) 35 – 40° C

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33. At each end of neural tube, a small opening is present which is called:

(a) neuro pore (b) embryo pore (c) neural aperture (d) neural openings

34. In a fertilized egg of ascidians, clear cytoplasm produces:

(a) larval epidermis (b) muscle cells (c) gut (d) neural tube

35. During gastrulation the blastoderm splits into two layers:

(a) ectoderm and endoderm (b) microblast and megablast

(c) epiblast and hyperblast (d) epiblast and hypoblast

36. Environmental factor causmg or contributing to abnormal development is grouped together as:

(a) teratogens (b) mutagens (c) ecogens (d) photogens

37. From Hensen's node, dorsal mesoderm is formed and is organized into:

(a) coelom (b) hensen's groove (c) somites (d) gastrocoel

38. In addition to auxin, which hormone also play important role in apical dominance:

(a) abscisic acid (b) gibberellins (c) 2, 4 – D (d) cytokinin

39. Notochord is one of the few prominent structural features in chick embryo of about:

(a) 18 hours (b) 20 hours (c) 22 hours (d) 24 hours

40. In chordates the healing of fracture and repair of a skin wound are some other examples of:

(a) asexual reproduction (b) regeneration

(c) cells rearrangement (d) cleavage

41. A longitudinal folding has occurred, establishing the neural groove in the mid dorsalline, on either side of neural folds, in chick embryo of:

(a) 31 – 32 hours (b) 25 – 26 hours (c) 21 – 22 hours (d) 35 – 36 hours

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42. In incubating eggs artificially, the incubators are usually regulated at temperature between:

(a) room temperature (b) slightly high temperature (c) 30 – 32°C (d) 36 – 38°C

43. Secondary growth is from:

(a) apical meristem (b) intercalary meristem (c) lateral meristcm (d) any cell

44. It is known that different cytoplasmic components contain different morphogenetic determinants that are responsible for cell:

(a) division (b) elongation (c) maturation (d) differentiation

45. The syndrome, which is an example of trisomy of the sex chromosome, is:

(a) turner's syndrome (b) down's syndrome

(c) klinfelters syndrome (d) edward's syndrome

46. On the basis of structure and shape of the cap, two species of acetabularia have been identified:

(a) A. mediterranea and A. crenulata (b) A. typhi and A. mediteraenea

(c) A. crenulata and A. sisso (d) A. crenulata and A. Arabica

47. One of the most important correlative effects in plants is:

(a) apical dominance (b) open growth

(c) strong power of regeneration (d) growth inhibition

48. Sub germinal space is present in stage:

(a) morula (b) gastrula (c) blastula (d) neurula

49. The capacity of some cells to evoke a specific developmental response in others is called:

(a) embryonic induction (b) apical dominance

(c) abnormal development (d) regeneration

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50. The cavity between the yolk and the endoderm, which has been called gastrocoel is later termed as:

(a) primitive streak (b) primitive gut (c) neurocoel (d) blastocoel

51. The cavity formed between somatic and splenchnic mesoderm is:

(a) blastocoel (b) primitive gut (c) neurocoel (d) coelom

52. The hypoblast is mainly presumptive:

(a) ectoderm (b) endoderm (c) mesoderm (d) both ectoderm and mesoderm

53. The progressive changeThat are undergone before an organism becomes adult constitute embryonic:

(a) development (b) induction (c) morphogenesis (d) fluctuation

54. The light that enhances cell division but retard cell enlargement is:

(a) blue (b) red (c) ultra violet (d) infrared

55. The condition in which one of the sex chromosome is missing:

(a) turner's syndrome (b) down's syndrome (c) klinfelter's syndrome (d) metafemale syndrome

56. When the cell enlargement ceases, the process of _____ starts.

(a) differentiation (b) growth (c) development (d) secondary growth

57. Which of following is correct?

(a) morula is unicellular (b) blastula has 2 layers

(c) gastrula has 2 layers (d) gastrula has 3 layers

58. Experiments on sea urchin egg to study development were performed by:

(a) Thimann (b) Skoog (c) Hans Driesch (d) Spemann

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59. The only cells which possess the ability of embryonic induction are the cells from:

(a) dorsal lip of the blastopore (b) ventral lip of the blastopore

(c) lateral lip ofthe blastopore (d) all parts of the blastopore

60. Which cells of the root behave as root cambium?

(a) endodermis (b) pericycle (c) cortex (d) epidermis

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UNIT NO. 6 (BIOENERGETICS)

1	A	2	D	3	A	4	B	5	C	6	A	7	A	8	D	9	B	10	C
11	C	12.	B	13	B	14	D	15	D	16	C	17	B	18	A	19	A	20	B
21	D	22	B	23	A	24	B	25	C	26	B	27	A	28	B	29	B	30	A
31	B	32	C	33	A	34.	A	35	D	36	A	37	C	38	D	39	A	40	B
41	C	42	D	43	C	44	D	45	C	46	A	47	A	48	B	49	A	50	B
51	D	52	B	53	A	54	A	55	A	56.	A	57	D	58	C	59	A	60	B

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EXERCISE NO. 2

1. An aggregate of cells having common origin, structure and function is called:

(a) organ (b) organ system (c) tissue (d) cell

2. The tissue which covers the surface of the body, ducts vessels and body cavity is:

(a) epithelial tissue (b) connective tissue (c) muscular tissue (d) nervous tissue

3. The motile projections, with a small granule at the base oil the free surface of epithelial tissue are:

(a) villi (b) flagella (c) cilia (d) microvilli

4. The mucus producing cells which lie in the inner lining of epithelial cells are:

(a) kupfer cells(b) goblet cells (c) keratin cells (d) basal cells

5. The epithelium which forms the most of lining of urinary passage and is structun and functionally similar to non-cornified stratified epithelium is:

(a) columnar epithelium (b) simple epithelium

(c) cornified stratified epithelium (d) transitional epithelium

6. An example of fluid connective tissue is:

(a) blood and lymph (b) mucus (c) water (d) urine

7. tonsils are:

(a) capsules (b) lymph nodes

(c) capsulated lymphatic tissue (d) capsulated lymphatic tissue and lymph

8. The iron containing pigment present in erythrocytes (RBC) is:

(a) xanthophyll (b) haemoglobin (c) myoglobin (d) carotene

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9. The blood, a fluid connective tissue contains:

(a) one type of cells (b) two types of cells (c) three types of cells (d) four types of cells

10. Cartilage is a type of:

(a) epithelial tissue (b) connective tissue (c) muscular tissue (d) nervous tissue

11. The erythrocytes are meant for:

(a) imparting red colour to blood (b) carrying oxygen

(c) exchange of gases (d) all of the above

12. The red blood cells are produced in:

(a) bone marrow (b) liver (c) spleen (d) blood plasma

13. In blood RBC and WBC are present in ratio of:

(a) 1 : 10 (b) 1 : 100 (c) 1: 500 (d) 1 : 1000

14. A decrease of leucocyte count below 5000 per cubic mm is called:

(a) anemia (b) leucopenia (c) leucomia (d) anoxia

15. The fibrous cartilage is found in:

(a) intervertebral disc (b) knee joint (c) public symphysis (d) all of the above

16. The bones consists of both spongy and compact region of the hard matter which is covered with:

(a) bone marrow (b) periosteum (c) fibres (d)bone membrane

17. The enzyme responsible for bone formation is:

(a) alkaline phosphatase (b) acidic phosphatase

(c) alkaline calcinase (d) acidic calcinase

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18. The quick healing of a fracture requires a rich supply of:

(a) blood (b) oxygen (c) water (d) nerves

19. The red bone marrow is found at the:

(a) early childhood (b) middle childhood (c) adolescence (d) old age

20. The mineral ions found reserved in bones is:

(a) calcium (b) phosphate (c) manganese (d) both (a) and (b)

21. Chemically the fats consist of:

(a) esters of glycerol (b)fatty acids (c) alcohols (d) both (a) and (b)

22. Muscles are responsible for:

(a) maintaining the height (b) stiffness in body

(c) body movements (d) softness in body

23. The longest cell in human body is:

(a) mast cell (b)nerve cell (c) myofibril (d) bone cell

24. The muscles of our body constitute about _____ of the body by weight.

(a) 50 % (b)60 % (c) 70 % (d) 40 %

25. In body the adipose tissues are important for:

(a) their nutritive value (b) forming the shock absorbing pads

(c) conservation of body heat (d) all of the above

26. The uninucleated spindle shape muscle is:

(a) cardiac muscle (b) smooth muscle (c) skeletal muscle (d) none of the above

27. The unit of muscle tissue is:

(a) sarcoplasm (b) muscle fibers (c) myofibrils (d) flesh

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28. The two main parts of a nerve cell are:

(a) nissl's granule and axon (b) cell body and axon

(c) cytoplasm and axon (d) dendrite and myelin sheath

29. In myelin sheath, the constriction at the regular interval is called:

(a) node of ranvier (b)node of laterman (c) node of myelin (d) constriction node

30. Involuntary muscle fibres are:

(a) smooth and skeletal muscle fibres (b) skeletal muscle fibres

(c) cardiac and smooth muscle fibres (d) cardiac and skeletal muscle fibres

31. The voluntary muscle fibres are:

(a) cardiac muscle fibres (b) skeletal muscle fibres

(c) smooth muscle fibres (d) both (a) and (c)

32. The fatty pads of adipose tissue are present in:

(a) heart (b) hip joints (c) soles of feet (d) ankle

33. The protoplasm of a muscle cell is called:

(a) cytoplasm (b) sarcoplasm (c) muscuoplasm (d) sarcomere

34. The several small processes which come out of the cell body of a motor neuron are called:

(a) dendrites (b) synapse (c) axon (d) node ofranivers

35. The skin helps to:

(a) protect the internal body organs (b) regulate and maintain the body temperature

(c) prevent the entry of pathogens in body (d) all of the above

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36. The glands present in skin are:

(a) sweat glands (b) sebaceous glands (c) thyroid glands (d) both (a) and (b)

37. The vitamin synthesized in skin is:

(a) vitamin-e (b) vitamin-d (c) vitamin-a (d) vitamin-b

38. The skin helps to maintain body temperature by:

(a) sweating (b) cutaneous vasodilation

(c) hair erector muscles (d) all of the above

39. The mammary glands are a type of modified:

(a) sweat glands (b) sebaceous glands (c) ceruminous glands (d)salivary glands

40. The skin acts as a storage organ because it stores:

(a) water (b) blood (c) both of these (d) hormones

41. The body part where there is no hair is:

(a) urogenital aperture (b) palm (c) soles (d) all of these

42. Pyrexa is the condition in which the body temperature is:

(a) 7°F to 104°F (b) 98°F to 105°F (c) 99°Fto 105°F (d) 100°F to 105°F

43 You cannot swallow with open mouth because:

(a) air obstruct the path of food (b) teeth close when you open the mouth

(c) epiglottis obstruct the path of food (d) epiglottis obstruct the path of air

44. Swallwing is initiated by the voluntary action of:

(a) paharynx (b) mouth (c) longue (d) stomach

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45. The body part which prevents the entry of food into trachea is:

(a) pharynx (b) epiglottis (c) tongue (d) medullaobiongata

46. The vitamin required for blood clotting is:

(a) vitamin-K (b) vitamin-A (c) vitamin-C (d) vitamin-D

47. In addition to vitamins, body needs some minerals too. Among these minerals and iron is specifically necessary for:

(a) bone formation (b) thyroxin formation

(c) hernogiohin formation (d) development of teeth

48. The digestive gland which acts both as an endocrine and exocrine gland is:

(a) salivary gland (b) pancreas (c) liver (d) gastric glands

49. The biggest gland of the body is:

(a) salivary gland (b) pancreas (c) liver (d) crypts ofliberkhun

50. Which of the following is the rich source of vitamin-C?

(a) cereals (b) green vegetables (c) citrus fruits (d) legumes

51. The deficiency of vitamin-A causes:

(a) scurvy (b) night blindness (c) rickets (d) ben-ben

52. The deficiency of vitamin-C causes:

(a) scurvy (b) night blindness (c) rickets (d) ben-hen

53. T[he deficiency of vitamin-D causes:

(a) scurvy (b) night blindness (c) rickets (d) ben-ben

54. The deficiency of vitamin-B causes:

(a) scurvy (b) night blindness (c) rickets (d) beri-beri

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55. The gastric enzyme pepsin can only digest proteins when the medium is:

(a) strongly alkaline (b) weakly alkaline (c) strongly acidic (d) neutral

56. The enzyme erepsin helps break down peptones into amino acids in:

(a) stomach (b) jejunum (c) Ileum (d) colon

57. The rhythmic muscular movement of alimentary canal is called:

(a) penistalsis (b) cvclosis (c) maceration (d) metachronal

58. The deficiency of iron causes:

(a) sickle cell anemia (b) pernicious anemia (c) anemia (d) haemophilia

59. The shape of human stomach is like the English alphabet:

(a) S (b) H (c) U (d) J

60. Which of the following enzyme is absent in man?

(a) cellulose (b) amylase (c) lactase (d) dipeptidase

UNIT NO. 6 (BIOENERGETICS)

1	C	2	A	3	C	4	B	5	D	6	A	7	D	8	B	9	C	10	B
11	D	12.	A	13	D	14	B	15	D	16	B	17	C	18	A	19	B	20	D
21	D	22	C	23	B	24	D	25	D	26	B	27	B	28	B	29	A	30	C
31	B	32	C	33	B	34.	A	35	D	36	D	37	B	38	D	39	A	40	B
41	D	42	C	43		44	A	45	B	46	A	47	C	48	B	49	C	50	C
51	B	52	A	53	C	54	D	55	C	56.	B	57	A	58	C	59		60	A

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EXERCISE NO. 3

1. The three types of glands found on tongue are:

(a) mucous glands, serous glands and lymph glands

(b) mucous glands, serous gland and sublingual glands

(c) parotid gland, sublingual and sub maxillary glands

(d) mucous glands, parotid glands and pyloric glands

2. Phyarynx serves as a channel to transport food from:

(a) mouth to stomach (b) mouth to larynx (c) mouth to epiglottis (d) mouth to esophagous

3. The vermiform appendix is outgrowth of:

(a) caecum (b) ileum (c) stomach (d) duodenum

4. The rectum functions as the:

(a) reservoir for semi solid feaces

(b) site for the digestion of cellulose

(c) site for water absorption

(d) both as site of water absorption and reservoir for semi solid feaces

5. The lacteals present in each villus contain:

(a) a milky fluid rich in carbohydrates (b) a milky fluid rich in fatty acids and glycerol

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(c) a milky fluid rich in proteins (d) a milky fluid rich in vitamins and minerals

6. Some digestive enzymes like pepsin act in acidic medium while enzymes like trypsinActs in alkaline medium to:

(a) maintain the water balance in body (b) maintain the ionic balance in blood

(c) maintain the blood reaction constant (d) maintain the water and ionic balance in blood

7. The bacteriolytic enzyme present in saliva is:

(a) carbonic anhydrase (b) lysozyme (c) salivary amylase (d) phosphatase

8. The diseases which can be diagnosed using saliva are:

(a) rabies, polio and mumps (b) typhoid, polio and mumps

(c) malaria, polio and tuberculosis (d) polio, typhoid and mumps

9. The rennin present in gastric juice helps to:

(a) digest the fats (b) coagulate the milk (c) digest fats and proteins (d) digest sucrose

10. In small intestine (ileum), the digestion of cane sugar is carried out by:

(a) invertase (b) arnylase (c) maltase (d) surcase

11. The bile juice secreted from gall bladder is:

(a) product of secretion (b) product of excretion

(c) both (a) and (b) (d) neither (a) nor (b)

12. The bile salts help in absorption of:

(a) vitamin a and b (b) vitamin a and d (c) vitamin a and c (d) vitamin c and d

13. The main chemical stimulus for pancreatic secretion is:

(a) secretin (b) gastrin (c) entrokinase (d) pancaryornyzin

14. The process of vomiting is governed by vomiting centre which is located in:

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(a) cerebrum (b) cerebellum (c) medulla oblongata (d) hypothalamus

15. The carbohydrates are absorbed in ileum in form of:

(a) glucose (b) fructose (c) sucrose (d) either (a) or (b)

16. The protein digestion begins occurs in:

(a) mouth (b) stomach (c) duodenum (d) ileum

17. The protein which cannot be digested in man is:

(a) collagen (b) gelatin (c) albumin (d) elastin

18. The salivary amylase acts on:

(a) raw starch (b) boiled starch

(c) both on raw and boiled starch (d) does not act on starch

19. The action of proteolytic enzyme pepsin on living gastric membrane is prevented by:

(a) presence of anti-pepsin gastric mucosa

(b) presence of cathepsin in gastric mucosa

(c) presence ofhydrochloric acid in gastric mucosa

(d) all of the above

20. The trypsin present in form of trypsinogen in pancreatic juice is activated by:

(a) gastrin from stomach (b) enterokinase from ileum

(c) bile juice from gall bladder (d) mechanical stimulation of duodenum

21. The approximate length of alimentary canal from mouth to anus is:

(a) 4 metres (b) 9 metres (c) 8 metres (d) 10 metres

22. The typical brownish colour of feaces is due to the presence of:

(a) undigested fats in the feaces (b) undigested cellulose in faces

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(c) bile pigments like biliverdin (d) all of the above

23. The muscular layer which separates the thoracic and abdominal cavity is:

(a) bronchus (b) intercoastal muscles (c) diaphragm (d)pleural membrane

24. The number of nostrils present in man is:

(a) two (b) three (c) four (d) five

25. The cells which produce and secrete the mucus in respiratory region are:

(a) mucus cells(b) kupffer cells (c) flepatic cells (d) goblet cells

26. The number of tracheal cartilages in man is:

(a) 12 (b) 20 (c) 16to20 (d) 33

27. Vocal cord acts as:

(a) filter with its vibrations oriented laterally (b) vibrator with its vibrations oriented laterally

(c) supporter with its vibrations oriented laterally (d) vibratory with its vibrations oriented anteriorly

28. Alveoli are sac like structures which are:

(a) open sac (b) collapsed sac (c) blind sac (d) none of the above

29. The total number of ribs present is:

(a) five pairs (b) seven pairs (c) nine pairs (d) twelve pairs

30. During inspiration:

(a) both diaphragm and intercoastal muscles contract

(b) both diaphragm and intercoastal muscles relax

(c) diaphragm contract while intercoastal muscles relax

(d) diaphragm relax and intercoastal muscles contract

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31. The free two pair of ribs which are not attached to sternum is called:

(a) thoracic ribs (b) floating ribs (c) detached ribs (d) respiratory ribs

32. The volume of air inhaled or exhaled during normal breathing is called:

(a) inspiratory reserve volume (b) residual volume

(c) expiratory reserve volume (d) tidal volume

33. The volume of air which always remains in lungs is:

(a) inspiratory reserve volume (b) alveolar residual volume

(c) expiratory reserve volume (d) tidal volume

34. The carcinogenic agent present in cigarette smoke is:

(a) hydrogen cyanide (b) ammonia (c) hydrogen chloride (d) sulphur dioxide

35. In conditions like cardiac failure or any lung disease, the number of RBC:

(a) increased (b) decreases (c) remain unaffected (d) first decreases then increases

36. The hormone present in blood which regulates the RBC production is:

(a) aproferritin (b) erythropoietin (c) transferrin (d) folic acid

37. In an adult, the RBC is produced in:

(a) liver (b) kidney (c) bone marrow (d) lymph nodes

38. In a foetus Se RBC are produced in:

(a) liver (b) kidney (c) bone marrow (d) lymph nodes

39. In RBC the synthesis of hemoglobin takes place in:

(a) nucleus (b) ribosomes (c) mitochondria (d) Golgi apparatus

40. The serum is:

(a) blood plasma (b) blood plasma + RBC

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(c) blood – WBC (d) blood plasma – fibrinogen

41. The heme-portion of hemoglobin has amino acids:

(a) amino acid isoleucjne and acetic acid (b) amino acid glycine and acetic acids

(c) amino acid tyrosine and acetic acid (d) amino acid glycine and oxalic acid

42. The vitamin-B which takes part in RBC maturation is:

(a) thiamine (b) niacin (c) cyanocobalamin (d) both (a) and (b)

43. The number of atoms of oxygen that can bind to a molecule of haemoglobin is:

(a) four (b) six (c) eight (d) twelve

44. Every person has a special system for combating the different infections and toxicAgents. This is composed of:

(a) leucocytes (b) lymphoid tissue (c) macrophage system (d) all of the above

45. The lymphocytes and monocytes develop in:

(a) bone marrow (b) spleen (c) lymphoid tissue (d) thymus gland

46. The pus which comes out of a wound contains:

(a) necrotic tissue (b) dead neutrophils (c) dead macro-phages (d) all of the above

47. The blood platelets:

(a) are fragments of monocytes (b) are fragments of granulocytes

(c) are fragments of megakaryocytes (d) fragments of liver cells

48. The mature lymphocytes are destroyed in:

(a) lympjoid tissue (b) spleen (c) liver (d) adrenal glands

49. In RBC, the synthesis of hemoglobin takes place in:

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(a) nucleus (b) ribosomes (c) mitochondria (d) Golgi apparatus

40. The serum is:

(a) blood plasma (b) blood plasma + RBC (c) blood – WBC (d) blood plasma – fibrinogen

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(a) lympoid tissue (b) spleen (c) liver (d) adrenal glands

49. Both in young ones and adults the main source of lymphocytes is:

(a) adrenal gland (b) thymus gland (c) pineal gland (d) pituitary gland

50. Heparin which help prevent the intra-vascular clotting is secretedby:

(a) neutrophils (b) lymphocytes (c) basophil (d) monocytes

51. The basic difference in ABO system and Rh system is that: .

(a)in ABO system agglutinins responsible for causing transfusion never occur

(b)in ABO system, agglutinins responsible for causing transfusion reaction occurspontaneously

(c)in RH system agglutinins responsible for causing a transfusion reaction occurspontaneously

(d)both(a)and(c)

52. After the blood of a donor and a receiver is mismatched, the hemoglobin appear inBlood plasma because of:

(a) clumping of RBC (b) engulfing of RBC by WBC

(c) hemolysis of RBC (d) both (a) and (c)

53. The blood flow is stopped from small cuts because of:

(a) blood clotting (b) formation of platelets plug

(c) vascular spasm (d) both (a) and (b)

54. The sequence of blood coagulation is:

(a) prothrombin — thrombin — fibrin (b) thrombin — fibrin — prothrombin

(c) fibrin — thronìbiiì — fibrinogen (d) prothrombin — fibrin — fibrinogen

55. Sometimes the death of person occur because of lack of calcium ions. In lack ofCalcium ions there occur:

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(a) muscle tetany (b) delayed coagulation (c) cardiac failure (d) respiratory failure

56. Immunity is:

(a) ability to resist organism which tend to damage the tissues

(b) ability to resist toxins which tend to damage the tissues

(c) ability of skin to prevent any invasion of pathogens

(d) both (a) and (b)

57. The immune system in body forms to attack and destroy specificOrganism or toxins.

(a) antigen (b) antibody (c) lymphocytes (d) both antibodies and lymphocytes

58. The antibodies are formed in:

(a) bone marrow (b) lymphoid tissue (c) liver (d) both in liver and lymphoid tissue

59. To provide the passive immunity an infected person is administered with:

(a) living organisms which have been attenuated

(b) dead organisms

(c) antibodies

(d) both by living organisms which have been attenuated and antibodies

60. The major side effect of immunity is:

(a) rheumatic fever (b) allergy (c) mysthemia fravis (d)glomerulo nephritis

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UNIT NO. 6 (BIOENERGETICS)

1	A	2	D	3	A	4	D	5	B	6	D	7	B	8	A	9	B	10	A
11	C	12.	B	13	A	14	C	15	D	16	B	17	D	18	B	19	A	20	B
21	B	22	C	23	C	24	A	25	D	26	B	27	B	28	C	29	D	30	A
31	B	32	D	33	B	34.	A	35	C	36	B	37	C	38	A	39	C	40	D
41	B	42	C	43	C	44	D	45	C	46	D	47	C	48	A	49	B	50	C
51	B	52	C	53	B	54	A	55		56.	D	57	D	58	B	59	C	60	B

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EXERCISE NO. 4

1. The working of heart is normally diagnosed by:

(a) E EG (b) ECG (c)HEG (d)HFIG

2. When a person is at his best of health, the heart pumps:

(a) 2 — 4 litres of blood per minute (b) 4 — 6 litres of blood per minute

(c) 6 — 8 litres of blood per minute (d) 8 — 10 litres of blood per minute

3. With the advancing age, the arterial pressure increases because of:

(a) arteriosclerosis (b) decreased reflexes(c) increased reflexes (d) size of heart reduces

4. When a person is said to have hypertension, it means that:

(a) pulse pressure is greater (b) arterial pressure is greater

(c) arterial pressure is less (d) pulse pressure is less

5. The largest lymphoid tissue in body is:

(a) lymph node (b) spleen (c) liver (d) macrophage

6. Chyle is milky white fluid present in:

(a) lacteals in villi (b) spleen (c) lymphatic ducts (d) thoracic duct

7. The lymph is formed from:

(a) blood in arteries (b) blood in veins (c) tissue fluid (d) both (a) and (b)

8. Spleen plays an important role in:

(a) defense mechanism of both (b) synthesis of hormones

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(c) conversion of carotenes into vitamin-A (d) in the deamination of amino acids to form urea

9. The total quantity of blood present in a person circulates through kidney an:

(a) 2 to 3 minutes (b) 4 to 5 minutes (c) 7 to 8 minutes (d) 10 to 11 minutes

10. The chemical secreted at neuro-muscular junctions is:

(a) non-adrenalin (b) sodium chloride (c) acetyl choline (d) myoglobin

11. In muscular contraction, the direct source of energy is:

(a) creatinine phosphate (CP) (b) adenosine diphosphate (ADP)

(c) nicotinamide phosphate (NADP) (d) adenosine triphosphate (ATP)

12. The muscle fatigue is caused by:

(a) deprivation of ATP and deposition of lactic acid

(b) excess of ATP and lack of lactic acid

(c) excess ofATP and lactic acid

(d) deprivation of both lactic acid and ATP

13. Rigor mortis' is term used to describe:

(a) state of muscular movement (b) state of muscular rigidit after death

(c) state of muscular relaxation (d) state of muscular contraction

14. The mitochondria present in sacromere are called:

(a) nucleosornes (b) mesosomes (c) srcosomes (d) mitosomes

15. 'Biceps and triceps' are muscles of:

(a) leg (b) stomach (c) upper arm (d) heart

16. Paralysis of the muscles mean:

(a) damage of muscle libres (b) lack of muscular contraction

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(c) lack of muscular relaxation (d) damage to neuron or axon supplying the muscle

17. Muscular atrophy is atype of abnormality caused due to:

(a) lack of muscular contraction (b) lack of muscular relaxation

(c) an increase in an individual muscle fibre (d) both (a) and (b)

18. The axial skeleton consists of:

(a) skull and vertebral column (b) skull, vertebral column and sternum

(c) skull, vertebral column, sternum and ribs (d) skull ertebral colunm and pectoral girdles

19. The palm contains:

(a) metacarpals (b) carpals (c) phalanges (d) both (a) and (b)

20. The humerus bone is present in:

(a) lower arm (b) upper arm (c) lower leg (d) upper leg

21. The femur bone is present in:

(a) lower arm (b) upper arm (c) lower leg (d) upper leg

22. In man the endoskeleton is composed of:

(a) only cartilages (b) bones

(c) both cartilages and hones (d) bones, cartilages and skeletal muscles

23. The number of phalange in thumb is:

(a) one (b) two (c) three (d) four

24. The skull contains:

(a) 1 8 bones (b) 20 bones (c) 22 bones (d) 28 hones

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25. The largest bone of human body is:

(a) humerus (b) femur (c) sternum (d) fibula

26. The joints which permit the free motion are:

(a) hingejoint (b) glidingjoint (c) ball-socket joint (d) non-synovial joint

27. The part of brain responsible for controlling and regulating the, memory andReasoning is:

(a) cerebellum (b) cerebrum (c) hypothalamus (d)medulla oblongata

28. Medulla oblongata continues as:

(a) optic nerve (b) auditory nerve (c) spinal cord (d) vertebral column

29. The vitamin required for proper functioning of rod and cone cells is:

(a) vitamin-a (b) vitamin-c (c) vitamin-b (d) vitamin-d

30. The cells responsible for vision in dark are:

(a) rod cells (b) cone cells (c) Amacrine cells (d) ganglion cells

31. The middle ear is connected to pharynx by:

(a) eustachian tube (b) auditory passage (c) utriculus (d) semicircular canal

32. The taste buds for sweet taste are located in:

(a) front of tongue (b) back of tongue (c) centre of tongue (d) all of the above

33. The receptor cells for sensation of smell are:

(a) sustenular cells (b) hair cells of organ of corti

(c) maxillary cells (d) olfactory cells

34. The sensation of smell occurs during:

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(a) inhalation (b) exhalation (c) both (a) and (b) (d) neither (a) nor (b)

35. The thyroxine which regulates the metabolism of glucose is secreted by:

(a) pituitary gland (b) parathyroid gland (c) adrenal gland (d) thyroid gland

36. Oxytocin in females is responsible for:

(a) contraction of pregnant uterus (b) ejection of milk during lactation

(c) regulation of water level in blood (d) both (a) and (b)

37. Prolactin in females is responsible for:

(a) contraction of pregnant uterus (b) ejection of milk during lactation

(c) regulation of water level in blood (d) both (a) and (b)

38. The food is stored in form of glycogen in:

(a) muscles (b) liver (c) pancreas (d) both liver and muscles

39. The main male reproductive organ is:

(a) testes (b) ovary (c) penis (d) urethra

40. The main female reproductive organ is:

(a) uterus (b) ovary (c) vagina (d) fallopian tube

41. A spermatozoan is:

(a) a male gamete (b) female gamete (c) an embryo (d) a zygote

42. The mature ovum in ovary is called:

(a) secondary follicle (b) primary follicle (c) graffian follicle (d) both (a) and (b)

43. The mature sperms are stored in:

(a) epididymis (b) seminiferous tubules (c) testes (d) vas deferens

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44. Sperm mobility is caused by:

(a) sperm nucleus (b) sperm body (c) sperm tail (d) testes

45. An ovum produced by ovary, is received by a funnel shape tube called:

(a) fallopian tube (b) uterus (c) vagina (d) none of the above

46. The uterus in a female is:

(a) spindle shaped (b) pear shaped (c) oval shaped (d) spherical shaped

47. In human female the fertilization occurs in:

(a) uterus (b) ovary (c) oviduct (d) vagina

48. The hormone whose presence in urine of women indicates that she is pregnant is:

(a) progesterohe (b) chorionic gonadotropis (c) oestrogen (d) progesterone

49. Parturition means:

(a) pregnancy (b) abortion (c) birth of a child (d) none of the above

50. Which endocrine gland becomes inactive during old age?

(a) pituitary (b) pineal (c) adrenal (d) thymus

51. The endocrine gland nearest the lung is:

(a) pituitary (b) pineal (c) thymus (d) adrenal

52. The largest part of the brain is:

(a) cerebrum (b) medulla oblongata (c) cerebellum (d) corpora quadrigemina

53. Brain develops from:

(a) ectoderm (b) mesoderm (c) endoderm (d) none

54. Optic nerve is responsible for:

(a) eye movement (b) eye sight (c) both (a) and (d) none of these

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55. The largest cranial nerve is:

(a) trigeminal (b) olfactory (c) hypoglossal (d) glossopharyngeal

56. Cardiac muscles contact:

(a) quickly and get fatigued (b) slowly and get fatigued

(c) slowly and do not get fatigued (d) normally and do not get fatigued

57. Percentage of total blood pumped into

(a) 25% (b) 15 % (c) 50% (d) 75 %

58. Blood clot sometimes formed in vessels blocking the flow of blood is called:

(a) bolus (b) pus (c) ulcer (d) thrombus

59. Presence of RBC in urine is known as:

(a) protejnurja (b) alkaptonuria (c) hematuria (d) uraethiasis

60. Interstitial fluid closely resembles:

(a) sea water (b) lake water (c) pond water (d) rain water

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UNIT NO. 6 (BIOENERGETICS)

1	B	2	B	3	A	4	B	5	B	6	A	7	C	8	A	9	10	C
11	D	12	A	13	B	14	C	15	C	16	D	17	D	18	C	19	A	20	B
21	D	22	C	23	B	24		25	B	26	C	27	B	28	C	29	A	30	A
31	A	32	A	33	D	34.	A	35	D	36	D	37	B	38	D	39	A	40	B
41	A	42	C	43	A	44	C	45	A	46	B	47	C	48	B	49	C	50	D
51	C	52	A	53	A	54	B	55	A	56.	D	57	B	58	D	59	C	60	A

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In his creative way, Professor Shahid has opted for a hand written style of teaching in videos in order to students a feel of a standard classroom.

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BIOENERGETICS

MAJOR CONCEPTS

Content

→ Photosynthesis and cellular respiration 9' Learning Outcomes:

(a) Photosynthetic pigments and their absorption spectrum

(b) Light dependent stage

(c) Light independent stage

(d) Describe the respiration at cellular level including:

- Glycolysis, Krebs cycle, Electron Transport Chain

KEY POINTS

1. The quantitative study of energy relationships in biological systems is called bioenergetics.

2. Biological energy transformations obey the laws of thermodynamics.

3. No organism call: directly use solar energy for metabolism. All use chemical energy present in the food(suchas sugars etc)

4. The chloroplasts of the plants capture light energy coming from the sun and convert it into the chemical energy. This chemical energy is stored in sugar and then in other organic molecules.

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5. With the origin of photosynthesis O_2 started accumulating in the atmosphere. Then aerobic respiration started.

Note: Photosynthesis is a redox process. $CO_2$is reduced in two ways. H_2O is oxidized.

6. ATP is a chemical link between catabolism and anabolism.

PHOTOSYNTHESIS	RESPIRATION
Photosynthesis is an energy-capturing process	Respiration is an energy releasing process
Photosynthetic organisms use solar energy to synthesize organic compounds (such as carbohydrates).	Energy stored in the organic compounds is, as released in a controlled manner during I glycolysis and respiration. This energy is then used by cells /organisms
It is anabolic process.	It is catabolic process.
Photosynthesis occurs during day time	Respiration is day and night process. During darkness leaves and other active parts respire and use oxygen and release carbon dioxide
Photosynthesis uses the products of respiration (absorbs CO_2 and releases O_2)	Respiration uses the products of photosynthesis (absorbs O_2 and releases CO_2 and H_2O)
Photosynthesis does not occur in the absence of CO_2	Respiration can occur in the absence of O_2
By it organism gains weight	By it organism loses weight

7. The light intensity at which the net gaseous exchange is zero is called compensation point, OR During day time when photosynthesis and respiration is going on and there is no net gaseous exchange between the leaves and the environment is called compensation point.

8. Oxygen released during photosynthesis comes from water.

9. In 1930's, Van Niel hypothesized that plants split water as a source of hydrogen and the oxygen is released as a by-product. This was confirmed by the use of isotope O^{18}.

10. An isotope is used in biological research to trace a chemical pathway/reaction.

11. During photosynthesis Hydrogen produced by splitting of water reduces $NADPH_2$+ ($NADPH + H^+$)

12. $NADPH_2$ and ATP both are formed during light reactions in thylakoid membranes. These are products of light reaction. These reduce CO_2 to form sugar during 'dark reactions' in

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the stroma $NADPH_2$ is also called the "reducing power" while ATP is called assimilating power.

13. Chloroplasts are present in all green parts of a plant. However they are present on the leaves in a large number.

14. One square millimeter of the leaf surface contains about half a million chloroplasts. Therefore the leaves are the major sites of photosynthesis in most plants.

15. Chloroplasts are present mainly in the cells of mesophyll tissue inside the leaf.

16. Each mesophyll cell has about 20 – 100 chloroplasts.

17. The stroma of chloroplast has most of the enzymes which are involved in the production of carbohydrate molecules.

18. The system of membranes called thylakoids is present in the stroma. In some places, thylakoid sacs are stacked in columns called grana (sing granum).

19. About 50 or more thylakoids form one granum.

20. The grana are interconnected by intergrana and are suspended in the stroma.

21. Chlorophyll (and other photosynthetic pigments) is embedded in the thylakoid membranes. Actually photosynthetic pigments are present in the photosystem I and II. These photosystems and electron transport chains form Z-scheme of light reaction. Thylakoid membranes are also involved in ATP synthesis by chemiosmosis.

22. Chlorophyll (and other pigments) absorbs light energy, which is converted into chemical energy of ATP and NADPH.

23. Photosyntheticprokaryotes have no chloroplasts. However they have unstacked photosynthetic membranes which work like thylakoids.

24. Chloroplasts contain pigments that absorb visible light (380-750 run in wavelength). Different pigments absorb light of different wavelengths (colours).

25. In eukaryotic photosynthetic plants and algae chlorophyll a, b, c and d are found.

26. In photosynthetic bacteria bacteriochlorophylls are found.

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27. Chlorophylls absorb mainly violet-blue and orange-red wavelengths. Green and yellow wave lengths are least absorbed by chlorophylls and are transmitted or reflected. The yellows are covered by darker green colour. Therefore plants appear green unless masked by other pigments.

28. A chlorophyll molecule has two main parts which are head and tail. Head is flat square light absorbing and hydrophilic. It is porphyrin ring which is made up of 4 joined smaller pyrrole rings. An atom of magnesium is present in the center of porphyrin ring and is coordinated with the nitrogen of each pyrrole ring. Haerne portion of haemoglobin is also a porphyrin ring but contains an iron atom instead of magnesium atom in the centre. The tail is phytol ($C_{20}H_{39}$). It is anchoring and hydrophobic and is attached to one of the pyrrole rings. The chlorophyll molecule is embedded in the hydrophobic part of thylakoid membrane by the tail.

TABLE: Difference between Chlorophyll a and b

CHLOROPHYLL A	CHLOROPHYLL B
Molecular formula is $C_{55}H_{72}O_5N_4Mg$	Molecular formula is $C_{55}H_{70}O_6N_4Mg$
The functional group bonded to the prophyrin is the methyl group (– CH_3)	The functional group bonded to the prophyrin is the carbonyl group (– CHO)
Blue-green	Yellow-green
It is found in all photosynthetic organisms except photosynthetic bacteria.	It is found with chlorophyll a in all green plants (embryophytes) and green algae
Some wavelengths not absorbed by chlorophyll Bare effectively absorbed by chlorophyll A	Some wavelengths not absorbed not by chlorophyll Aare effectively absorbed by chlorophyll B
Of all the chlorophylls, chlorophyll a is the mostAbundant	It is less abundant
It takes part directly in the light reaction which converts solar energy to chemical energy	The chlorophyll B transfers the energy to chlorophyll A
Chlorophyll a initiates the light reactions	Chlorophyll B is the accessory pigment because it absorbs light and transfer the energy to chlorophyll A

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Chlorophyll a has many forms which differslightly in red absorbing peaks (e.g. at 670, 680, 690, 700 nm)	It has only one form

29. Due to a slight difference in structure, the two chlorophylls show different colours and slightly different absorption spectra.

30. Due to differences in structure of chlorophyll a and b, the range of wavelength of the light absorbed is increased.

31. Chlorophylls are insoluble in water but soluble in the organic solvents (such as carbon tetrachloride or alcohol etc).

32. Carotenoids are red to orange (carotenes) and yellow (xanthophylls) pigments that absorb the blue-violet range wavelengths.

33. The carotenoids and chlorophyll b are called accessory pigments because they absorb light and transfer the energy to chlorophyll a. The chlorophyll a initiates the light reactions.

34. Some carotenoids protect chlorophyll from intense light. In this case they absorb am. disperse (but do not transfer to chlorophyll) the excessive light energy. Similar carotenoids may be protecting human eye.

35. Light is a form of energy called electromagnetic energy or radiations. Light behaves as 'waves or particles called photons.

36. Only about one percent of the light falling on the leaf surface is absorbed, the rest is reflected or transmitted.

37. A graph of absorption of light of different wavelengths by a pigment is called absorption spectrum of the pigment. (OR) The part of the spectrum which is absorbed by the chlorophyll is-called as absorption spectrum

38. The Spectrophotometer measures relative abilities of different pigments to absorb different wavelengths of light.

39. Absorption spectrum for chlorophylls indicates that absorption is maximum in blue and red parts of the spectrum. Absorption peaks of carotenoids are different from those of chlorophylls.

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40 Plot showing relative effectiveness of different wavelengths (colours) of light in driving photosynthesis is called action spectrum of photosynthesis.

41. The first action spectrum was obtained by German biologist T.W. Engelmann in 1883. He worked on Spirogyra.

42. Different wavelengths are differently absorbed by photosynthetic pigments. Similarly they are differently effective in photosynthesis.

43. Action spectrum is obtained by estimation of relative CO_2 consumption or oxygen release during photosynthesis.

44. Photosynthesis in 500 – 600 nm (including green light) is more than the absorption of green light by the chlorophyll. This difference is due the accessory pigments (carotenoids).

45. About 10 percent of total photosynthesis occurs on land. The rest occurs in oceans, lakes and ponds.

The carbon source for land plants is atmospheric CO_2 which is about 0.03 – 0.04.

46. When equal intensities of light are given, there is more photosynthesis in the red than in blue part of spectrum.

47. However the carbon sources for aquatic photosynthetic organisms are dissolved CO_2, bi-carbonates and soluble carbonates in water.

48. Stomata cover 1 – 2of the leaf surface but they allow much more gas to diffuse.

49. Daily rhythmic opening and closing of stomata is due to an internal clock located in the guard cells. Even if a plant is kept in a dark place, stomata will continue their daily rhythm of opening and closing.

50. Photosynthetic pigments are organized in photosystems in the thylakoid membranes. Here solar energy is efficiently absorbed and utilized.

51. Each photo system consists of: a light-gathering 'antenna complex' and a 'reaction center'. Antenna complex has many molecules of chlorophyll a, chlorophyll band carotenoids. Most of them forward the energy to reaction center. Reaction centre has one or more molecules of chlorophyll a, a primary electron acceptor and ETS. Chlorophyll a of reaction center and associated proteins are linked to ETS. ETS generates ATP by chemiosmosis.

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52. There are two photosystems, photosystem I (PS 1) and photosystem II (PS II). These are named.in the order of their discovery.

53. Photo system I has chlorophyll a which absorbs best the light of 700 nm and is called P_{700}. Photosystem II has chlorophyll a which absorbs best the light of 680 nm and is called P_{680}.

54. Non-cyclic phosphorylation/Non-cyclic electron flow is the common/main type of electron transport.

55. The water splitting step of photosynthesis that releases oxygen is called photolysis. The oxygen produced during photolysis is the main source of atmospheric oxygen.

56. When electrons move through electron transport chain, energy is released that is used by thylakoid membrane to produce ATP. This ATP formation is called photophosphorylation because it occurs by light energy.

57. The path of electrons through the two photosystems during non-cyclic photophosphorylation is known as Z-scheme from its shape.

58. Formation of ATP during cyclic electron flow is called cyclic phosphorylation. It is less common type of electron transport. The electrons pass through only photo system I.

59. Cyclic phosphorylation will continue only until ATP supply meets the demand.

60. Pumping of H^+ (during photosynthesis) across the membrane of thylakoids into the thylakoid interior and then the movement of H^+ down their gradient into the stroma through ATP synthase, to produce ATP is called chemiosmosis. OR It is the process that uses thylakoid membranes for redox reactions to produce ATP.

61. In both cyclic and non-cyclic phosphorylation, the mechanism for ATP synthesis chemiosmosis. Similarly in Mitochondria formation of ATP in ETS is by Chemiosmosis.

62. The cyclic series of reactions, catalyzed by enzymes, by which the carbon is fixe-d and reduced, resulting in the synthesis of sugar during the dark reactions of photosynthesis is called Calvin Cycle.

63. The path of carbon in these reactions was discovered by Melvin Calvin and his colleagues at the University of California. Calvin was awarded Nobel Prize in 1961.

64. There are three phases of Calvin cycle: Carbon fixation, Reduction, and Regeneration of CO_2 acceptor (RUBP).

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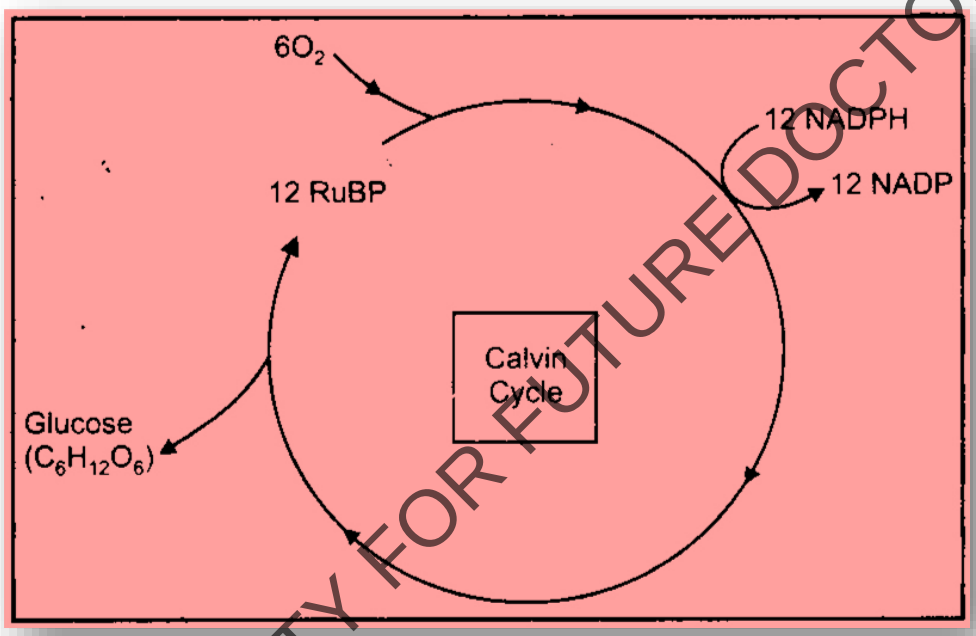
65. From the Calvin cycle, G3P is produced directly (not glucose).

66. For every three molecules of CO_2 entering the Calvin cycle and combining with molecules of five carbon RuBP, six molecules of G3P (containing 18 carbon in all are produced, however only one molecule leaves the cycle.

67. G3P is used by the plant for making glucose, sucrose, starch or other carbohydrates a. other organic compounds.



68. The exchange of respiratory gases (CO_2 and O_2) between the organism and its environment is called external respiration/organismic respiration.

69. Cellular respiration is the process by which organism's breakdown complex C-chain molecules in a cell to get maximum usable energy. This energy is released in the cell step by step.

70. The most common fuel used by the cell to provide energy by cellular respiration is glucose.

71. In cells glucose is broken down to pyruvic acid which is processed in three ways:

    (i) alcoholic fermentation

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(ii) lactic acid fermentation and

(iii) aerobic respiration

The first two reactions occur in the absence of oxygen and are called as anaerobic (without oxygen). The third reaction occurs in the presence of oxygen and is called as aerobic (with oxygen).

72. Anaerobic respiration is the process in which energy is obtained from organic compounds in the absence of free oxygen.

73. By alcoholic and lactic acid fermentations only2 of the energy present in the glucose molecule is converted into ATP.

74. Aerobic respiration is the process in which energy is obtained from organic compounds in the presence of free oxygen and the organic substrate (usually carbohydrate. glucose) is completely oxidized.

75. In ATP second and third phosphate bonds are "high energy" bonds. The breaking of the terminal phosphate of ATP releases 7.3 K cal. of energy.

76. To get free energy by oxidation-reduction reactions in a cell is the biological' oxidation.

77. There are 4 stages of cellular respiration: Glycolysis; Pyruvic acid oxidation; Krebs cycle or citric acid cycle; Respiratory chain.

78. Glycolysis is the breakdown of glucose upto the formation of pyruvic acid. Glycolysis occurs in the cytosol. It can take place both in the absence of oxygen (anaerobic condition) or in the presence of oxygen (aerobic condition). In both, the end product of glycolysis is pyruvic acid.

79. Glycolysis can be divided into two phases, a preparatory phase and an oxidative phase.

80. Pyruvate is equivalent to half glucose molecule that has been oxidized by losing two hydrogen atoms.

81. The Pyruvate or Pyruvic acid (a 3-carbon molecule) which is the end product of glycolysis does not enter the Krebs cycle directly. It is first changed into 2 carbon (acetic acid) molecule. One carbon is released as CO_2 (de-carboxylation). Acetic acid when enters the mitochondrion unites with coenzyme-A (CoA) to form acetyl CoA (active acetate). Here more hydrogen atoms are transferred to NAD.

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82. Krebs cycle is the fundamental metabolic pathway in the cellular respiration.

83. A cyclic series of chemical reactions in which Acetyl CoA is oxidized to CO_2 at ATP is generated is called the Krebs cycle (after the name of the biochemist who discovered it). This cycle is also known as citric acid cycle.

84. Synthesis of ATP in the presence of oxygen is called oxidative phosphorylation. This ATP formation is by chemiosmosis.

85. Absorption spectrum: The region of the spectrum of electromagnetic energy (usual visible light) that is absorbed by a particular molecule or atom.

86. C4 plants: Plants that can photosynthesize in hot. dry climates at a faster rate than (plants due to special leaf anatomy and a unique biochemical pathway which begins witt stable, four-carbon sugar intermediate.

87. Calvin cycle: The dark reaction of photosynthesis.

88. Carotenoid pigment: A pigment related to vitamin A that appears red, orange, yellow to the human eye.

    (It includes carotenes and xamthophylls)

89. Cytochrome: Any of a class of iron-containing proteins that act as carriers in the electr: transport chain of the cellular respiration.

90. Dark reaction: The second-stage reactions of the photosynthesis." which do not require light energy to proceed and in which CO_2 is reduced to carbohydrate.

91. Electron transport chain: The final phase of cellular respiration, in which the compounds $NADH_2$ and F ADH_2 are oxidized and their electrons pass along a chain oxidation-reduction steps.

92. FAD (flavin adenine dinucleotide): Along with NAO^+, a coenzyme that cam electrons and hydrogen in a variety of metabolic oxidations and reductions, such as those of the Krebs cycle.

93. Fermentation: A set of anaerobic reactions in which pyruvate generated by glycolysis modified to ethanol, lactate, or some other organic end products.

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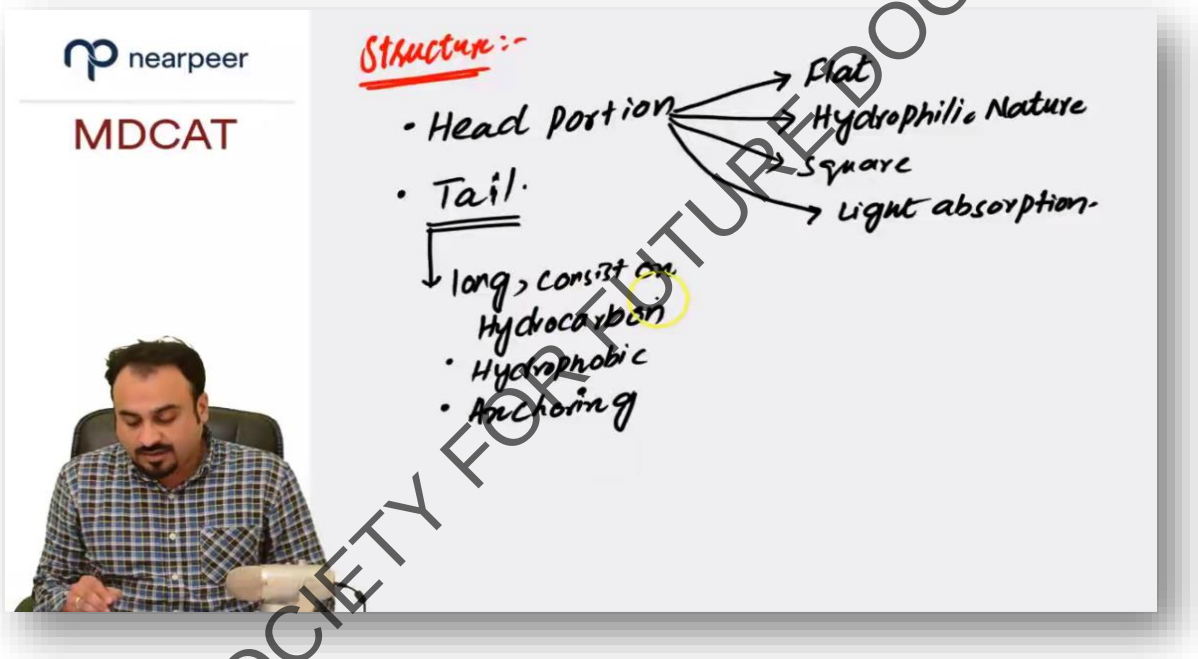
94. Glycolysis: The first phase of energy metabolism in the cells. By way of the multistep glycolysis pathway, a single six-carbon glucose molecule is converted into two melee: of the three-carbon compound pyruvate, two molecules of NADH, and two moleculesATP.

95. Krebs cycle: The fundamental metabolic pathway in cellular respiration. consists of a series of chemical reactions in which pyruvate (the end product glycolysis) is oxidized to carbon dioxide, and ATP is generated,also known as the citric acid cycle.



96. This table indicates that, for each molecule of glucose, 36 molecules of ATP are produced.

97. **Light reaction:**

The first of the two distinctive sets of reactions in photosynthesis in which the light energy is required to oxidize water and O_2 is released.

98. **Light-independent reactions:**

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The second stage of photosynthesis in which carbon dioxide is reduced to carbohydrate and which can occur whether light is present or not.

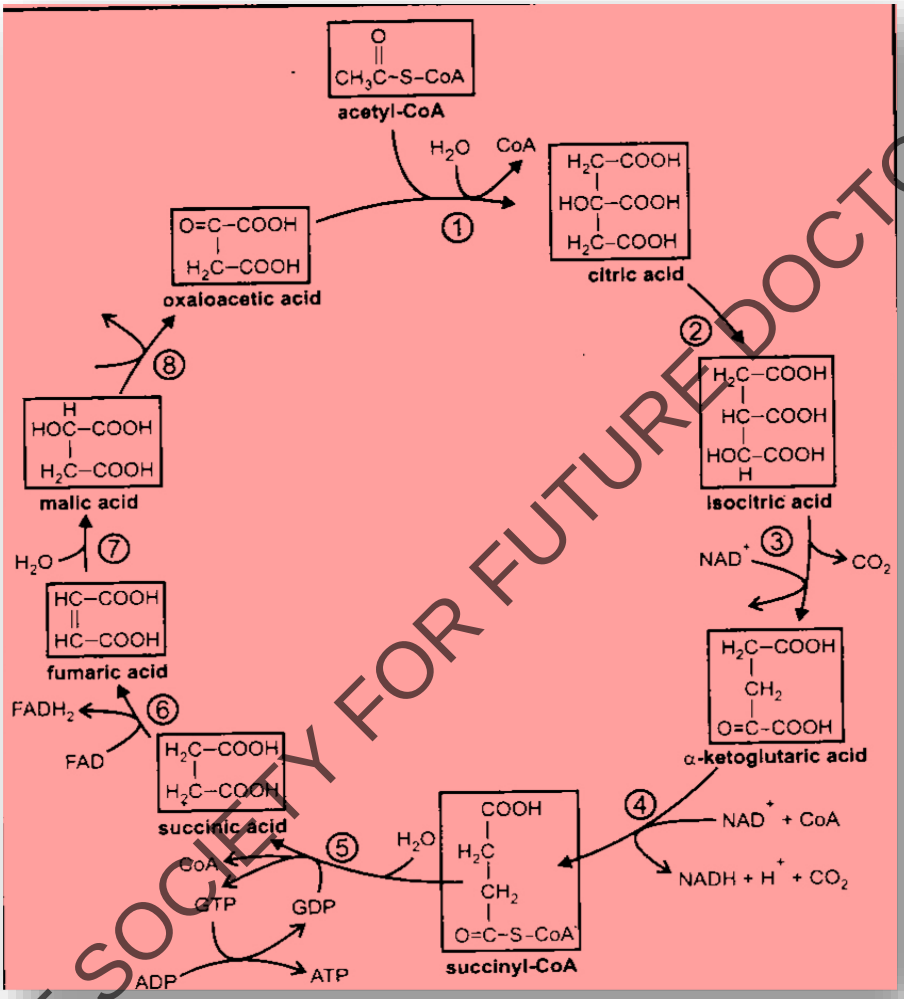

Fig. The Krebs (citric acid) cycle

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TABLE: The overall process of glucose breakdown, Stages 2, 3 and4 can be thought of asthe aerobic (oxygen-requiring) reactions and take place in the mitochondria

Stage	Site within cell	Overall process	Number of ATP molecules produced
Glycolysis	Cytosol	Glucose is split into 2 molecules of pyruvate	2 per glucose

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Pyruvateoxidation	Matrix (inner fluid) of mitochondria	Pyruvate IS converted into acetyl Co-A	None
Krebs cycle	Matrix (inner fluid) of mitochondria	Acetyl Co-A drives a cycleof reactions which produces hydrogen	One per turn, so 2 perglucose
Electron transport chain	Inner membrane of mitochondria	Hydrogen drives a seriesof redox reactions which release enough energy to make ATP	Upto 32 per glucose

99. **NAD^+(Nicotinamide adenine dinucleotide):**

One of the two important coenzymes (the other is FAD) that serves as an electron and hydrogen carrier in the metabolic oxidation and reductions of the krebs cycle and other cell processes.

100. **Oxidative phosphorylation:**

The process by which energy released during oxidation reactions is stored in high energy phosphate bonds.

101. **Oxygen debt:**

The condition in which reduced metabolic products (such as lactic acid comprising the "debt" accumulate due to the inability of oxidative metaholism to functior. rapidly enough. The debt is paid off when the metabolism that produces reduced product slows.

102. **Phosphorylation:**

The addition of phosphate groups to a molecule.

103. **Photophosphorylation:**

The production of A TP through the transport of electrons exitec by light energy down an electron transport chain.

104. **Photosystem I and II:**

The two basic molecular systems for converting light to chemical energy during photosynthesis. Photosystem II tends to absorb light with a wavelength near 680 nm.

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105. **Pyruvate:**

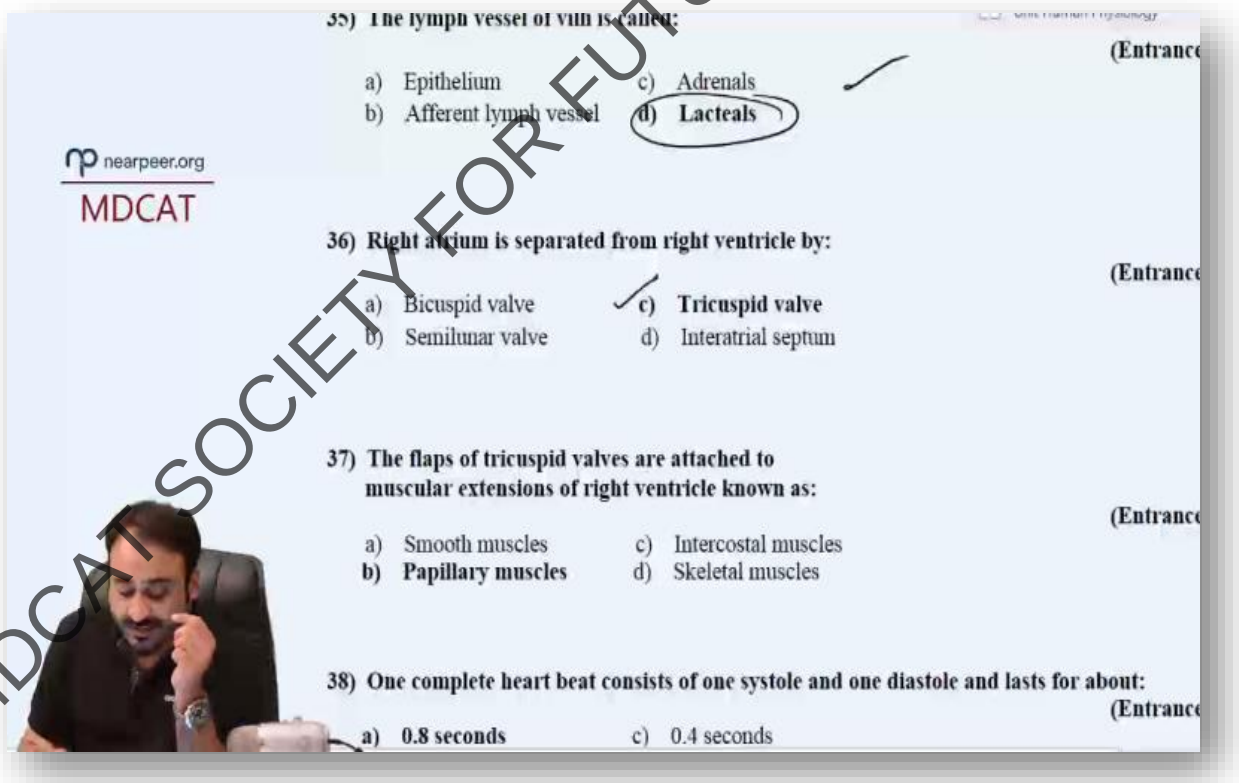
A three carbon compound formed by the breakdown of glucose during glycolysis.

106 **Ribulosebis phosphate (RUBP):**

A short lived precursor of PGA that absorbs CO_2 and helps catalyze the light independent reactions of photosynthesis.

107. **Ribulose biphosphate carboxylase oxygenase (Rubisco):**

A key enzyme that catalyzes the first reaction in the metabolic pathway leading to the reduction of CO_2 in the dark reactions of photosynthesis: probably the most abundant protein found in nature.



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QUESTION FOR PRACTICE

1. The major/final function of the cellular respiration is to make:

(a) ATP (b) NADP

(c) FAD (d) water

2. Each chemical reaction in cellular respiration requires:

(a) specific enzyme (b) ATP

(c) NADP (d) ATP and NADP

3. Which process needs oxygen?

(a) glycolysis (b) krebs cycle

(c) chemiosmosis (d) ETS

4. The net product of non-cyclic electron flow in photosynthesis is:

(a) ATP (b) $NADPH_2$

(d) O_2 (d) all of these

5. Which is not photosynthetic?

(a) mushroom (b) grass

(c) moss (d) fern

6. Heterotroph gets energy from:

(a) heat (b) light

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(c) organic (d)inorganic

7. Wave lengths which are least absorb by chlorophyll is:

(a) green (b) yellow

(c) indigo (d) all of these

8. Unstable 6-C compound in dark reaction splits into:

(a) PGA (b) PGAL

(c) RUBP (d) none of these

9. During light reaction, the active chlorophyll forms are:

(a) P-700 (b) P-690

(c) P-680 (d) both P680 and P700

10. Chlorophyll a in photosystem I absorb red peaks at:

(a) 680 nm (b) 690 nm

(c) 700 nm (d) 680 nm + 700 nm

11. The carbohydrate produced directly from the Calvin cycle is:

(a) G3p (b) glucose

(c) galactose (d) RUBP

12. More familiarly respiration or external respiration means:

(a) oxidation (b) exchange of respiratory gases

(c) oxidation reduction (d) hydrolytic reactions

13. $NADHH^{+}$ and FAD^{+} collectively yield:

(a) 3ATP (b) 5ATP

(c) 2ATP (d) 6ATP

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14. Carbon dioxide enters the leaves through:

(a) stomata (b) pore

(c) guard cells (d) hydathodes

15. Haeme portion of haemoglobin contains:

(a) magnesium atom (b) iron atom

(c) oxygen atom (d) Ca

16. Chlorophyll absorbs light energy, which is converted into chemical energy of:

(a) ATP (b) NADPH

(c) ATP and NADPH (d) ATP, NADPH and FAD

17. Chlorophyll b is found along with chlorophyll a in all green plants and:

(a) algae (b) golden algae

(c) blue green algae (d) green algae

18. Wavelength of visible light longer than:

(a) infra-red (b) ultra violet

(c) radiowaves (d) microwaves

19. How many molecules of redeuce NADP are required to produce one G3P?

(a) 3 (b) 6

(c) 12 (d) 18

20. ATP produced in one calvin cycle:

(a) 0 (b) 6

(c) 18 (d) 12

21. During respiration, conversion of energy is mainly in the form of:

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(a) glucose (b) $Co_2$and H_2O

(c) ATP (d) NADP

22. The connecting linke between glycolysis and Kerb's cycle is:

(a) pyruvic acid (b) cytochromes

(c) acetyl Co-A (d) citric acid

23. Co-enzymes Q is oxidized by cytochrome:

(a) b (b) a

(c) a_3 (d) c

24. Glycolysis is not:

(a) in cytoplasm (b) Formation of acetic acid

(c) formation of pyruvic acid (d) break down of glucose

Ribosome and RER

25. ATP is not forming in the:

(a) glycolysis (b) krebs cycle

(c) electron transposrt chain (d) none of these

26. Citric acid is the first product of _____ after entrance of Acetyl CoA.

(a) glycolysis (b) krebs cycle

(c) electron transport chain (d) none of these

27. The mechanism for ATP synthesis is:

(a) chemosynthesis (b) photosynthesis

(c) chemiosmosis (d) phosphorylation

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28. Carbon dioxide not enters the leaves through:

(a) lenticels (b) guard cells

(c) stomata (d) both lenticels and guard cells

29. Which of the following releases most energy during respiration?

(a) conversion of glucose to ethanol

(b) oxidation of pyruvate to carbon dioxide and water

(c) phosphorylation of glucose

(d) reduction of pvruvate to lactate

30. Chlorophyll absorbs light energy, which at the end of photosynthesis, is converted into chemical energy of:

(a) ATP (b) NADPH

(c) ATP and NADPH (d) glucose

31. Porphyrin ring is made up of:

(a) pyrrole rings (b) mg

(c) n (d) phytols

32. First action spectrum was obtained with Spirogyra by:

(a) T.W. Engelmann (b) Van Niel

(c) Melvin Calvin (d) A + B

33. When cytochrome b is reduced, it:

(a) takes e (b) gives H^+

(c) gives e (d) takes H^+

34. Glycolysis is the breakdown of:

(a) fructose (b) glucose

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(c) lactose (d) maltose

35. The Krebs cycle occurs in:

(a) chloroplast (b) mitochondria

(c) SER (d) cytoplasm

36. Carbon fixation refers to the initial incorporation of:

(a) carbon (b) CO_2

(c) oxygen (d) hydrogen

37. Pigment with yellow color is:

(a) carotene (b) carotenoid

(c) xanthophylls (d) chlorophyll c

38. Which one is catabolic process?

(a) photosynthesis (b) respiration

(c) protein synthesis (d) lipid formation

39. In ATP, P stands for:

(a) phosphorous (b) phosphate

(c) adenosine diphosphate (d) adenosine triphosphate

40. In the conversion of glucose to two molecules of Pyruvate, which of the following does not occur:

(a) hydrolysis of ATP

(b) phosphoryt-t.on ot adp

(c) decarboxylation

(d) reduction ofnad

41. Copper containing protein during non-cyclic phosphorylation is called:

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(a) plastoquinone (b) ferredoxin

(c) quinine (d) plastocyanin

42. What happens with the oxygen in the respiration cnain?

(a) it is released as gas

(b) it is reduce to water

(c) it is used as an clec.rcn carrier

(d) it is used to supply the energy for a tp synthesis

43. Which substance enters in the mitochondrion during respiration?

(a) glucose (b) pyruvate

(c) acetic acid (d) acetyl Co-A

44. How much amount of energy is utilized while break down of glucose into Pyruvate"?

(a) 7300 calories (b) 14600 calories

(c) 21900 calories (d) 29200 calories

45. When light energy is absorbed by photosystem II:

(a) photolysis occurs

(b) photophosphorylation occurs

(c) oxidative phosphorylation occurs

(d) both photophosphorylation arid photolysis occurs

46. Which one of the following is the hydrogen acceptor during light reaction?

(a) flavin adnine dinucleotide

(b) nicotinamide adnine dinucleotide

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(c) nicotinamide adnine dinucleotide phosphate

(d) phosphoenol pyruvic acid

47. What happens during the light phase of photosynthesis?

(a) ADP is hydrolyzed and NADPH oxidized

(b) ADP is phosphorylated and NADP reduced

(c) ATP is hydrolyzed and NADPH oxidized

(d) A TP is hydrolyzed and NADP reduced

48. Which one is energy incarcerating process?

(a) lipid break down (b) catabolism

(c) photosynthesis (d) respiration

49. For formation of one G_3P how many molecules of CO_2 enters the calvin cycle?

(a) 1 (b) 2

c) 3 (d) 4

50. Suppose CO_2 labelled with 14C has been used to identify the intermediate compound in the Calvin cycle. Which compound would be the first to contain the 14C?

(a) G3P (b) PGA

(c) RuBP (D) RuP

51. In the conversion of RuBP to PGA:

(a) A molecule of CO_2 is required (b) A stable 6C molecule is produced

(c) ATP is hydrolyzed (d) Three molecules of CO_2 are required

52. The breaking of terminal phosphate of A TP releases about ----- Kcal. energy.

(a) 7.3 (b) 73.3

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(c) 73.0 (d) 7.73

53. Which of the following occurs in the light reaction of photosynthesis?

(a) ADP is phosphorylated (b) Hexose phosphates are hydrolyzed

(c) Reduced NADP is oxidized (d) A TP is hydrolyzed

54. In predominant type of electron transport called non-cycle electron flow, electrons pass through:

(a) PS I (b) PS II

(c) both PS I and PS II (d) Calven Cycle

55. Which sequence of colours would give an increasing photosynthetic response?

Smallest Largest response

(a) Blue → Green → Yellow → Orange → Red

(b) Green → Yellow → Orange → Red → Blue

(c) Red → Orange → Yellow → Green → Blue

(d) Yellow → Green → Orange → Blue → Red

56. Cell processes pyruvic acid by:

(a) Alcoholic and lactic acid fermentation and aerobic respiration

(b) Alcoholic and lactic acid fermentation and anaerobic respiration

(c) Alcoholic and acetic acid fermentation and aerobic respiration

(d) Alcoholic and oxalic acid fermentation and aerobic respiration

57 Pyruvic acid (pyruvate), the end product of glycolysis, does not enter the → cycle directly.

(a) Calvin (b) Krebs

(c) Malvin (d) Malvin-Calvin

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58. Chlorophylls absorb mainly violet-blue and wavelengths.

(a) orange-red (b) orange-yellow

(c) Yellow-red (d) Infra-red

59. The carotenes are red to:

(a) blue (b) yellow

(c) orange (d) green

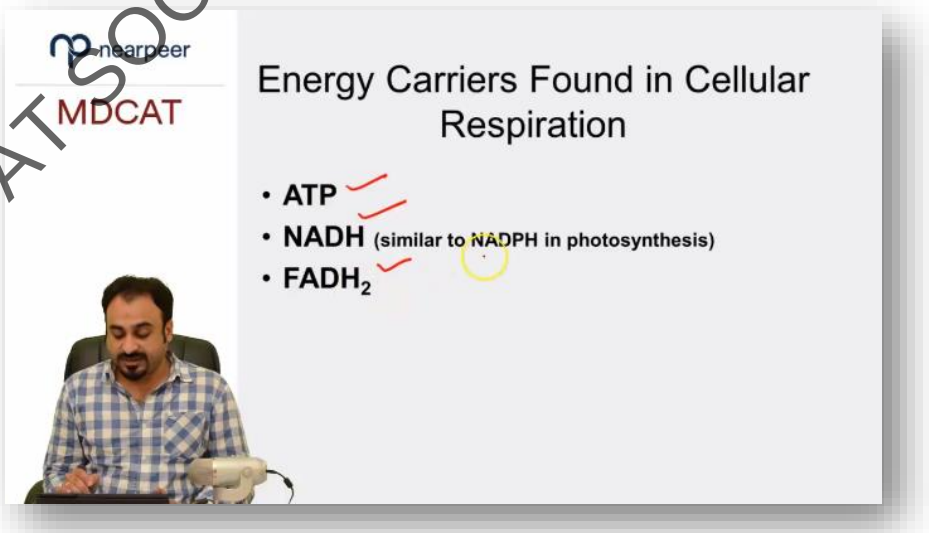
60. During photosynthesis, which process releases electrons that return chlorophyll molecule to their reduced state?

(a) activation of photo system I (b) oxidation of reduced NADP

(c) photolysis of water (d) phosphorylation of ADP

UNIT NO. 6 (BIOENERGETICS)

1	A	**2**	A	**3**	D	**4**	D	**5**	A	**6**	**C**	7	D	8	A	9	D	10	C
11	A	**12.**	B	**13**	A	**14**	A	**15**	B	**16**	**C**	17	D	18	B	19	B	20	A
21	C	**22**	C	**23**	A	**24**	B	**25**	D	**26**	**B**	27	C	28	D	29	B	30	D
31	A	**32**	A	**33**	A	**34.**	B	**35**	B	**36**	**B**	37	C	38	B	39	B	40	C
41	D	**42**	B	**43**	C	**44**	B	**45**	D	**46**	**C**	47	B	48	C	49	C	50	B
51	D	**52**	A	**53**	A	**54**	C	**55**	D	**56.**	**A**	57	B	58	A	59	C	60	C



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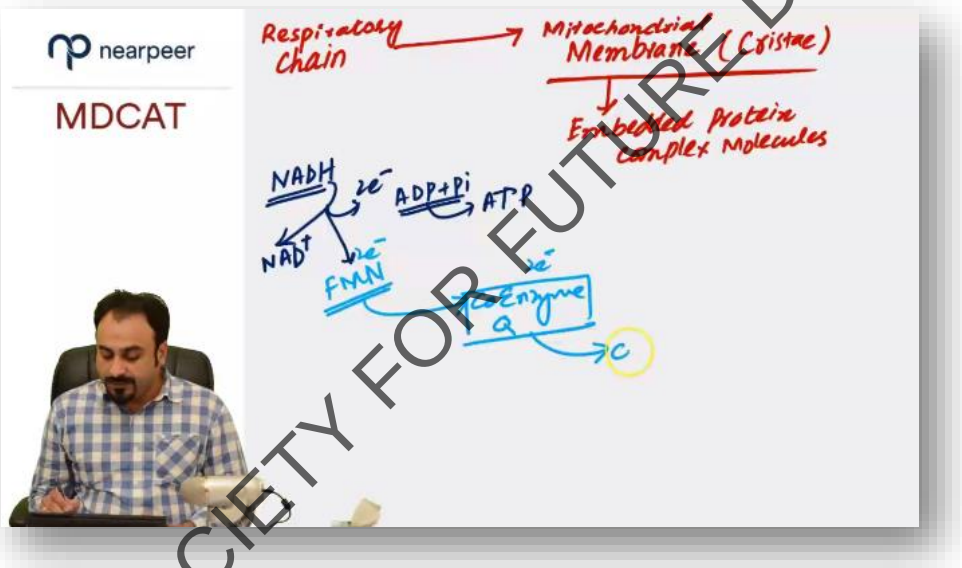

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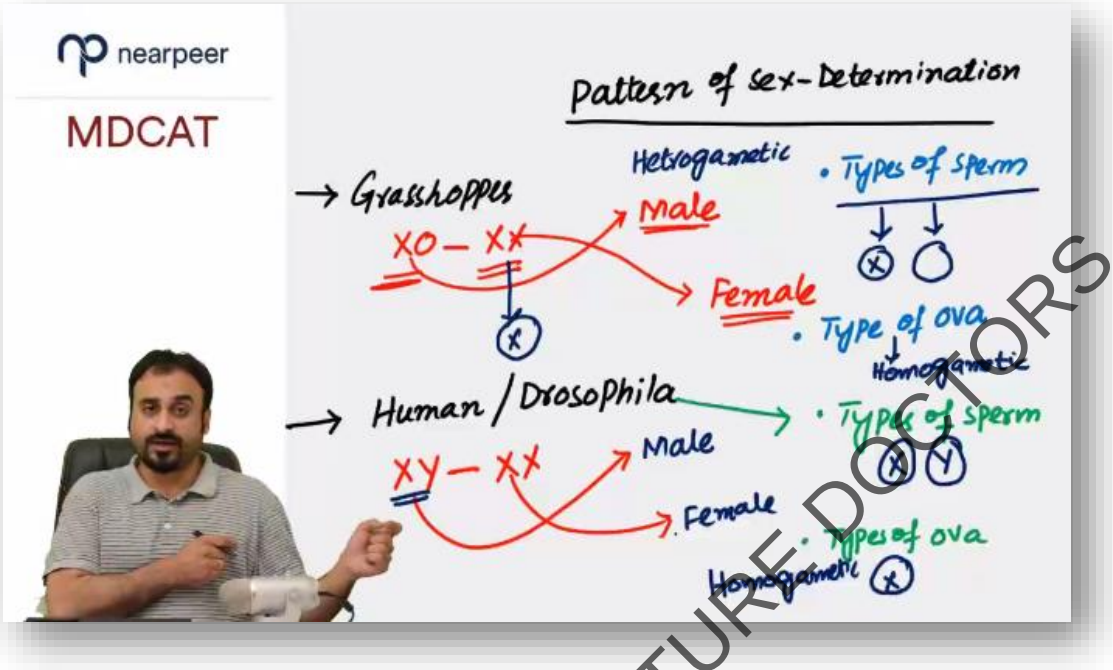

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BIOTECHNOLOGY

MAJOR CONCEPTS

Content

→ DNA Technology

Learning Outcomes:

Explain Recombinant DNA Technology

(b) Discuss Polymerase Chain Reaction (detailed procedure)

(c) What do you understand by the following terms?

- Gene therapy
- Transgenic animals

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RECOMBINANT DNA TECHNOLOGY:

Recombinant DNA is the DNA which contains DNA from two different sources and the technology for the formation of recombinant DNA is called Recombinant DNA technology.Following steps are very important:

1. How to Get a ·Gene of Interest?

Isolation of gene from the chromosome: Genes can be isolated from the chromosomes by cutting the chromosomes on the flanking sites of the gen)' Special enzymes calledrestriction endonucleases are used to cut the genes.

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Chemical Synthesis of Genes: Small genes can be synthesized in the laboratory, making gene from mRNA by using reverse transcriptase enzyme. This DNA molecule is called complementary DNA (cDNA).

2. Molecular Scissors, Restriction Endonucleases:

The restriction enzymes are present in the bacteria naturally. The bacteria use these enzymes for their own protection against viruses.The restriction enzyme cuts down the viral DNA. But they do not harm the bacterial chromosome. They restrict the growth of viruses. So they are called restriction enzymes. In 1970, Hamilton O. Smith, at Johns Hopkins University, isolated the first restriction enzyme.

Bacteria produce a variety of such restriction enzymes. These enzymes cut the DNA at very specific sites. These sites have specific sequence of four or six nucleotides. These nucleotides are arranged symmetrically in the reverse order. Such sequences are known as palindromic sequences. So far more than 400 such enzymes have been isolated. About 20 of which are frequently used in the recombinant DNA technology.

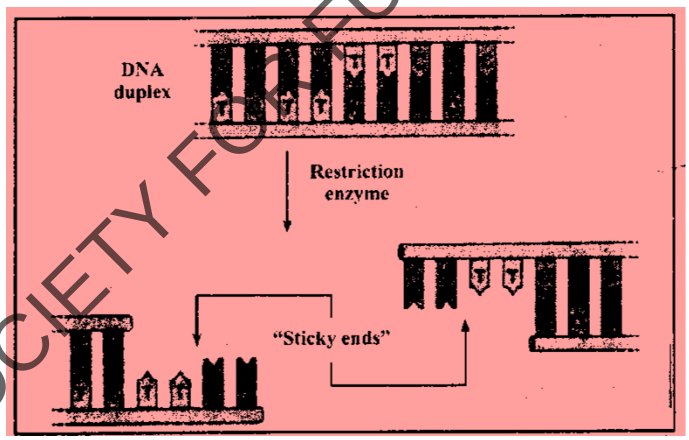

Fig. Restriction enzyme ECoRI, cuts this specific sequence of nucleotides in such a way that sticky ends are produced

EcoRI is a commonly used restriction enzyme. It cuts double-stranded DNA at the specific site. So a gap is produced in this DNA. A piece of foreign DNA with complementary ends can be placed in this gape.

The single stranded with complementary ends of the two DNA molecules is called "sticky ends". Thus plasmid and foreign DNA can bind by complementary base pairing. Therefore, the restriction enzymes help in the insertion of foreign DNA into vector DNA.

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3. Molecular Carrier Vector:

The means by which recombinant DNA is introduced into a host cell is called vector. A vector is selected to make recombinant DNA. One common type of vector is plasmid.

Plasmids:

Plasmids are natural extra chromosomal circular DNA molecules. Plasmid is common type of vector.

The DNA of bacterial virus can also be used as a vector. For example lambda phage

Recombinant DNA:

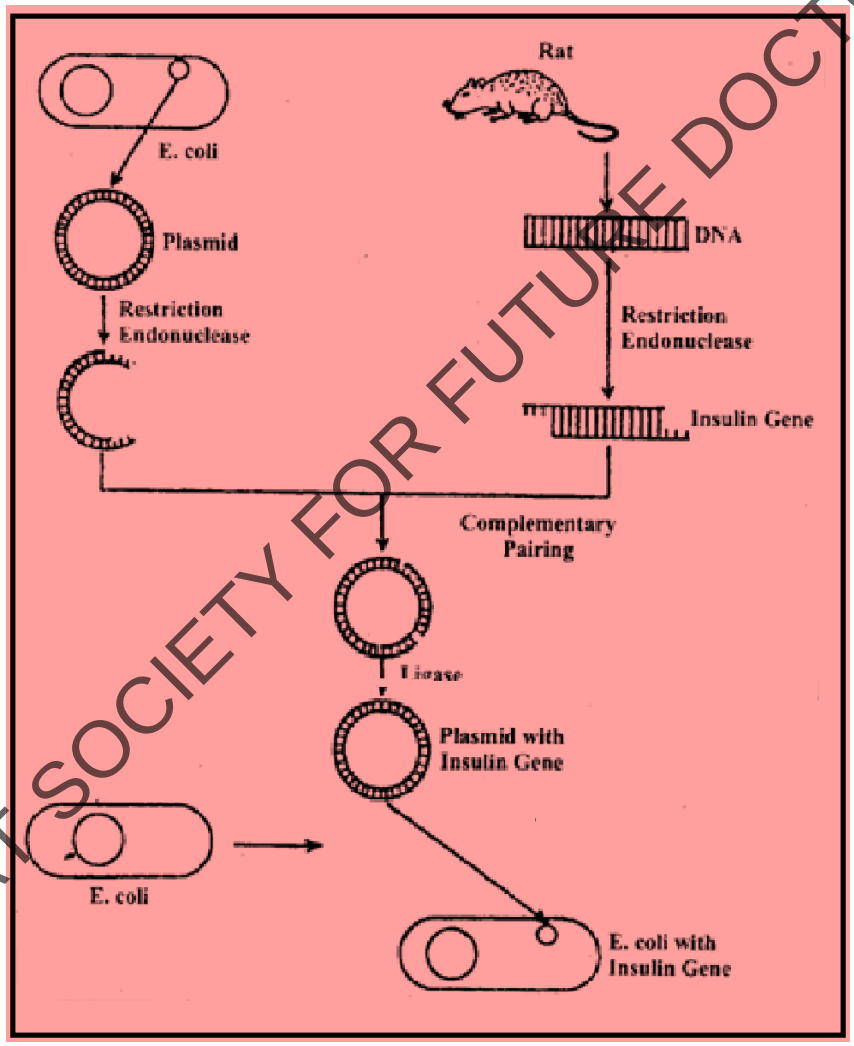

Fig: mechanism of transferring insulin gene rat DNA to E.Coli with a plasmis

4. Recombinant DNA:

The plasmids are cut with the enzyme for preparation of a recombinant DNA. It is the same enzyme which was used for isolation of the gene of interest. The gene of interest

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(insulin) is then joined with the sticky ends of plasmids with the help mother special enzyme known asDNA ligase.This enzyme seals the foreign piece of DNA into the vector. Now the two different pieces DNA have beenjoined together. It is now known as recombinant DNA or chimaeric DNA.

5. **Expression of the recombinant DNA:**

The bacterial cells are treated with calcium chloride. It makes the bacterial membranemore permeable. Now the bacterial cells take up recombinant plasmid. The bacteria reproduce product. The protein product can be separated.Two techniques have been developed to insert genes into the eggs of animals.

TRANSGENIC ANIMALS

Simple methods to develop transgenic animals:

Microinjection of Genes:

There can be microinjection of foreign genes into the eggs by hand.

Vortex Mixing:

The eggs are placed in an agitator with DNA and silicon carbide needles. The needles make tiny holes through which the DNA can enter, these eggs are fertilized and producetransgenic offspring.

APPLICATION:

The technique of producing transgenic animals has following applications.

1. Higher Growth Rate of Animals:

The genes for bovine (cattle) growth hormone arc injected by this technique into mar' types of animal eggs. Thus many larger fishes, cows, pigs, rabbits and sheep are produced by this procedure.

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2. Gene Pharming:

The use of transgenic farm animals to produce pharmaceuticals is called gene Pharming,a number of firms are using this technique. In this technique the genes of therapeutic (antibodies) and diagnostic proteins are incorporated into the animal's DNA.Thus these proteins appear in the animal's milk. The scientists are trying to produce drugs for the treatment of cystic fibrosis, cancer, blood diseases and other disorders. Ant thrombin III is produced by a herd, goats. It prevents the blood clotting during surgery.

Procedure of Producing Transgenic Mammals for Gene Pharming:

DNA containing the gene of interest is injected into donor eggs. The egg is fertilized in vitro (in test tube) and zygote is formed. The zygotes are placed in host females. The off spring are developed, female offspring become mature. The product is secreted in the milk. The scientists of United States Department of Agriculture have produced genetic engineered mice that produce human growth hormone in their urine instead of milk. Urine is preferred over milk for selection of biotechnology product.

Cloning of Transgenic Animals:

The production of the genetically identical copies of the organisms or cells asexual reproduction is called cloning. The animals are genetically engineered to produce a biotechnology product. Now identical copies of these animals are obtained by asexual reproduction throughcloning.

Cloning requires only the genes of one animal. So cloning is a form of asexual reproduction. In 1997, scientists at the Roslin institute in Scotland produced a cloned sheep called Dolly. Since then calves and goats have been cloned.

Procedure of Cloning:

The eggs are enucleated (remove nucleus). A 2n nuclei of adult cells are injected into this enucleated egg.The modified cell is implanted in the uterus and development begins. The offspring is produced. The off spring have the genotype and phenotype of the adult that donated the nuclei. Therefore, the adult has been cloned.

For cloning of Mice, following procedure was adapted

The 2n nuclei were taken from cumulus cells

Cumulus cells are those that cling to an egg after ovulation occurs

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GENE THERAPY

The insertion of genetic material into human cells for the treatment of a disorder is gene therapy. Nowadays Gene therapy is used for two purpose. Faulty genes of the patients are replaced by healthy genes.The use of genes to treat various other human illnesses such as cancer and cardiovascular. There are two main methods used for gene therapy i.e. Ex-vivo and in Vivo.

VIVO GENE THERAPY:

Tile gene therapy in which genes are inserted into the cell outside the body is called viivo gene therapy. Following diseases are treated by this method.

Treatment of SCID:

The severe combined immunodeficiency syndrome (SCID) is treated by Ex-vivo gene. These children lack an enzyme adenosine deaminasc (ADA) that is involved in the nutrition of T and B cells.

Bone marrow stem cells are removed from the blood and infected with a retrovirus (RNA) that carries a normal gene for the enzyme then the cells are returned to the patient, the becomes normal.

Treatment of Hypercholesterolemia:

Hypercholesterolemia is also treated by Ex-vivo gene therapy. In case of hypercholesterolemia the liver cells lack a receptor for removing cholesterol from the blood.

A small portion of the liver is surgically removed.

It is infected with a retrovirus containing a normal gene for the receptor.

Several patients have experienced a lowering of serum cholesterol levels following this procedure.

In Vivo Gene Therapy:

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The gene therapy in which genes are inserted in the cells within the body is called in Vivo gene therapy.

(a) Treatment of Cystic Fibrosis:

In this case the patients lack a gene. That gene codes for trans-membrane carrier of the chloride ion. Patients often die due to numerous infections of the respiratory tract.

When lipoproteins are put into a solution, liposomes are spontaneously formed. The liposomes are microscopic vesicles. The liposomes are coated with the gene needed to cure cystic fibrosis.

Then the solution is sprayed into patient's nostrils. There is limited gene transfer in this case. So this procedure is not successful.

(b) In vivo gene therapy is also done in cancer patient.

It makes the patient more tolerant for chemotherapy.

(c) Coronary Artery Angioplasty:

A balloon catheter (tube) is used to open up a closed artery in coronary artery angioplasty. But artery close's up once again.

So the investigators have adapted a new procedure. The balloon is coated with a plasmid This plasmid contains a gene for vascular endothelial growth factor.

The expression of the gene promotes the proliferation of blood vessels. Thus the blooci bypasses the obstructed area.

(c) Hemophilia, diabetes Parkinson disease, or AIDS can be cured by in vivo therapy. In the case of hemophilia, the patients are given regular doses of cells. These cells contain normal clotting genes or such cells can be placed in organoids. The organoids are artificial organs that can be implanted in the abdominal cavity. In case of Parkinson's disease dopamine-producing cells can be grafted directly into the brain.

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IMPORTANT POINTS

1. The use of living organisms. systems or processes in the manufacturing and sen-ice industries is biotechnology. OR The use of a natural biological system to produce a product or to achieve an end desired by humans.

2. There are many different branches of Biotechnology: Fuel biotechnology, enzyme biotechnology, Agriculture biotechnology and Genetic engineering etc.

3. The production of many identical copies of a gene is called gene cloning.

4. A very large number of copies of a gene is produced by recombinant DNA technology.Lesser number of copies of a gene is produced by the polymerase chain reaction (PCR) within a laboratory test tube.

5. A genome is a full set of genes of an individual.

6. A genomic library is a collection of bacterial or bacteriophage clones,each clone containing particular segment of DNA from the source cell.

7. A probe is a single stranded nucleotide sequence that will hybridize (form pair) into a certain piece of DNA. The probe is either radioactive of fluorescent.

8. The technique in which DNA is copied many time by the enzyme DNA polymerase in test tube is called polymerase chain reaction.

9. Kary B. Mullis developed the polymerase chain reaction (PCR) in 1983.

10. PCR is used for producing genes in smallest quantities.

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THE POLYMERASE CHAIN REACTION

- PCR can create millions of copies of a single gene or any specific piece of DNA quickly in a test tube.

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- Generally any size (even very small) can be used.
- PCR takes its name from DNA polymerase, the enzyme that carries out DNA replication in a cell.
- It is a chain reaction because DNA polymerase will carry out replication over and over again, until there are millions of copies of the desired DNA. PCR does not replace gene cloning, which is still used whenever a large quantity of gene or protein product is needed.
- Before carrying out PCR, primers - sequences of about 20 bases that are complementary to the bases on either side of the "target DNA" must be available.
- The primers are needed because DNA polymerase does not start the replication process; it only continues or extends the process. After the primers bind by complementary base pairing to the DNA strand, DNA polymerase copies the target DNA
- DNA polymerase used is temperature insensitive (thermostable) extracted from the bacterium Thermus aquaticus, which lives in hot springs. Commonly this enzyme is alsoknown as Taq polymerase.
- It can withstand high temperature, which is used to separate double stranded DNA, therefore replication need not be interrupted by the need to add more enzyme.
- PCR machine is also called thermocycler.

11. DNA test/DNA fingerprinting can be used to diagnose viral infections, genetic disorders and cancer.

12. The principle of DNA test/DNA fingerprinting is: When Restiction enzymes are put on DNA samples:

    (a) Similar DNA samples have similar DNA fragments

    (b) Different DNA samples have different DNA fragments

13. A unique collection of different sized fragments of DNA of the genome (of an individual) by restriction enzymes is called RFLP.

    Note: The process in which the DNA pieces are sorted out on the basis of their size through size fractionation is called Gei electrophoresis.

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14. The plant cells whose cell walls are removed are called protoplasts.

15. A weed called mouse-eared cress has been genetically engineered. It produces a biodegradable plastic (polyhydroxy-butyrate) in cell granules.

16. The use of transgenic farm animals to produce pharmaceuticals is called gene Pharming.

17. German botanist Gottlieb Haberlandt said in 1902 that plant cells are totipotent. Totipotent means each cell has the full genetic potential of the organism. Therefore, a single cell can become a complete plant.

18. In 1987, John C Sanford and Theodore M. Klein of Cornell. University developed a method of introducing DNA into a plant tissue culture callus. They constructed the particle gun. This gun bombards a callus with DNA coated microscopic metal particles. Then genetically altered somatic embryos develop. These embryos develop into genetically adult plants.

19. In 1999 transgenic crops were planted on more that 70 million acres worldwide.

20. Vernolic acid and ricinoleic acid are derivatives of the Oleic acid. Vernolic acid and ricinoleic acid can be used as hardness in paints and plastics. These genes were derived from Vernonia and castor bean seeds and were transferred into the soybean genomes.

21. The scientists first identified a gene coding for a channel proteins. These proteins transport Na and H^+ across a vacuole membrane. Na^+ arc Sequestered in a vacucle Thus Na T does not interfere into plant metabolism. Thenthe scientists cloned the gene and used these genes in genetically engineered plants. These plants overproduce the channel protein. The modified plants grow in water with a salty solution.

22. Today crop production is reduced by 50 of due to salinization.

23. By genetic engineering the stomata may be altered. It will boost the carbon dioxide intake or cut down on water loss.

24. By genetic engineering the efficiency of the enzyme RuBP carboxylase can be improved. RuBP carboxylase captures CO_2 in plants.

25. A team of Japanese scientists are working on introducing the C_4 photosynthetic cycle into rice. The C_4 plants do well in hot dry weather. These modifications will require a complete engineering of plant cells than the single gene transfers. So far only single gene transfer has been done.

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Note: Traditional method in Molecular biology is "one gene in one experiment". In a technique "DNA microarray" we can monitor the whole genome on a single chip. Therefore it is better to study interactions among thousands of genes.

26. Scientists from Bio-source Technologies located in Vacaville, California used the tobacco mosaic virus as a vector. They introduced a human gene into adult tobacco plants in the field. This technology by passes the need for tissue culture completely.

27. C_3 photosynthesis: The main cycle of the dark reactions of photosynthesis in which CO_2 binds to ribulose 1, 5 bisphosphate (RuBP) to form two three-carbon phosphoglycerate molecules.

28. C_4 photosyntheisi: A process of CO_2 fixation in photosynthesis by which the first product is the four-carbon oxaloacetate molecule.

29. **Cloning:** Producing a cell line or culture all of whose members contain identical copies of a particular nucleotide sequence; an essential element in genetic engineering.

30. **Cystic fibrosis:** An autosomal disorder that produces the most commonfatal genetic disease in Caucasians, characterized by secretion of thick mucus that clogs passages in the lungs, liver and pancreas.

31. **Genomic library:** A collection of bacterial or bacteriophage clones, each clone containing a particular segment of DNA from the source cell.

32. **Genomics:** The science of studying the DNA sequences and properties of entire genomes.

33. **Plasmid:** An extra-chromosomal DNA, usually circular, that replicates independently of the main chromosome, although it may have been derived from it.

34. **Palindromic sequence:** Nucleotide sequence that is identical to its complementary strand when each is read in the same chemical direction-for example GATe. i.e.

5' …. GATe …. 3'

3' …. CTAG …. 5'

35. **Plesmagel:** Thicker cytoplasm just beneath the plasma membrane.

36. **Polymerase chain reaction(PCR):** A process by which DNA polymerase is used to copy a sequence of interest repeatedly making millions of copies of the same DNA.

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37. **Restriction endonuclease:** An enzyme that cleaves a DNA duplex molecule at a particular base sequence usually with in or near a palindromic sequence, also called restriction enzyme.

38. **Transfection:** Introduction of a foreign DNA molecule into a eucaryotic cell. It is usually followed by expression of one or more genes in the newly introduced DNA.

39. **Transgenic organism:** Free living organisms in the environment that have had a foreign gene stably inserted into them. This gene can be passed on to successive generations.

40. **Transposon:** A DNA sequence capable of moving from one site in the DNA sequence to another, apparently random.

41. **Tropomyosin:** Rod-shaped protein spiral about the F-actin core which helps to stiffen it.

42. **Vector: In** cell biology, the DNA of an agent (virus or plasmid) used to transmit genetic material to a cell or organism.

QUESTION FOR PRACTICE

1. Cystic fibrosis patients lack a gene that codes for trans-membrane carrier of the:

(a) sodium ion (b) chloride ion

(c) carbonate ion (d) phosphate ion

2. Dopamine producing cells can be grafted into the brain of man in order to cure:

(a) haemophilia (b) parkinson's disease

(c) epilepsy (d) alzheirnaers disease

3. A botanist, Steward grew a complete carrot plant in 1958 from a tiny piece of:

(a) cortex (b) xylem

(c) phloem (d) pith

4. The coconut milk contains the plant hormone called:

(a) auxin (b) gibberellins

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(c) cytokinin (d) acetic acid

5. The meristem of plant is not subjected to the attack of:

(a) protozoans (b) fungi

(c) viruses (d) bacteria

6. The enzyme produced by an insect commonly called Firefly is:

(a) firase (b) ferase

(c) luciferase (d) luciferase

7. Agricultural plants like potato and soybean have been engineered to improve:

(a) protein only (b) starch only

(c) protein / starch (d) nucleic acids

8. The vernolic acid and ricinolic acid can be used as hardness in:

(a) paints (b) plastic

(c) painta and plastic (d) rubber

9. Plasmid + Foreign Gene = ?

(a) recombinant DNA (b) chimeric DNA

(c) recombinant DNA/Chimeric DNA (d) chromosomal DNA

10. Particle gun method is:

(a) gene + particle (b) DNA + Particle

(c) chromosome + particle (d) A + B

11. Sticky ends are produced in:

(a) probes (b) DNA

(c) both probes and DNA (d) proteins

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12. In genetic engineering the plasmid in which gene is incorporated is:

(a) foreign DNA (b) recombinant DNA

(c) chromosomal DNA (d)recombinant plasmid

13. The natural extra chromosomal circular DNA molecule of a bacterium is a vector called as:

(a) chimaera (b) lambda phage

(c) clone (d) plasmid

14. Which statement is true?

(a) plasmids and viruses act as vector (b) only plasmids act as vector

(c) any chromosome can act as vector (d) any gene act as vector

15. The bacterial cells become more permeable to take up recombinant plasmid if they are treated with.

(a) calcium chloride (b) calcium carbonate

(c) calcium sulphate (d) cesium chloride

6. Kary B. Mullis developed the polymerase chain reaction in:

(a) 1883 (b) 1938

(c) 1838 (d) 1983

17. Enzyme for DNA replication is:

(a) polymerase I (b) polymerase II

(c) polymerase III (d) primase III

18. A collection of bacterial or bacteriophage clones, each clone containing a particular segment of DNA from the source cell:

(a) genomic library (b) RFLP

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(c) plasmids (d) palindromic sequence

19. The science of studying the DNA sequences and properties of entire genomes:

(a) genomics (b) inheritance

(c) genetic (d) molecular genetics

20. Thicker cytoplasm just beneath the plasma membrane:

(a) plasmagel/ectoplasm (b) gel

(c) colloid (d) sol

21. The enzyme luciferase is produced by an insect commonly called as the:

(a) housefly (b) butterfly

(c) firefly (d) both housefly and butterfly

22. Restriction fragment length polymorphism (RFLPs):

(a) are achieved by using restriction enzymes

(b) identify individuals genetically

(c) are the basis for DNA finger prints

(d) all of these

23. Recombinant DNA is introduced into the host cell by means of a:

(a) vector (b) bacterium

(c) fungus (d) phage

24. What is the benefit of using a retrovirus as a vector in gene therapy?

(a) it incorporates the foreign gene into the host chromosome

(b) it is not able to enter cells

(c) it incorporates the foreign gene into the host MRNA

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(d) it incorporates the foreign gene into the host ribosome

25. To prevent blood clotting during Surgery_____ is used.

(a) prothrombin II (b) prothrombin III

(c) antithrombin II (d) antithrombin III

26. Cells from Graafian follicle that surround the ovulated mammalian egg are:

(a) cumulus cells (b) stem cells

(c) embryonic cells (d) any cell

27. Dopamine producing cells can be grafted directly into the brain of man in order to cure:

(a) parkinson's disease (b) parkinson's disease and epilepsy

(c) epilepsy (d) alzheimer's disease

28. The meristem of plant is not subjected to the attack of:

(a) viruses (b) fungi

(c) protozoan's (d) bacteria

29. In cystic fibrosis there is secretion of:

(a) liposome (b) chloride

(c) sodium (d) thick mucus

30. Use of transgenic farm animals to produce pharmacy products is gene:

(a) forming (b) farming

(c) variation (d) pharming

31. The bacterial cells become more permeable to take up recombinant plasmid if they are treated with:

(a) calcium chloride (b) calcium carbonate

(c) calcium sulphate (d) calcium

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32. Gel electrophoresis line up the:

(a) DNA fragments (b) rRNA fragments

(c) mrna fragments (d) tRNA fragments

33. Cell suspension culture of Cinchona ledgeriana produce:

(a) quinine (b) digitoxin

(c) polludrin (d) anti toxin

34. DNA polymerase used in PCR is extracted from the bacterium:

(a) thermus terrestris (b) thermus indicus

(c) thermus aquat icus (d) thermus botani

35. German botanist Gottlieb Haberlandt said in 1902 that plant cells are:

(a) totipotent (b) protoplast receiving

(c) more resistant (d) less resistant

36. Children in the SCID syndrome are treated by:

(a) chemotherapy (b) ex-vivo gene therapy

(c) in-vivo gene therapy (d) antibiotics

37. Dideoxy ribonucleoside triphosphates are used to terminate DNA synthesis different site. Which method involves this procedure?

(a) Maxam-gilberts method (b) Sangars method

(c) K.R Mullis's method (d) Gottlieb' s method

38. It is possible to produced millions of somatic embryos at ones in large tanks called:

(a) biofilter (b) bio tanks

(c) bioreactors (d) bio cylinder

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39. A company, which has now sequenced the entire human genome, was founded by:

(a) K.B. Mullis (b) Gottlieb Haberland

(c) Theodore M. Klein (d) J. Craig Venter

40. One favorite method to accomplish micro propagation is by:

(a) protoplast culture (b) anther culture

(c) cell suspension culture (d) meristem culture

41. The organism that has had a foreign gene inserted in to them is called:

(a) extragenic (b) translated

(c) transgenic (d) transmitted

42. Phenylalanine is an organic chemical needed to a make a dipeptide sweetener known as:

(a) aspartic acid (b) ascorbic acid

(c) aspirin (d) aspartame

43. Sanford and Klein constructed a device called the particle gun that bombards a callus with:

(a) RNA (b) DNA

(c) NAD (d) ATP

44. An enzyme that can be used to treat a human lysosome storage disease is:

(a) β-galactosidase (b) α-galactosidase

(c) glucosidase (d) invertase

45. The DNA of bacterial viruses e.g. A. Phage can also be used as a:

(a) vector (b) probe

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(c) primer (d) none of them

46. The entire human genome was published in:

(a) 1999 (b) 2000

(c) 2001 (d) 2002

47. The familial hyper cholesterolemia is a condition that develops when liver cells lack a receptor for removingfrom the blood:

(a) cholesterol (b) homogenetisic acid

(c) ADA (d) chloride ions

48. The gene of choice can also be synthesized in the laboratory from mRNA using reverse transcriptase. This DNA molecule is called:

(a) complementary DNA (cDNA) (b) replicative DNA

(c) synthetic DNA (d) very small DNA

49. The gene of interest is joined with the sticky ends produced after cutting the plasmid with the help of another special enzyme known as:

(a) DNA ligase (b) DNA polymerase

(c) restriction endonuclease (d) reverse transcriptase

50. The product produced by genetically engineered organisms is called:

(a) genetic products (b) engineered products

(c) biotechnology products (d) all of them

51. There are three billion base pairs in the:

(a) horse genome (b) pig genome

(c) human genome (d) monkey genome

52. If each cell has the full genetic potential of the organism then it is called:

(a) genopotent (b)favorite

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(c) somaclonal (d) totipotent

53. Urine is a preferable vehicle for a biotechnology product than:

(a) milk (b) blood

(c) plasma (d) tissue fluid

54. Vernolic acid is derivative of:

(a) ricinolic acid (b)oleic acid

(c) vernonia (d) castor oil

55. Due to C_4 cycle there is:

(a) more light reaction (b) continuous dark reaction

(c) continuous photosynthesis (d)different means of capturing CO_2

56. Antithrombin III, for preventing blood clots during surgery, is currentlybeingproduced by a herd of:

(a) cats (b) cows

(c) dogs (d) goats

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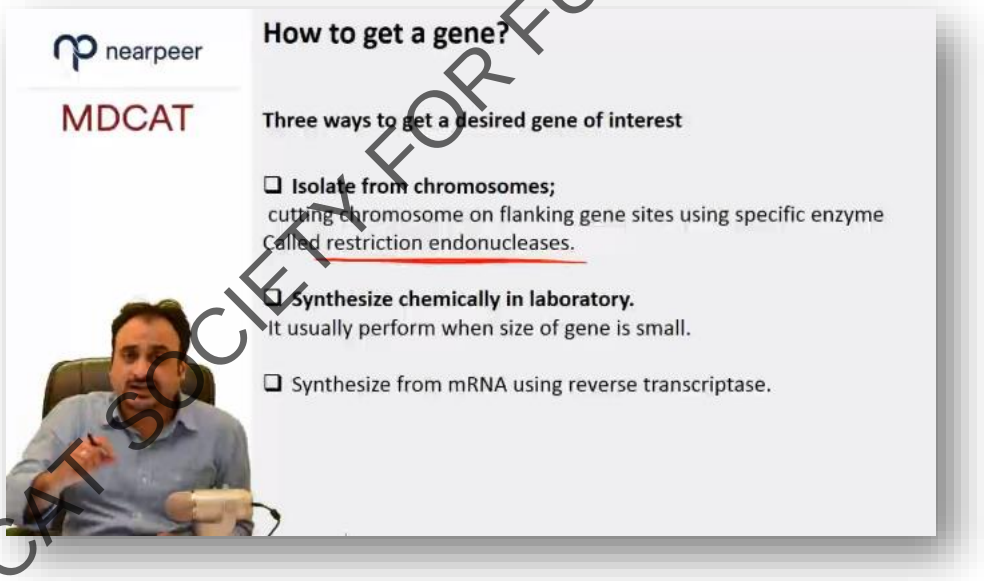
UNIT NO. 7 (BIOTECHNOLOGY)

1	B	2	B	3	C	4	C	5	C	6	D	7	C	8	C	9	C	10	B
11	C	12.	B	13	D	14	A	15	A	16	D	17	C	18	A	19	A	20	A
21	C	22	D	23	A	24	A	25	D	26	A	27	A	28	A	29	D	30	D
31	A	32	A	33	A	34.	C	35	A	36	B	37	B	38	C	39	D	40	D
41	C	42	D	43	B	44	B	45	A	46	C	47	A	48	A	49	A	50	C
51	C	52	D	53	A	54	B	55	D	56.	D								



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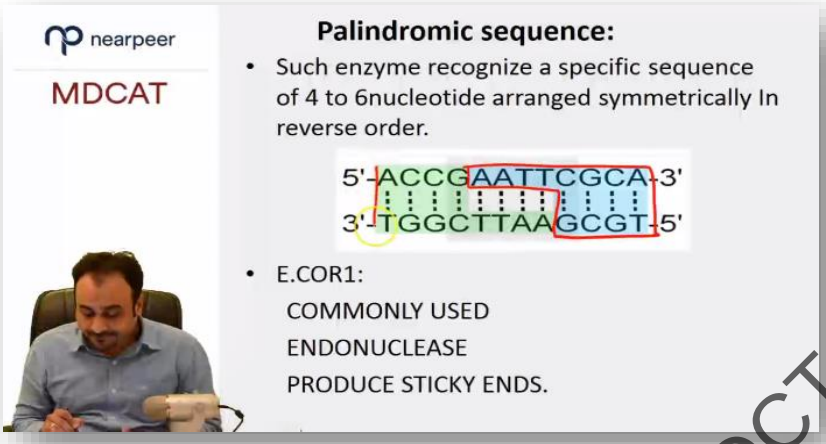

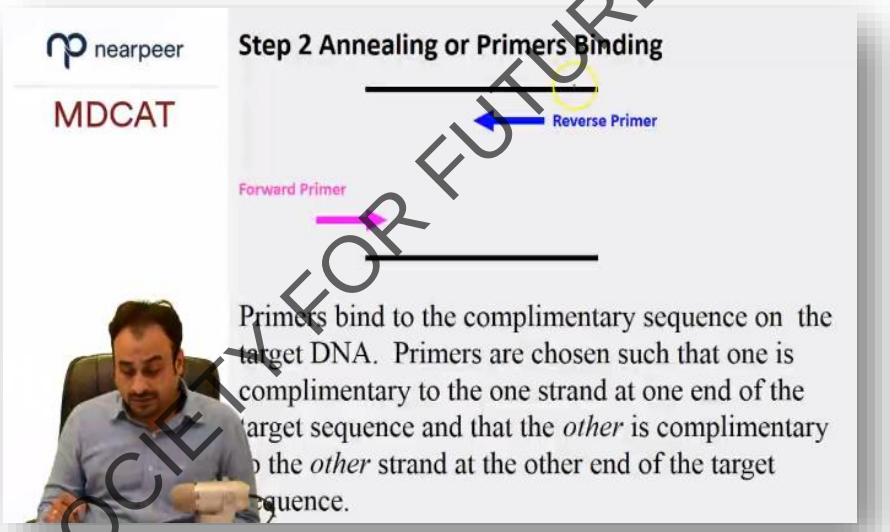

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All of these and many other video lectures of this unit at
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ECOLOGY

MAJOR CONCEPTS

Content

→ Components of Ecosystem Biological succession Energy flow in ecosystem

→ Impacts of human activity on ecosystem Learning Outcomes:

LEARNING OUTCOMES

(a) Abiotic and biotic components of ecosystem

(b) What is succession; give various stages of succession on land?

(c) Explain the following terms:

- Predation, parasitism, symbiosis, mutualism, commensalism, grazing

(d) Describe the flow of energy in an ecosystem

- Food chain
- Food web

(e) What is the significance of human activity on ecosystem as population, deforestation, ozone depletion, atmospheric pollution, greenhouse effect, industrial effluents (insecticides and herbicides).

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COMPONENTS OF ECOLOGY

KEY POINTS

1. The term ecology formed from Greek words oikos, meaning the "family household" and logy, meaning "the study or'. This term originally was formed by the German zoologist Ernst Haeckel in 1866. He called it oecologic.

2. The physical and biological conditions under which an organism lives is called environment.

3. The actual location of place where an organism lives is called its habitat.

4. Niche is the role of a species played in a community (including behaviour and influence).

5. Levels of ecological organization are:

   Species → Population → Community → Ecosystem/Biome → Biosphere

6. The ecosystem is a major unit of ecology.

7. Three levels of integration are studied in the community. These are: Individual, Population and community.

8. Biotic components of ecosystem are: Producers (autotrophic organisms), consumers (heterotrophic organisms) and Decomposers (mainly Fungi and bacteria).

9. A-biotic components of ecosystem includes: Air, atmospheric pressure, water, precipitation, soil, minerals, light, temperature, fire, topography, Gravity.

10. A biological community together with the associated abiotic environment IS called ecosystem.

11. Population is a group of inter-breeding individuals belonging to a particular species and living in a common geographic area.

12. A population can be described in terms of number, growth rate, and age distribution.

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13. The major regional ecological community of plants and animals (+ environment) is called biomes.

14. A thin layer of earth in which all living organism exist is called biosphere. Biosphere is spreading over the surface of planet earth. It extends about 8 – 10 kilometers in the upper reaches of atmosphere and also in same distance into the depths of oceans.

15. The study of relationship of a single population to its environment is called autecology (population ecology).

16. The study of relationship of different communities or group of population to their environment is synecology or community ecology.

17. Earth/Sphere has three main parts: Atmosphere (air), Hydrosphere (water), lithosphere (soil).

18. The main processes occurring in an ecosystem are:

    (i) Feeding

    (ii) the circulation of chemical elements and

    (iii) the energy flows through the ecosystem

19. The senes of steps of eating and being eaten of the organisms is called food chain.

    (Example: Grass (T_1) → caterpillar (T_2) → blue bird (T_3) → eagle (T_4)

20. The combination of many food chains is called food web. Most animals eat more than one type of food at different times. Thus food web is not so simple.

21. Due to food web alternative food source is available. Therefore due to food web the ecosystem remains stable.

22. The chance in the community structure and non-living environment of an ecosystem over a period on time is called succession.

23. Succession is a kind of "community relay".

24. Due to change in community, ecosystem also changes. The successful competitor species become dominant, replace the previous earlier weak species. The process goes on until a stable, self-sustained climax community is reached.

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25. Each succession begins by a few hardy invaders called pioneers.

26. The formation of ecosystem from bare rock, sand or clear glacial pool where previous life do not exist is called primary succession. It often requires thousands of years. If primary succession starts in water it is Hydrosere. If primary succession starts on dry habitat it is xerosere.

27. The formation of a new ecosystem after the disturbance of an existing ecosystem (fire etc.) called secondary succession. Secondary succession is rapid than primary succession.

28. The first stage of xerosere is crustose lichen stage.

    Then Foliage Lichen Stage → Moss stage → Herbaceous (plant) stage → Climax forest stage

29. an animal that preys on other animals is called predator. A predator is a consumer. The animal that is caught and eaten is the prey. The overall process is called presation.

30. The predator-prey relationship helps to maintain the ecosystem stable.

    Note: Food relationship of predator-prey creates a Cycle.

31. Examples or predator/prey are: cat/mouse, fox/ rabbit, seal/fish, frog/mosquito, & hawk/small birds. etc.

32. Parasitism is an association between a host and a parasite, which involves providing the parasite with food, protection and conditions for its survival.

33. The parasite may or may not harm the host.

34. Diseases in living organisms which caused by parasites are called infestations.

35. There re two types of parasites:

    (i) **Ectoparasites**:

    The parasite that live outside the body of the host e.g. fungi causing dandruff in hair.

    (ii) **Endoparasities**:

    Endoparasite lives inside the body of the host e.g., tape worm in intestine of amn.

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36. The association between two organisms in which one or both the organisms get benefit is called symbiosis. There are two types of symbiosis:

    (i) Mutualism is an association in which both the organisms get benefit. Its examples are: Lichens, Root nodules, Mycorrhizae, Relationship between insect and flowering plants

    (ii) The relationship in which only one organism gets benefit from the relationship is called commensalism.

37. The mode of feeding in which animals feed on grasses is called grazing. Animals like rabbits, goat, sheep, cow, buffalo and horses feed on grasses and are called grazers. These animals live in pastureland where they feed on grasses, herbs and shrubs.

38. The grasses are more resistant than herbaceous plants. They have ability to re-grow very fast.

39. The hooves of grazing animals trample the soil. It changes the soil into hard layer. The rain water cannot penetrate into the soil. The water runs off from the upper surface and removes the topsoil with it. Thus over grazing may lead to formation of desert.

40. Moderate grazing is very helpful to maintain grassland ecosystem because it destroys the competitors and helps the grass to grow well.

41. The cyclic movement of nutrients from living to non-living to living portions o: ecosystem is called biogeochemical cycles.

42. The chemical elements essential for life in living organisms are called biogenic elements or nutrient elements. There are two types of nutrient:

    (i) Macronutrients: These nutrients are required by organism in large amount like water, carbon, hydrogen, oxygen, nitrogen, phosphorus, sulphur and calcium.

    (ii) Micronutrients: These nutrients are elements required by organisms in small quantity or in trace amount like zinc, molybdenum, iron, iodine.

43. The process by which limited amount of nitrogen is circulated and re-circulated throughout the world of living organisms is known as the nitrogen cycle.

44. The chief reservoir of nitrogen is the atmosphere (78%). Most living things cannot use this N_2. They are dependent on nitrogen present in soil.

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45. Three principal stages of N cycle are ammonification, nitrification and assimilation.

46. The breakdown of nitrogenous compound like protein, amino acids into ammonia (or ammonium ions (NH_4) with the help of microorganism like fungi and bacteria is called ammonification.

47. Several bacteria in soil oxidize ammonia or ammonium ions in to nitrates. This oxidation is known as nitrification.

48. The absorption and utilization of ammonia or nitrates by the plant is called assimilation.

49. Nitrates are steadily lost from the soil by Soil erosion, fire and water percolation down through the soil. Certain soil bacteria reduce the nitrates. These bacteria breakdown nitrates in the absence of oxygen, they release the nitrogen back into the atmosphere and use the oxygen for their own respiration. This process is known as de-nitrification this process takes place in the poorly drained (poorly aerated) soils.

50. Energy enters into the ecosystem in the form of radiant heat and light from the sun. It flows through different trophic levels (links) of an ecosystem. It radiates again back into outer space.

51. The total amount of energy formed by plants is called gross primary production (GPP/GP).

52. The amount of energy left after plants have met their respiratory needs is net primary production. A plant shows this energy in the form of plant biomass (GP – R= NP).

53. About l % of the total energy from the sun is trapped by the producers. The remaining 99 of the solar energy is used to evaporate water, heat up soil and then lost to the outer space. 80 to 90 of the original energy are lost when energy is transferred from one trophic level to the next from producer to primary consumer.

54. A pyramid of energy can be constructed showing energy transfer in a community of organisms.

55. Decomposers obtain energy by converting plant and animal tissues and waste into inorganic mineral ions.

Note: A short food chain of two or three trophic levels supports a community more efficiently than long chain of five trophic levels because much of the original energy from the producers never reaches up to higher trophic levels.

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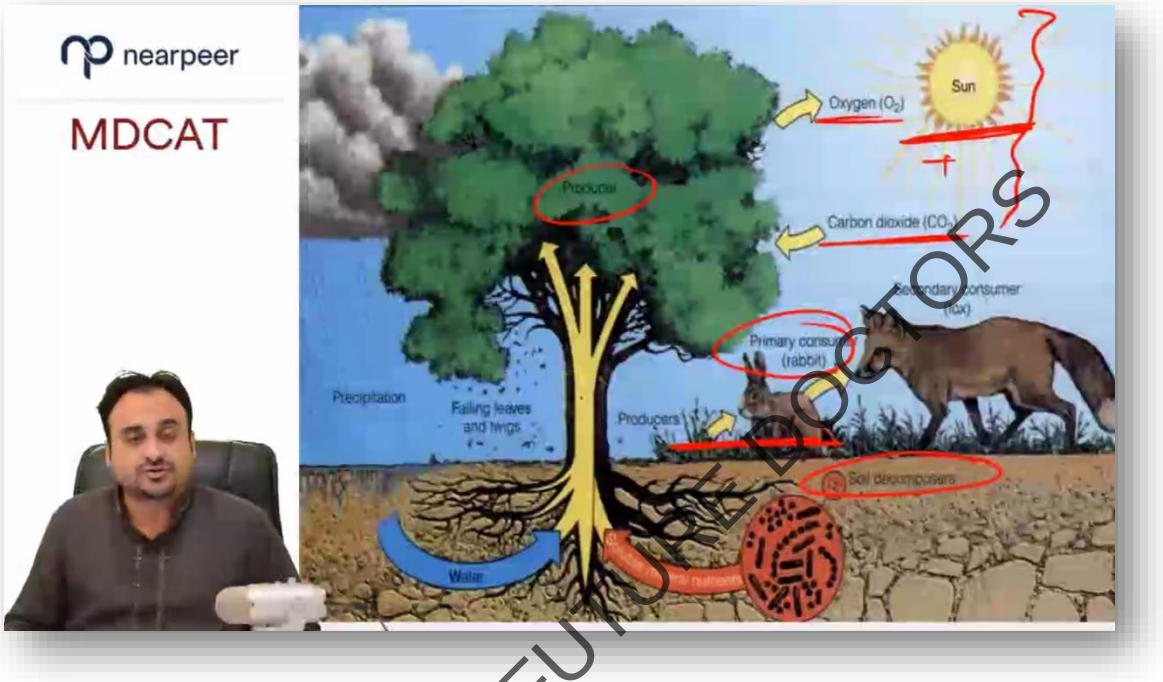

MAN AND HIS ENVIRONMENT

1. The first humans we're hunters (natural predators and herbivores).

2. With the start of agriculture (10000 years ago) human populations and conversion of land to agricultural production began to increase.

3. Environment is a treasure of all types of resources essential to maintain life on earth.

   Environment is a direct or indirect source for food, shelter, clothing, fuel etc. for humans.

4. Air, water, food, land, forests and wild life are renewable resources because they are never depleted. They are recycled in the nature.

5. Non-renewable resources include various metals, non-metallic minerals and fossil fuels (coil. oil and natural gas). These resources are exhaustible and once consumed cannot be replaced.

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6. The balance in the nutrient cycle can be upset when:

   (i) Not enough food is produced

   (ii) Too much is consumed

   (iii) Decayed nutrients arc not returned to the ground

7. Air is several kilometers thick layer of atmosphere surrounding the earth. Air consists of nitrogen (79), oxygen (20), carbon dioxide (0.03) and traces of inert gases called noble gases.

8. Air pollution is due to industrialization and automobiles. Polluted air contains certain gases; like carbon monoxide, hydrocarbons and oxides of nitrogen and sulphur. Greenhouse effects and acid rains are global effects of the air pollution.

9. 75 % of the earth surface is covered with water. It is also a component of soil and air. It is also a major component of living organisms, comprising 65 - 89 of their body weight. About 97 of the total water of planet earth are in ocean. 2 water is in the form of frozen ice - caps and only 1 % as available fresh water in lakes, streams and rivers Main use of water is:

   (i) domestic/ industrial use 10 %

   (ii) irrigation 90 %

10. Soil can be defined as "the upper layer of earth's crust." The basic, constituents of soil are soil particles, soil water, soil and inorganic matter and soil organisms.

11. Only 30 % of earth is land, 11 % of the total area of the world is under cultivation.

12. Wild life refers to all non-cultivated plants and non-domesticated animals.

13. Organisms living in the unfavorable conditions and are not reproducing normally are called threatened species.

14. Organisms that are at the verge of extinction are endangered species.

15. Wild life is Renewable (if reproducing)/non-renewable (if not reproducing) resource.

16. Energy resources are inexhaustible and exhaustible. Inexhaustible resource includes solar energy, falling water (hydropower), wind, ocean thermal gradients, waves, tides,

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currents, geothermal and biomass. Exhaustible sources of energy are fossil fuels like coal, oil and natural gas etc.

17. 95 % of our daily energy requirements are met from Coal, oil and gas.

18. The kinetic energy of falling water is used to turn turbines fixed at the base of dams. The turning turbines drive generator to produce electricity, which is known as hydroelectric power or electricity (cheapest and non-pollutant source of energy)

19. Tides are mainly caused by the gravitational pull of the moon and to a lesser extent by the gravitational pull of sun on the water in sea and oceans. The difference in height of the water at high and low tides is made use of in a tidal power station to generate electricity A tidal power station consists of a long barrier called a tidal barrage.

20. Wind is moving air. Wind blows from area of high pressure to area of lower pressure. All the windmills stop working when the wind stops blowing, for windmill to work, efficiently, they have to be built in large number at different location with strong erne steady winds, for continuous supply of electric / mechanical energy.

21. Nuclear energy is obtained from nuclear fuels by nuclear fission in a nuclear reactor. Large amount of heat generated is used to convert water into steam, which drives steam turbines for generating electricity. Nuclear power station does not produce waste gases. Each nuclear power station only can last for about 30 years.

22. Volcanoes, hot springs and geysers allow the escape of hot substance from the inside of the earth. The natural heat energy trapped underground is called geothermal energy.

23. Conversion of waste materials like trash, paper, organic manure, plastic materials, cans, agriculture and industrial waste etc. by hydrogenation, pyrolysis (destructive distillation) or bioconversion can provide oil and gas. However it can be the source of pollution.

24. In oceans, especially in tropical regions, temperature of surface water is about 25° C and that at the depth of few hundred meters only 5° C. This develops an ocean thermal gradient and heat is conducted from region of higher to lower temperature. Man has developed the technology to use this thermal gradient to drive a turbine for electricity generation.

25. Only 30 of the earth is dry land the remainder being covered with water

26. Modern man is called Homo sapiens and has been on this earth for about 40,000 years.

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27. Early man was primary consumer feeding on roots and fruits. Later became secondary consumer and predator in hunting and killing his prey.

28. Human culture commenced over 5000 years ago leading to the development of industry, technology and modern medicine in the last 200 years.

29. Demography is the study of human populations and things that affects them.

30. The population of Pakistan was 32.5 million at the time of independence in 1947. It has now increased to around 150 – 160 million people in year 2000. About 20 years ago the human population was increasing at the rate of 2 a year and was doubling every 35 years.

31. More people, more agriculture and more industrialization is stressing the environment.

32. "Clearance of vast areas of forest for lumber, planting subsistence crops or grazing cattle is called as deforestation". OR The destruction of forests leaves the soil barren and this is called deforestation.

33. Deforestation can be replaced with reforestation i.e. trees may be replanted.

34. A forestation is establishment of new forests where no forests existed previously.

35. Forest is an environmental buffer.

36. The disastrous flood in India. Bangladesh in recent years may be attributed to deforestation.

37. About half of the rain which falls in tropical forests comes from the transpiration of the trees themselves

38. A characteristic feature of tropical forests is the vast diversity of species they contain. Biodiversity is the total number of different species with in an ecosystem and resulting complexity of interactions among them.

39. Anything produced by humans that is or may be harmful to human life and other living organisms is called environmental pollution.

40. Some main types of pollution are:

    (i) Air pollution or atmospheric pollution

    (ii) Water pollution

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(iii) Soil pollution

(iv) Radiation pollution

(v) Noise pollution

41. Anything in the air that may be harmful to living - organisms is air pollution.

42. Harmful substance such as sulphur dioxide, carbon monoxide and oxide of nitrogen, lead compounds and chlorofluorocarbons are the sources of air pollution. These harmful substances are known as pollutants.

43. Due to air pollution we are facing the ozone layer depletion.

44. A layer of atmosphere extending from 10 – 50 kilometers above earth which filters most of UV radiation (ultraviolet rays) and protects us from the-e harmful rays of the sun is known as ozone.

45. In pure form ozone is bluish explosive and highly poisonous gas. Ozone (O_3) molecule is made up of three oxygen atoms bounded together.

46. The decline in thickness of the ozone layer is caused by increasing level of chlorofluorocarbon (CFC_s)which contains chlorine, fluorine and carbon.

47. As CFC, rise to the atmosphere, ultraviolet rays causes chlorine to release. The chlorine released destroys the ozone molecule in ozone layer.

48. A single chlorine atom can react with ultraviolet rays and destroy as many as one million ozone molecules.

49. As the ozone layer becomes thinner more ultraviolet rays from the sun are able to reach earth.

50. The level of ozone in ozone layer over the Antarctica has fallen drastically and has leads to a hole. The ozone layer has also been found to decrease over Arctic regions.

51. If more ultraviolet rays reach the earth's surface they will affect all life on earth by increasing temperature, increase in skin cancers and cataracts in human. It can also affect crops, plants, trees and even marine plankton and distort weather patterns.

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52. **Green House Effect:**

Light rays from the sun penetrate the glass of the green house and are absorbed by the plants and soil and are then reradiate as longer wave infra - red radiation (heat). The glass does not permit these rays to escape outside and so the heat remains within the green house. The carbon dioxide of the atmosphere behave like glass sheet of green house, absorb the sun energy but do not allow it to escape outside as a result of which the temperature of the atmosphere increases. This increase in temperature is known as "green-house effect".

53. Over urbanization, deforestation, industrialization are the causes of green-house effect.

TABLE: Air Pollutants

Air Pollutant	Sources	Harmful Effects
Chlorofluro carbon CFC_5	Aerosol sprays, foams, air-conditioning system and refrigerants	Thinning of ozone layerglobal warming due togreen-houseeffect
Sulphur dioxide	Power station and fossil fuel	Acid ram, breathing-I disorders, lung cancer
Lead compound	Combustion of leaded petrol or oil	Lead poisoning brain damage, forest decline
Oxides of Nitrogen	Burning of fossil fuels.	Global warming, brain damage, green-house effect, acid rain, headaches, cough
Carbon monoxide	Incomplete burning of carbonate and carbon compound. Cigarette smoke.	Headache, brain damage, death

54. **Acid rain:**

Sulphur dioxide and nitrogen dioxide emitted in the air during the burning of fossil fuels, combined with water vapours in the atmosphere forming acids. Days later and often hundreds or thousands kilometers away from the source, the acid falls either dissolved in rain or as microscopic dry particles called acid rain. This is also due to the overloading of nitrogen and sulfur cycle.

55. Stone monuments like "Taj Mahal' are being eroded due to "stone cancer" by acid rain

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56. Some detergents contain a lot of phosphate. This is not removed by sewage treatment and is discharged into rivers. The large amount of phosphate encourages growth of microscopic plant called eutrophication.

57. **Eutrophication or Algal Bloom:**

The natural process of excessive enrichment of water with nutrients by which large amount of living organic material grows in the water. Due to human activities this natural process is speeded up (by adding phosphates. excreta etc). Lakes slowly develop aquatic plant life which eventually decays. The dead algae are decomposed by aerobic bacteria which deplete the water oxygen content causing death of aquatic animals through oxygen lack. It occurs in fresh water and in seawater both developing unpleasant color and smell.

58. The chemical waste from industry is called effluents. They either kill the microorganisms that pollute the water and inhibit the growth of microorganism.

59. Insecticides + Fungicides + Herbicides = Pesticides.

A pesticide is a chemical which destroys agricultural pests or competitors.

60. Population of only one species (e.g. wheat) is called Monoculture.

61. The steady internal state of homeostasis is known as **normal health.** Disease is the departure from normal or steady internal state of homeostasis through structural or functional disorders of the body.

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CLASSIFICATION AND CAUSES OF DISEASES

The main types and causes of diseases in human are given in this table:

No.	Causes of Disease	Names of Diseases/Classification
1.	Genetic or heritable or congenital diseases	Hemophilia, Down' s syndrome Turner' s syndromes
2.	Infections or Pathogenic or Parasitic	Diseases due to the organism that can be transmitted to others, diphtheria, malaria, small pox, tuberculosis, Cholera, Gonorrhoea: AIDS
3.	Nutrition deficiency	Scurvy.· Beriberi, Anemia, Goiter, Kwashiorkor

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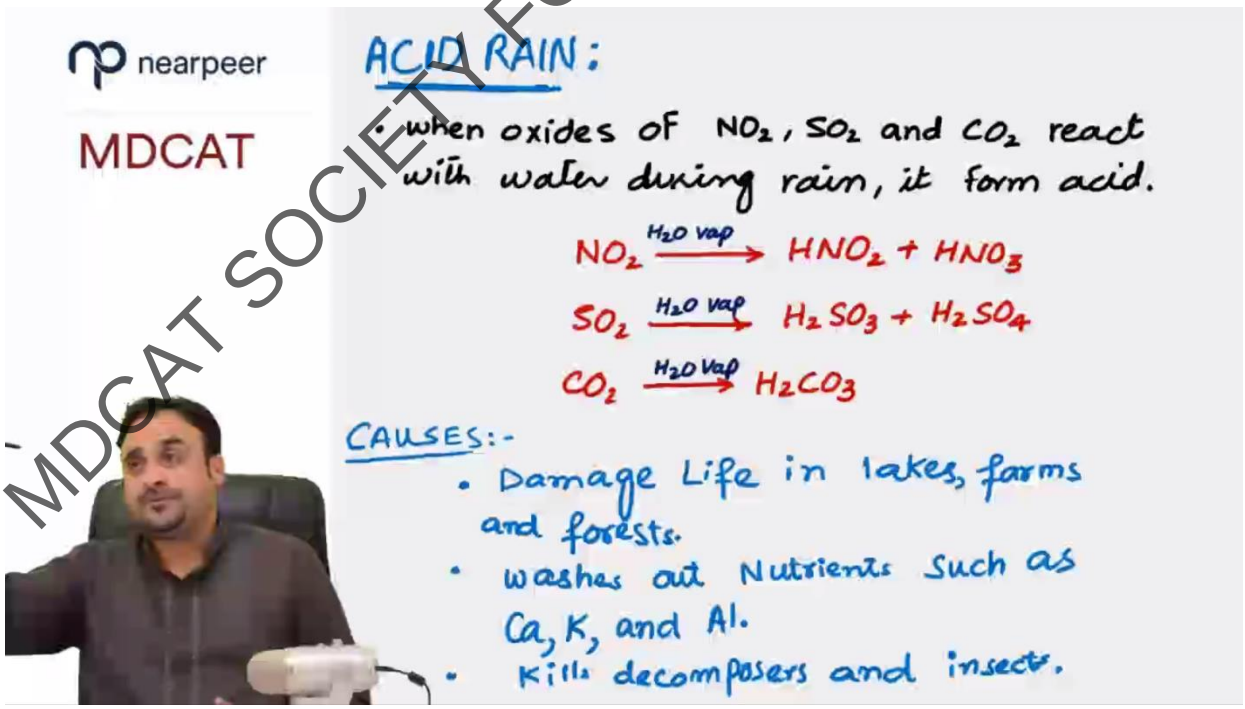
4.	Metabolic or hormonal disorders	Sugar (diabetes mellitus), cretinism and goiter
5.	Physical disorder	Due to injury and accident, heat, cold and radiation
6.	Chemical causes	Drug abuse, smoking, alcohol, poisoning
7.	Ageing or degenerative diseases	Osteoarthritis, artery wall hardening
8.	Metal illness	Damage of memory

62. **Ecological Pyramid:**

Pictorial graph representing biomass, organism number or energy content of each trophic level in a food web from the producer to the final consume: populations.

Visit **Unit 8 of BIO at www.nearpeer.org** for video lectures and practice questions with solutions.



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ADDITIONAL / RELATED READINGS

1. Life on earth, especially on land is affected by both weather and climate.
2. Weather is short-term fluctuations in temperature, humidity, cloud cover, wind and precipitation over periods of hours or days.
3. Climate is overall pattern of weather from year to year or century-to-century in a particular Region.
4. Salt-water ocean and sea are the largest ecosystems on the earth about 71 % of its surface. Fresh water ecosystem covers less than 1 %.
5. Water changes its temperature slower than air so temperature in aquatic eco-system is more moderate.
6. In clearest water the intensity of light decreases rapidly with depth, so at the depth of 600 feet or more, a little light is left to power photosynthesis.
7. The photosynthetic phytoplankton is the producers on which most other life ultimately depends.
8. The major factor that determines the quantity and type of life in aquatic ecosystems are energy and nutrient.
9. The productivity can be indicated by consumption of CO_2 and evolution of oxygen in the process of photosynthesis.
10. The productivity of aquatic ecosystem basically determined by the light and nutrients.
11. Light intensity and quality varies with the water depth, so the primary productivity also very with light.
12. The distribution of life in lakes depends on access to light to nutrients and to place for attachment.
13. Three zones of lakes: Littoral zone; Limnetic zone; Profundal zone.
14. Littoral Zone (Near-Shore): In this zone the water is shallow, and plants find abundant, light, anchorage and adequate nutrients from the bottom sediments.

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15. Plankton is also present in Littoral zone. Plankton can be divided into two groups:

    Phytoplankton: (Greek "drifting plants") they are including photosynthetic Protista, bacteria and algae.

    Zooplankton: (Greek "drifting animals") such as protozoa and tiny crustaceans.

16. The open water area is divided into two regions The. upper limnetic zone. The lower profundal zone.

17. Limnetic Zone: Enough light penetrates to support photosynthesis. Here phytoplankton including cyanobacteria (blue green algae) serves as producers.

18. Profundal Zone: Where light is insufficient to support photosynthesis. These are mainly nourished by detritus that falls from the littoral and limnetic zone and incoming sediment. Decomposers and detritus feeders such as snails and certain insect larva, bacteria, fungi and fishes inhabit it.

19. Eutrophication: The process by which a body of water becomes rich in dissolved nutrients from fertilizers or sewage thereby encouraging the growth and decomposition of oxygen-depleting plant life and resulting in harm to other organisms.

20. The ecosystem present on land or soil is called terrestrial or lithospheric ecosystem.

21. Both plants and animals have evolved supporting tissues like vascular bundles root (xylem-phloem) in plants and skeleton in animals to support them on land against the force of gravity.

22. Plants and animals evolved various methods to conserve water in their body e.g.

    Homeostasis: The mechanism of temperature regulation was developed by land plants and animals by developing bark and skin respectively.

23. Tundra and coniferous forest always occur in the Northern most parts of the Northern Hemisphere, while the deserts of Mexico, the Sahara, Saudi Arabia, South Africa and Australia are located around 20° to 30° North and South latitude.

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TEMPERATE DECIDUOUS FORESTS

24. In Pakistan temperate moist conditions are present in Neelam valley and Shogran. These forests originally covered India, southeast Asia, eastern North America, Europe, China Australia, Japan, North and South America.

25. During dry season, the trees cannot get enough water from the soil. So the plants shed the leaves to minimize the water loss. If the rains fail to return on schedule the trees delay forming new leaves until the drought passes.

26. The average rainfall is between 750 - 1500 mm / year.

27. Moderate temperature ranges from 4 C - 30 C.

28. Some dominant plants are Taxus, Pinus Wallichiana. Berberis lyceum. Manxherbs and shrubs, grasses, ferns and lichens are present.

29. Animals are Macaca mulatto, (rehesus) solenororots tibitanus (black bear). Felis bengalensis (leopard cat) deer and wolves

30. The soil of temperate deciduous forest is grayish brown in colour, very fertile and rich in organic matter, with maximum water holding capacity.

CONIFEROUS ALPINE AND BOREAL FORESTS

31. In Pakistan these forest are in upper Kaghan, Dir and Chilas, Malam Jaba in Swat valley In world they are in Eurasia (Europe + Asia) and North America. Canada. Northern, coniferous forests are also called Taiga. Conditions in taiga are harsher than those in the temperate deciduous forest.

32. Temperatures of coniferous forests may "be below freezing point up to 10 C.

33. The few months of warm weather are too short to allow trees the luxurious growth of re-growing. The result is evergreen coniferous trees.

34. In coniferous forests the waxy coating and small surface area of the needles reducewater loss by evaporation during cold months and leaves remain on the trees year around.

35. Coniferous forests located at high altitude are called alpine while coniferousforest located at high latitude is called boreal.

36. The small needles and pyramidal shape of conifers allows them to shed hem y snows.

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37. Because of harsh climate of coniferous forests the diversity of life is muchlow.

38. Plants like Pinus such as Pinus wallichiana, Pinus Roxburgii, Abies Pindrow, Picea smithiana Cederous deodara are present.

39. Large mammals, bison, wolf, black bear, deer, Marco polo sheep and smaller animals such as small Kashmir flying squirrel, snowshoe hare, wolverine and crossbills are present.

40. Due to severity of climate and remoteness most of the coniferous forests remains undisturbed, but these forests are major source of lumber for construction so forest have been cleared in the world.

GRASSLAND ECOSYSTEM

41. Grassland ecosystem is found in Gilgit, Kashmir, Waziristan, lower Chitral and north Kallat. In world you can see large grassland in the center of Eurasian continents.

42. Grassland present in temperate climates is also called Prairies such as Prairies of North America, pampas of Argentina. These grasslands do not have wood-plants so the; are known as prairies. But the grassland in tropic climates has woody trees and are called Savanna.

43. Annual rainfall is about 250 to 750 mm (l0 - 30 inches). In tropical and subtropical grassland, reaches about 1500 mm (60 inches).

44. Grassland occurs in regions where mean annual rainfall is midway between forest and a desert.

45. In the grassland there is a continuous cover of grass and almost no trees at all except along the rivers. Water and fire are the important factors in the competition between grasses and trees.

46. The dominant species are graminoids i.e. grasses and grasses like plants certain forbs" such as composites, legumes and many other herbaceous plant species are also associated with grasses.

47. Layering is the characteristic of grassland. Tall grasses (Andropogon, Panicum) form the first layer, mid high grasses (Stipa, Sporobolus, Oryzopsis) form the second layer and

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third layer is formed by short grasses and forbs and warfare species (Poa, Bromus) with mosses and lichens.

48. The soil moisture is limited due to low precipitation and high evaporation. Upper sc. layer in which grasses are rooted are normally moist but deeper layer are constantly dry. The soil of grassland is basically impermeable with excessive salinity.

49. Dominant species are herbivores: invertebrates including insects especially grasshopper is very numerous. The predators ere reptiles, amphibians and mammals, such as Lizards, toads and turtles prey on insects.

50. In temperate grassland the rate of primary production is about 700 - 1500 g/m^2 annually. In sub humid tropical grassland it is more than 4000 g/m^2.

51. In annual grassland. large grazing animals consume relatively small amount (5 – 10 %) the total herbage produced. Invertebrates, rodents and birds may consume equal amount or a little more.

52. The natural grasslands in world are used for crop production and livestock management.

53. Only a small fraction of world's grassland has been in cultivation due to acid climatic condition with soil erosion and salinity.

54. Grazing has prominent effects on grassland, over-grazing causes reduction in herbage cover and result is soil erosion. Many lands are converted into desert by process called desertification due to over grazing.

DESERT ECOSYSTEM

55. In Pakistan desert ecosystems include: Thur, Thai and Cholistan.

56. Desert biomes are found on every continent often around 20 to 30 North and south latitude and also in the rain shadows of major mountain ranges.

57. In desert ecosystem rain fall is less than 25 to 50 cm (10 - 20 inches) per year or not at all.

58. The plants are often spaced evenly as if planted by hand. The perennial plants are bushes or cacti with large shallow root systems.

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59. Plants are covered with the waterproof waxy coating to prevent evaporation of water is stored in thick stem of cacti and other succulents. Desert plants conserve water in a variety of ways. Cacti and Euphorbia have fleshy stems in which water is stored for use during the period of drought.

60. Animals can live in -short supply of water. Animals are hidden during the day but come out at night. The homed lizards, snakes and other reptiles emerge to feed, as do mammals such as kangaroo rat, and birds such as burrowing owl.

61. Most of the smaller animals survive without drinking and get water from respiration.

62. Large animals such as desert bighorn sheep and camel are dependent on permanent water holes during the driest times of the year.

63. Human activities are reducing many Biomes but spreading the deserts (a process called desertification).

TUNDRA ECOSYSTEM

64. The last biome before reaching the polar ice-caps is the arctic tundra. It is a vast treeless region near the Arctic Ocean. It is vegetation in treeless high latitudes between taiga and polar ice caps and at high altitude across the mountain above timberline such as mountain of Karakoram and Koh Hindu Kash in Pakistan.

65. Arctic tundra is in Northern North America, Northern Europe and Siberia (with high latitude).

66. The ground is covered with small perennial flowers and dwarf willow no more them a few centimeters tall and large lichen called reindeer moss. The standing pools provide mosquito habitat. The mosquitoes and other insects provide food for birds (ducks and geese) most of which migrate a long distance to nest and raise their young during the brief summer food.

67. The tundra vegetation supports lemmings, which are eaten by wolves, snowy owls arctic foxes and even grizzly bears.

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68. The tundra is perhaps the most fragile of all the biomes because of its short growing season. A willow 10 centimeter (4 inches) high may have a trunk 7 centimeter (3 inches) in diameter and be 50 years old.

Human activities in the tundra leave scars that persist for centuries.

QUESTIONS FOR PRACTICE

1. Main Nitrogen reservoir in the Biosphere:

(a) atmosphere (b) ocean

(c) rock (d) organisms

2. Which Kingdom has species that Fix Nitrogen?

(a) monera (b) protista

(c) fungi (d) plantae

3. Which convert Ammonium or Nitrate into amino acids?

(a) primary consumer (b) secondary consumer

(c) scavengers (d) producers

4. Which Kingdom has species that convert ammonia to Nitrite and Nitrite to Nitrate?

(a) monera (b) protista

(c) fungi (d) plantae

5. Producers in Profundal zone are:

(a) typha (b) sagittaria

(c) hydrilla (d) none of these

6. Energy and Nutrients enter a community by the help of:

(a) producers (b) consumers

(c) decomposers (d) scavengers

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7. The area near arctic zone is:

(a) tundra (b) deciduous forest

(c) coniferous boreal forests (d) tropical rain forest

8. A consumer whose c atoms have already passed through three species is:

(a) producers (b) primary consumers

(c) tertiary consumers (d) secondary consumers

9. Interconnected food chain is:

(a) food web (b) nutrient cycle

(c) energy pyramid (d) food chain

10. Most food chains have:

(a) 1 - 2 species (b) 3 - 4 species

(c) 9 - 10 species (d) 14 - 16 species

11. G. P -R = ?

(a) N. P (c) photosynthesis

(b) respiration (d) nitrobacter

12. Bacteria in roots for nitrogen fixation are:

(a) azotobacter (b) clostridium

(c) pseudomonas (d) rhizobium

13. The geographical limits within which a population exists:

(a) range (b) habitat

(c) niche (d) community

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14. 10 % of net plant production appears as net:

(a) carnivore production (b) herbivore production

(c) omnivore production (d) biomass

15. The rate of production of new bio mass per unit time is:

(a) standing crop (b) assimilation

(c) productivity (d) gross production

16. Demography is study of:

(a) population (b) graph

(c) frequency (d) community

17. Wild life refers to:

(a) non-cultivated plants

(b) non-domesticated animals

(c) both non-cultivated plants and non-domesticated animals

(d) cultivated crops

18. In an ecosystem, the function of producers is to:

(a) convert organic compounds into inorganic

(b) convert inorganic compounds into organic

(c) convert solar energy into radiant energy

(d) convert simple organic compounds into complex organic

19. Biosphere consists of:

(a) hydrosphere (b) lithosphere

(c) atmosphere (d) all of these

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20. Splitting of the nucleus of radioactive atom releases tremendous amount of energy called:

(a) nuclear energy (b) chemical flow

(c) kinetic energy (d) mechanical energy

21. Is the primary nuclear fuel used in the present day reactors?

(a) strontium (b) plutonium

(c) uranium (d) molybdenum

22. Nuclear energy is virtually _____ source of energy.

(a) exhaustible (b) inexhaustible

(c) consumable (d) finishing

23. Cancer of skin, bone marrow, lungs as well as leukaemia is some of the long ten consequences of exposure to:

(a) radiation (b) β-rays

(c) γ-rays (d) UV light

24. Hydro-electric power is produced more economically in _____ regions of country where rivers make natural falls.

(a) desert (b) plain

(c) mountainous (d) coastal

25. Is an infinite and inexhaustible source of energy which will be available or billions of years?

(a) earth (b) mars

(c) moon (d) sun

26. The flow of energy on earth's surface is:

(a) solar to producers to consumers to decomposers

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(b) solar to consumers to producers to decomposers

(c) solar to producers to decomposers to consumers

(d) solar to decomposers to producers to consumers

27. The energy produced due to natural radioactive decay in earth's core is:

(a) electrical energy (b) hydrothermal energy

(c) geothermal energy (d) solar energy

28. Solid wastes can be converted into gas or oil by the use of any of the three scientific processes i.e., hydrogenation, pyrolysis or:

(a) dehydrogenation (b) bioconversion

(c) bio-fowling (d) oxygenation

29. In tropical regions, temperature of surface water of oceans is about:

(a) 20° C (b) 25° C

(c) 30° C (d) 35° C

30. Tidal power can be used for large scale _____ generation.

(a) water (b) fish

(c) electricity (d) water and electricity

31. The relative amount of energy in an ecosystem is represented by:

(a) ecological pyramids (b) food chain

(c) food web (d) biomass

32. Stratification is the characteristic feature of:

(a) temperate deciduous forest (b) coniferous alpine forest

(c) grassland ecosystem (d) desert ecosystem

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33. Layering and stratification in an ecosystem differs in the respect of haying generally:

(a) plants of variable lengths of the same family

(b) plants of variable lengths belonging to different families/groups

(c) a complex of variable plants and animals

(d) animals of different sizes and ages

34. Dominant animal species in grassland ecosystem are:

(a) herbivores (b) carnivores

(c) omnivores (d) detritivores

35. The most dominant competitor among herbivores in grassland ecosystem is:

(a) mosquito (b) grasshopper

(c) aphid (d) drosophila

36. In sub humid tropical grassland the annual productivity is more than:

(a) 700 g/m^2 (b) 1500 gm/m^2

(c) 4000 g/m^2 (d) 6000 g/m^2

37. The total herbage consumed by herbivores in grassland is about:

(a) 5 – 10 % (b) 10 – 20 %

(c) 15 – 25 % (d) 20 – 30 %

38. The dominant insects in the pools of tundra are:

(a) grasshoppers (b) drosophila

(c) mosquitoes (d) aphids

39. The most fragile of all the biomes is:

(a) desert ecosystem (b) grassland ecosystem

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(c) coniferous alpine ecosystem (d) tundra ecosystem

40. The most probable reason for any ecosystem to be more fragile is:

(a) low temperature (b) high temperature

(c) less availability of food (d) short growing season

41. Two main causes of air pollution are industrialization and:

(a) urbanization (b) deforestation

(c) overgrazing (d) automobiles

42. Life on earth, especially on land is affected by:

(a) weather (b) climate

(c) light (d) both weather and climate

43. Monoculture is:

(a) population of one species (b) one organism

(c) culture in a lab (d) culture by one scientist

44. Area of world under cultivation:

(a) 75 % (b) 30 %

(c) 11 % (d) 70 – 90 %

45. Which disease is due to nutritional deficiency?

(a) scurvy (b) hemophilia

(c) gonorrhea (d) diabetes

46. Which is present in the northernmost parts of the northern hemisphere?

(a) tundra (b) coniferous forest

(c) tropical rain forest (d) both tundra and coniferous forest

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47. Major factors that determine the quantity and type of life are:

(a) light + nutrient (b) energy + nutrient

(c) temperature (d) temperature + energy + water

48. Temperature stratification is present in:

(a) tropical area (b) fresh water lakes

(c) atmosphere (d) soil

49. Which soil has excessive salinity?

(a) grassland (b) desert

(c) coniferous forests (d) both desert and coniferous forests

50. Bacterium associated with denitrification in the soil is:

(a) rhodospirillum (b) pseudomonas

(c) azotobacter (d) nitosomonas

51. Desert plants have:

(a) thick cuticle (b) shallow root system

(c) water conservation (d) all of these

52. Moderate grazing is helpful to maintain:

(a) producers (b) ecosystem

(c) grassland ecosystem (d) grazing animals

53. Insects, rodents and ruminants are _____ of terrestrial habitats.

(a) primary consumer (b) secondary consumer

(c) scavengers (d) producers

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54. Largest ecosystem is:

(a) salt water ocean ecosystem (b) forest ecosystem

(c) desert ecosystem (d) grassland ecosystem

55. Pastureland has:

(a) grasses (b) herbs

(c) shrubs (d) all of these

56. Bacteria converting ammonia to nitrites are:

(a) clostridium (b) nitrosomonas

(c) rhizobium (d) nitrobacter

57. The whole of the world's land is called as:

(a) biosphere (b) ecosphere

(c) nitro sphere (d) hydrosphere

58. Temperature is more moderate to support life in:

(a) grassland ecosystem (b) desert ecosystem

(c) tundra ecosystem (d) hydrospheric ecosystem

59. Rooted plants are found in the lake in:

(a) littoral zone (b) limnetic zone

(c) profundal zone (d) benthic zone

60. Maximum water holding capacity is found in the soil of:

(a) temperate deciduous forest (b) coniferous alpine and boreal forest

(c) the grassland ecosystem (d) desert ecosystem

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UNIT NO. 8 (ECOLOGY)

1	A	**2**	A	**3**	D	**4**	A	**5**	D	**6**	**C**	7	A	8	C	9	A	10	B
11	A	**12.**	D	**13**	A	**14**	B	**15**	C	**16**	**A**	17	C	18	B	19	D	20	A
21	C	**22**	B	**23**	D	**24**	C	**25**	D	**26**	**A**	27	C	28	B	29	B	30	C
31	A	**32**	C	**33**	B	**34.**	A	**35**	B	**36**	**C**	37	A	38	C	39	D	40	D
41	D	**42**	D	**43**	A	**44**	C	**45**	A	**46**	**D**	47	B	48	B	49	A	50	B
51	D	**52**	B	**53**	A	**54**	A	**55**	D	**56.**	**C**	57	C	58	D	59	A	60	A

MDCAT SOCIETY FOR FUTURE DOCTORS

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FULL LENGTH PRACTICE EXAMS

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FULL LENGTH PRACTICE EXAMS NO. 1

1. Which one of the following constitutes the best reason for distinguishing the living from the non-living?
   (a) Irritability (b) reproduction and locomotion
   (c) respiration and excretion (d) growth and locomotion
2. Rate of growth of stem is measured by:
   (a) hydrometer (b) photometer
   (c) osmometer (d) auxanometer
3. Characteristic features of the living being are:
   (a) irritability (b) metabolic activity
   (c) respiration and reproduction (d) all of these
4. Botanists believe that the first plants, which originated on the earth, were:
   (a) algae and fungi (b) mosses
   (c) pine and cycads (d) mosses and their relatives
5. Ultimate source of energy in an ecosystem is:
   (a) food (b) ATP
   (c) sunlight (d) glucose
6. There is interdependence amongst living beings, because:
   (a) they were created to live in this fashion
   (b) it is a biological miracle
   (c) it has no significance from the viewpoint of evolution
   (d) it is a result of adjustments in the long history of biological evolution
7. Animals are like plants in that:
   (a) they respire during night only
   (b) they respire when required
   (c) they respire during day and night
   (d) they respire during day only
8. Animals differ from plants mainly in:
   (a) structure (b) vital activity
   (c) nutrition (d) reproduction
9. The fundamental substance of all living beings is:
   (a) cell (b) nucleus
   (c) tissue (d) protoplasm
10. What is the most important property of water for which it is needed in the body?
    (a) it is in a liquid form
    (b) it is tasteless, colourless and odourless solvent
    (c it is a universal solvent
    (d) it is made of H_2, O_2 and this O_2 can be used in cellular metabolism
11. A plant cell differs from an animal cell in the absence of:
    (a) endoplasmic reticulum (b) mitochondria
    (c) centrioles (d) ribosomes
12. Mitochondria will be found in abundance in cells of the tissue having:
    (a) wound-healing activity (b) average activity
    (c) minimum activity (d) maximum activity

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13. To determine the ultra- structure of a cell organelle the most likely method successful observations would be:
(a) autoradiography (b) light microscopy
(c) electron microscopy (d) phase contrast microscopy
14. Activities of all living cells are controlled by:
(a) chloroplast (b) tonoplast
(c) nucleus (d) DNA and RNA
15. Golgi body is found in:
(a) RBE of man (b) all of the cells
(c) bacteria (d) all cells except RBC and bacterial cell
16. A cell increases in volume when placed in a solution which is:
(a) isotonic (b) slightly hypertonic
(c) extremely hypertonic (d) hypotonic
17. Animal cell is limited by:
(a) plasma membrane (b) cell wall
(c) cell membrane (d) basement membrane
18. The main difference between animal and plant cells is that:
(a) plant cells lack rigid cell wall (b) animal cells lack rigid cell wall
(c) plant cells possess small vacuoles (d) animal cells possess large vacuoles
19. Continuity of cytoplasm from cell to cell is maintained through:
(a) middle lamella (b) endoplasmic reticulum
(c) cell membrane system (d) plasmodesmata
20. Cell organelles are embedded in:
(a) mitoc HONDRIA (b) protoplasm
(d) neucleolus (d) cytoplasmic membrane
21. When green tomato turns red, then:
(a) chrornoplasts are changed into chloroplasts
(b) chloroplasts are disintegrated and get converted into chromoplasts
(c) new chromoplasts are made
(d) leucoplasts are developed
22. Which of the following types of plastids are commonly found in the cells not exposed to light?
(a) chloroplast (b) chromoplast
(c) leucoplast (d) all kinds of plastid
23. Nucleoli are rich in:
(a) DNA and RNA (b) DNA, RNA and proteins
(c) DNA (d) RNA
24. Artificial synthesis of DNA was done by:
(a) nirenberg (b) kornberg
(c) wastson and crick (d) khorana
25. Two strands of DNA are attached by:
(a) peptide bond (b) phosphate bond
(c) hydrogen bond (d) ester linkage

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26. The largest cell in the human body is:
(a) muscle cell (b) kidney cell
(c) liver cell (d) nerve cell
27. Vacuole of plant cell contains:
(a) cell sap (b) cytoplasm
(c) protoplasm (d) nucleus
28. The important cell inclusions are:
(a) nucleus and mitochondria (b) protoplasm and Golgi body
(c) ribosome and plastid (d) all of these
29. Which of the following does not have definite membrane bound nucleus?
(a) mycoplasma (b) bacteria
(c) blue green algae (d) all of these
30. Chromatin is important component of:
(a) nucleus (b) nucleolus
(c) cell sap (d) semen
31. Plasma membrane is:
(a) impermeable (b) formed of cellulose
(c) nonselective barrier (d) selective barrier
32. Middle lamella is found in:
(a) cell membrane (b) nucleoplasm
(c) cytoplasm (d) cell wall
33. The chemical substance most abundantly present in the middle lamella:
(a) pectin (b) lignin
(c) cutin (d) suberin
34. Cilia and flagella develop from:
(a) cilium (b) cristae
(c) chromosome (d) basal body
35. The cellular structure which always disappears during mitosis is:
(a) mitochondria (b) plastid
(c) nuclear membrane (d) plasma membrane
36. Meiosis is significant because:
(a) it produces identical cells
(b) it restores original number of chromosomes
(c) there is doubling of DNA content in the cell
(d) it occurs only in somatic cells
37. How many times mitotic divisions must occur in a cell of the root tip to from 256 cell?
(a) 64 (b) 8
(c) 32 (d) 128
38. Amitosis:
(a) cleavage of the nucleus without recognizable chromosomes
(b) a division of chromosomes
(c) an indefinite division of chromosomes
(d) chromosomes are present at the bridge
39. Daughter cell formed as result-of meiosis are not similar to that of parent cell because:

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(a) crossing over occurs and number of chromosome becomes half
(b) prophase is large
(c) there are two divisions
(d) synapsis occurs

40. Meiosis involves:
(a) one division of nucleus and one division of chromosome
(b) one division of nucleus and two division of chromosome
(c) two division of nucleus and two division of chromosomes
(d) two division of nucleus and one division of chromosomes

41. The structure of chromosomes can be best seen at:
(a) prophase (b) metaphase
(c) anaphase (d) telophase

42. in mitosis centromere divides at:
(a) prophase (b) metaphase
(c) anaphase (d) telophase

43. Meiosis and mitosis are unlike because in meiosis:
(a) homologous chromosomes pair and exchange part
(b) chromosomes number is halved
(c) the four nuclei formed are not identical
(d) all of the above three are correct

44. In the meiotic division four daughter cells are produced by two successive divisionsin which:
(a) first division is educational and second is reductional
(b) first division is reduction and second is educational
(c) both divisions are educational
(d) both divisions are reductional

45. Which is the longest phase of cell cycle?
(a) G_0 phase (b) s phase
(c) G_1 phase (d) G_2 phase

46. In which of the following would you observe high mitochondrial activity?
(a) germinating seeds
(b) falling leaves
(c) meristematic tissue
(d) both in germinating seeds and meristematic tissue

47. Tissues are:
(a) a group of cells which are similar in origin and function
(b) organs which are similar in origin and function
(c) group of cells which are not similar in function
(d) group of cells, which are not similar in origin

48. Tracheae, tracheids, wood fibres and parenchymatous tissue are found in:
(a) phloem (b) cortex
(c) xylem (d) medullary rays

49. Phloem sclerenchyma, sieve tubes, parenchyma and companion cells are found in:

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(a) xylem (b) phloem
(c) cambium (d) medullary rays

50. The hydathodes are:
(a) honey glands (b) water secreting glands
(c) oil secreting glands (d) mucilage secretingglands

51. The lateral meristem is responsible for:
(a) growth in length (b) growth in parenchyma
(c) growth in cortex (d) growth in thickness

52. Increase in length of a stem is caused by:
(a) apical meristem (b) cork cambium
(c) vascular cambium (d) mitotic division in pith and cortex

53. Companion cells are usually associated with:
(a) fibres (b) tracheids
(c) sieve tubes (d) vessels

54. The best method to detersmine the age of a tree is to:
(a) count the number of leaves on a tree (b) find out the number of branches
(c) count the number of annual rings (d) any of the above

55. The lateral roots, generally originate in:
(a) cortex (b) endoderms
(c) pericycle (d) hypoderms

56. Food is transported to different plant parts through:
(a) xylem (b) phloem
(c) cambium (d) root hair

57. The chief function of the vessels in the plant:
(a) is to give mechanical strength to stem
(b) to translocate food manufactured in the leaves to other parts of the plant
(c) is conduction of water and mineral salts
(d) to remove excess of water through root at night when there is no transpiration

58. Active cell division can be seen in:
(a) cortex (b) cambium
(c) pith (d) pericycle

59. External protective tissues of dicot plants are:
(a) epidermis and cork (b) cork and pericycle
(c) cortex and epidermis (d) pericycle and cortex

60. Cross section of the trunk of a tree showed 50 annual rings the age of the tree is:
(a) 25 years (b) 50 years
(c) 50 days (d) 100 years

61. A simple mechanical tissue with unlignified cell wall is:
(a) parenchyma (b) sclerenchyma
(c) collenchyma (d) chlorenchyma

62. The chief function of sieve tubes is:
(a) to translocate the organic materials manufactured in the leaves

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(b) to conduct minerals
(c) to transport water from root to leaves
(d) to help the plant in forming wood

63. Thickening of cell wall, lignification and specialization for mechanical functions are characteristics of:
(a) parenchyma (b) collenchymas
(c) sclerenchyma (d) chlorenchyma

64. Tendon is a structure, which connects:
(a) a bone with another bone (b) muscle with a bone
(c) a muscle with a muscle (d) a nerve with a muscle or bone

65. Fibrous tissue, which connects bones is:
(a) tendon (b) adipose tissue
(c) ligament (d) connective tissue

66. Tendons and ligaments are tissues of the category of:
(a) connective (b) epithelium
(c) muscles (d) nerve

67. Axons serve to:
(a) bring impulses to cell body
(b) bring blood into heart
(c) take away impulses from cell body
(d) take impulses to cell body and then away from cell body

68. Blood platelet are necessary for:
(a) metabolism (b) digestion
(c) excretion (d) blood clotting

69. Mast cells secrete:
(a) histamine (b) serotonin
(c) heparin (d) all of these

70. Myelin sheath is a layer covering:
(a) a vertebrate nerve fibre (b) a vertebrate muscle fibre
(c) an insect nerve fibre (d) all of these

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ANSWER FULL LENGTH PRACTICE EXAM NO. 1

1.	C	**11.**	C	**21.**	B	**31.**	D	**41.**	C	**51.**	D	**61.**	C
2.	D	**12.**	D	**22.**	C	**32.**	D	**42.**	C	**52.**	A	**62.**	A
3.	D	**13.**	C	**23.**	B	**33.**	A	**43.**	D	**53.**	C	**63.**	C
4.	A	**14.**	D	**24.**	B	**34.**	D	**44.**	B	**54.**	C	**64.**	B
5.	C	**15.**	D	**25.**	C	**35.**	C	**45.**	B	**55.**	C	**65.**	C

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6.	D	**16.**	D	**26.**	D	**36.**	B	**46.**	D	**56.**	B	**66.**	A
7.	C	**17.**	A	**27.**	A	**37.**	B	**47.**	A	**57.**	A	**67.**	C
8.	C	**18.**	B	**28.**	D	**38.**	A	**48.**	C	**58.**	B	**68.**	D
9.	D	**19.**	D	**29.**	D	**39.**	A	**49.**	B	**59.**	A	**69.**	A
10.	C	**20.**	B	**30.**	A	**40.**	D	**50.**	B	**60.**	B	**70.**	A

FULL LENGTH PRACTICE EXAMS NO. 1

1. The "blood bank" of our body is:
   (a) spleen (b) lungs
   (c) heart (d) liver
2. Which of these is a kind of tissue?
   (a) liver (b) blood
   (c) gut (d) pancreas
3. Function of nervous tissue is:
   (a) sensitivity (b) irritability
   (c) responsiveness (d) contractility
4. Branch of biology dealing with microscopic anatomy of tissues is:
   (a) cyctology (b) morphology
   (c) histology (d) taxonomy
5. RBCS of man are:
   (a) round, biconcave, non-nucleated (b) round, biconcave, nucleated
   (c) round, biconvex, non-nucleated (d) oval, non-nucleated
6. Which of the following embryonic layers originate from the mesoderm of mammals?
   (a) skeleton (b) muscle
   (c) brain (d) both (a) and (b)
7. What is meant by binomial nomenclature?
   (a) indication of the name, by its species and variety
   (b) indication of the name by its genus and species
   (c) indication of the name by its family and genus
   (d) indication of the name by its order and family
8. Strongest muscles in human body are found in:
   (a) jaws (b) thighs
   (c) hands (d) neck
9. According to botanist first plants, which originated on the earth were like:
   (a) mosses and relatives (b) virus and bacteria
   (c) algae and fungi (d) ferns and lycopods
10. In which of the following groups would you place a plant which produces seeds but lacks flowers?
    (a) gymnosperms (b) bryophytes

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(c) pteridophytes (d) fungi

11. Algae and fungi are grouped in which of the following:
(a) thallophyta (b) gymnosperms
(c) angiosperm (d) bryophytes
12. Which of the following plants have maximum power of adaptability?
(a) pteridophytes (b) angiosperms
(c) bryophytes (d) algae
13. Thallophytes having chloroplast are:
(a) algae (b) fungi
(c) bacteria (d) moss
14. Liverworts and mosses are kept under:
(a) angiosperms (b) gymnosperms
(c) bryophyte (d) pteridophyta
15. Which of the following group of plant produces spores, has vascular tissue and lacks seeds?
(a) gymnosperms (b) pteridophytes
(c) bryophytes (d) fungi
16. The most primitive vascular plants are:
(a) cyeas (b) ferns
(c) red algae (d) brown algae
17. Embryophyta includes:
(a) angiosperms only (b) all the plants
(c) algae and fungi (d) bryophyta and pteridophyta
18. Which of the following are kept in tracheophyta?
(a) algae and fungi
(b) gymnosperms and pteridophyta
(c) pteridophyta and angiosperms
(d) pteridophyta, gymnosperms and angiosperms
19. Which of the following is not a pteridophyte?
(a) selaginella (b) fern
(c) equisetum (d) sphagnum
20. Blue-green mold" name is given to:
(a) aspergillus (b) penicillium
(c) alternaria (d) agaricus
21. Which one is not a bryophyte?
(a) polytrichum (b) dawsonia
(c) pellia (d) fern
22. Gymnosperm differs from angiosperm in having:
(a) tracheids only (b) naked ovules
(c) no ovary (d) all of these
23. Which phylum of animals is exclusively marine's?
(a) porifera (b) coelenterate
(c) Mollusca (d) Echinodermata
24. Which of the following is most un-matching group?

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(a) cockroach, king-crab, spider, silverfish (b) whale, bat, lizard, sea horse
(c) starfish, sea urchin, sea cucumber (d) crayfish, cuttlefish, sawfish, hagfish

25. Body is segmented in:
(a) mollusca (b) porifera
(c) coelenterate (d) annelida

26. Phylum arthropoda is characterized by:
(a) hairs, external segmentation, 3 pairs of legs
(b) exoskeletal system, 1 pair of chelicerae
(c) external segmentation, a pair of chelicerae, a pair of pedipalp
(d) chitinous exoskeleton, external segmentation, paired jointed appendages

27. Radial symmetry is seen in:
(a) sponges (b) fishes
(c) starfish (d) mollusca

28. Integument of arthropoda is covered with:
(a) chitinous cuticle (b) smooth muscle
(c) strong calcareous shell (d) none of these

29. Air bladder is:
(a) excretory organs of mammals (b) reparatory organ of birds
(c) hydrostatic organ of bony fishes (d) organ of hydrophytes

30. Peculiarityof fish heart is that it has:
(a) all arterial blood (b) all venous and partly arterial
(c) partly venous and partly arterial (d) no blood at all

31. Coelentrates differ from the other animals in having:
(a) nematocysts (b) skeleton
(c) bilateral symmetry (d) polymorphism

32. Cephalopoda is a class of animals in which:
(a) notochord extends up to head (b) foot is located upon head
(c) head is fused with thorax (d) head is located upon foot

33. Group amniota includes:
(a) birds and reptiles (b) birds and mammals
(c) reptiles, birds and mammals (d) reptiles and mammals

34. Which of the protozoans is considered as connecting link between animal and plants?
(a) paramecium (b) monocystis
(c) englena (d) entamoeba

35. Which of the following phylais not having vascular, respiratory and excretory organs?
(a) arthropoda (b) annelid
(c) porifera (d) Platyhelminthes

36. Water vascular system is typically found in:
(a) sponge (b) hydra
(c) starfish (d) leech

37. Chordates are distinguished from non-chordates by the presence of:

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(a) ventral nerve cord (b) dorsal nerve cord
(c) brain (d) dorsal tubular nerve cord

38. Eumetazoa includes:
(a) protista (b) coelenterate
(c) sporozoa (d) protozoa

39. An endoskeleton is found in:
(a) earthworm (b) scorpion
(c) snake (d) cockroach

40. The main function of the contractile vacuole in amoeba and other aquatic protozoans is:
(a) nutrition (b) osmoregulation
(c) circulation of food (d) excretion of nitrogenous wastes

41. Phylum coelenterata has remained at:
(a) cellular level of organization (b) tissure level of organization
(c) tis sure level of organization (d) organ level of organization

42. heretima is:
(a) sterile (b) unisexual
(c) radially symmetrical (d) hermaphrodite

43. Lung book are the respiratory organs of:
(a) scorpion (b) hydra
(c) cockroach (d) prawn

44. Acoelomates:
(a) have cavity lined with mucus cells
(b) have cavity not linked with epithelial cells
(c) have coelom
(d) lack coelom

45. Paramoecium has:
(a) two contractile vacuoles (b) one contractile vacuoles
(c) four contractile vacuoles (d) many contractile vacuoles

46. Which one of the following is a genetically transmitted disease?
(a) haemophilia (b) blood cancer
(c) typhoid (d) bone cancer

47. Which of the following pair is correctly matched?
(a) scabies: entamoeba (b) malaria : plasmodium
(c) tetanus: haemophilus (d) pneumonia: sarcoptes

48. Which of the following statements is not characteristic of echinoderms?
(a) all are marine (b) the body is segmentrical
(c) adults are radially symmetrical (d) water vascular system is present

49. Which of the following disease is caused by bacteria?
(a) cholera (b) malaria
(c) elephantiasis (d) measles

50. Which one of the following is communicable disease?
(a) cancer (b) diphtheria
(c) rheumatism (d) diabetes

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51. Human beings belong to:
(a) the order primates under the class chordate
(b) the class primates under the phylum chordate
(c) the class primates under the phylum chordate
(d) the class mammalia under the phylum chordate

52. A person suffering from tetany is treated by the administration of:
(a) thvroxin (b) calcitonin
(c) aldosterone (d) parathonnone

53. Which one of the following is not mosquito borne disease?
(a) dengue fever (b) filariasis
(c) sleeping sickness (d) malaria

54. Wine turns sour because of:
(a) aerobic bacteria (b) anaerobic bacteria
(c) exposure to light (d) heat

55. Which of the following disease is caused by bacteria?
(a) arthritis (b) diphtheria
(c) beri-beri (d) small pox

56. The bacterium haemophilous influenzae causes:
(a) pneumonia (b) meningitis
(c) influenza (d) small pox

57. Bacterium responsible for fermentation of dairy milk and plant product is:
(a) lactobacter (b) haybacillus
(c) acetobacter (d) rhizobium

58. Bacterial cell division in every minute, it takes an hour to fill a cup, how much time it will take to fill half the cup?
(a) 59 minutes (b) 30 minutes
(c) 60 minutes (d) 29 minutes

59. Bacterial cell membrane is made up of:
(a) lipo-protein (b) cellulose
(c) chitin (d) fat

60. Which are the smallest bacteria among the following?
(a) cocci (b) spirilli
(c) bacilli (d) vibrios

61. Tobacoo mosaic disease is caused by:
(a) virus (b) bacilli
(c) vibrios (d) fungi

62. Bacteria multiply:
(a) asexuallyby fission (b) fusion
(c) spore formation (d) zygospore formation

63. Spirogyra:
(a) is filamentous (b) has chloroplast
(c) belongs to chlorophyte (d) all of these

64. Which of the following statement is correct?
(a) all the blue-green algae can fix nitrogen

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(b) most of the blue-green algae can fix atmospheric nitrogen
(c) none of the blue-green algae can fix atmospheric nitrogen
(d) blue-green algae can fix nitrogen only when present in root nodules of legumes

65. Which of the following is the symbiotic N_2 fixing prokaryote?
(a) anabaena (b) cladophora
(c) batrachospermurn (d) coleochaete

66. Mycorrhiza, a relationship between fungi and roots of higher plants is:
(a) parasitic relationship (b) saprophytic relationship
(c) symbiotic relationship (d) epiphytic relationship

67. A mushroom is:
(a) agaricus (b) algae
(c) fungi (d) pinus

68. The amphibians of the plants kingdom are:
(a) thallophytes (b) pteridophytes
(c) angiosperms (d) bryophytes

69. A moss differs from the fern in having:
(a) flagellated antherozoids (b) archegonia
(c) haploid spores (d) dependent sporophyte

70. In cockroach accessory glands are meant for:
(a) circulation (b) respiration
(c) excretion (d) reproduction

ANSWER FULL LENGTH PRACTICE EXAM NO. 2

1.	A	**11.**	A	**21.**	D	**31.**	A	**41.**	C	**51.**	D	**61.**	A
2.	B	**12.**	B	**22.**	D	**32.**	D	**42.**	D	**52.**	D	**62.**	A
3.	C	**13.**	A	**23.**	D	**33.**	C	**43.**	A	**53.**	B & C	**63.**	D
4.	C	**14.**	C	**24.**	D	**34.**	C	**44.**	D	**54.**	A	**64.**	B
5.	A	**15.**	B	**25.**	D	**35.**	C	**45.**	A	**55.**	B	**65.**	A
6.	D	**16.**	B	**26.**	D	**36.**	C	**46.**	A	**56.**	C	**66.**	C
7.	B	**17.**	B	**27.**	C	**37.**	D	**47.**	B	**57.**	A	**67.**	C
8.	A	**18.**	D	**28.**	A	**38.**	B	**48.**	B	**58.**	A	**68.**	D
9.	A	**19.**	D	**29.**	C	**39.**	C	**49.**	A	**59.**	A	**69.**	D
10.	A	**20.**	B	**30.**	B	**40.**	B	**50.**	B	**60.**	A	**70.**	D

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FULL LENGTH PRACTICE EXAMS NO. 3

1. Tracheae and trachioles are the:
   (a) respiratory organs of cockroach (b) respiratory organs of earthworm
   (c) respiratory organs of ascaris (d) respiratory organs of neries
2. The mode of nutrition in amoeba is:
   (a) heterotrophic (b) autotrophic
   (c) saprophytic (d) parasitic
3. The toad is:
   (a) herbivorous (b) a frog
   (c) omnivorous (d) carnivorous
4. Parotid glands are found in:
   (a) frogs and toads (b) toads only
   (c) frogs only (d) fish
5. Chemically enzymes are:
   (a) carbohydrates (b) proteins
   (c) fats (d) amino acids
6. if food intake is greater than greater used, the surplus is deposited as:
   (a) fat (b) proteins
   (c) carbohydrates (d) enzymes
7. More energy is produced from 1 gram mol of:

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(a) fats (b) sugars
(c) proteins (d) vitamins

8. Scurvy is a disease caused by:
(a) presence of Rh antigen in blood
(b) deficiency of vitamin E
(c) deficiency of vitamin C or ascorbic acid
(d) deficiency of vitamin D

9. Vitamins are:
(a) organic substances and cannot be synthesized by animals
(b)inorganic substances and can be synthesized by animals
(c) organic substances which can mostly be synthesized by animals
(d) inorganic substances which one converted into organic by simple animals only

10. Deficiency of vitamin a causes:
(a) beri-beri (b) retarded growth and development
(c) rikets (d) night blindness

11. Function of vitamin k is in:
(a) regulation of phosphorus and calcium metabolism
(b) blood dotting
(c) carbohydrate metabolism
(d) respiration

12. The most common concentrated source of proteins in Pakistan is:
(a) potatoes (b) meat
(c) eggs (d) pulses

13. Starch is:
(a) carbohydrate (b) protein
(c) enzyme (d) fat

14. Sucrose is found in:
(a) milk (b) honey
(c) sugarcane (d) orange

15. Which one of these carbohydrates is a monosaccharide?
(a) cellulose (b) sucrose
(c) starch (d) glucose

16. Vitamin D is also called:
(a) calciferol (b) ascorbic acid
(c) retinol (d) folic acid

17. Micro-nutrients:
(a) are less important in nutrition than macro-nutrients
(b) are as important in nutrition as macro-nutrients
(c) may be emitted from culture media without any detriment effect on the plants
(d) are called 'micro' because they play only a minor role in plant nutrition

18. Which of the following is not a macro-nutrient?
(a) Mg (b) Ca
(c) Fe (d) P

19. Mineral salts are absorbed by the roots from the soil, in the form of:

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(a) very dilute solution (b) dilute solution
(c) concentrated solution (d) very concentrated solution

20. Plants always take their food:
(a) in organic form (b) in inorganic form
(c) in solid form (d) in soluble form

21. The first step in photosynthesis is:
(a) photolysis of water
(b) formation of ATP
(c) excitement of an electron of chlorophyll by a photon of light
(d) formation of NADPH

22. In which of following process the light energy is converted into chemical energy:
(a) digestion (b) respiration
(c) fermentation (d) photosynthesis

23. In light phase of photosynthesis there is formation of:
(a) ATP and $NADPH_2$ (b) NADPTB
(c) ATP (d) carbohydrates

24. What is the source of oxygen liberated in photo-synthesis?
(a) CO_2 (b) H_2O
(c) carbohydrates (d) photosynthetic enzymes

25. During dark reaction of photosynthesis:
(a) water splits
(b) Co_2 is reduced to organic compounds
(c) chlorophyll is activated
(d) 6 carbon sugar is broken down into 3 carbon sugar

26. Ptyalin of saliva acts in:
(a) slightly alkaline medium (b) slightly acidic medium
(c) neutral medium (d) all type of media

27. Bile juice assists in digestion of fats by:
(a) emulsifying the fats
(b) contributing a lipolytic enzyme
(c) stimulating secretion of lipase
(d) increasing the alkalinity of digestive medium

28. Liver cells secrete:
(a) amylopsin (b) trypsin
(c) bile juice and no enzymes (d) Digestive enzymes

29. Protein digestion requires:
(a) proteases (b) peptides
(c) proteolytic enzymes (d) all of these

30. Some proteolytic enzymes are:
(a) trypsin, erepsin, pepsin (b) amylase, lipase, zymase
(c) amylase, steapsin, ptyalin (d) all of these

31. Whichof these is a group of end products of carbohydrate digestion?
(a) glucose, galactose, fructose (b) sucrose, galactose, maltose

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(c) galactose, glucose, maltose (d) lactose, maltose, glucose

32. Pancreatic juice takes part in digestion of:
(a) proteins carbohydrates (b) proteins, fat, carbohydrates
(c) proteins only (d) proteins and fats

33. Conversion of glucose into glycogen in liver is called:
(a) glycogenolysis (b) glycogenesis
(c) glycolysis (d) gluconeogenesis

34. Oxygen carrier or the respiratory pigment in blood of frog and other vertebrates is:
(a) haernocyanin (b) haemoglobin
(c) cytochrome (d) haernolyrnph

35. A frog must swallow air if the lungs are to be expanded, because frog:
(a) has no diaphragm (b) normally breathes through its skin
(c) has no vagus nerve (d) is relatively low form of life

36. Anaerobic respiration is likely to occur in:
(a) ants (b) earthworms
(c) echinoderms (d) tapeworms

37. What is the end product of glcolysis?
(a) pyuvic acid (b) acetyl Co-A
(c) citric acid (d) lactic acid

38. Out of there, the end product of anaerobic respiration is:
(a) $Co_2 + H_2O$ (b) fumaric acid
(c) pyruvic acid (d) lactic acid

39. In glycolysis, ultimately:
(a) protein is converted to glucose (b) glucose is converted to fructose
(c) glucose is converted to pyruvic acid (d) starch is converted to glucose

40. A person with blood group O can receive blood transfusion from persons with blood group:
(a) Oand AB (b) O,A and B
(c) O only (d) AB only

41. Universal recipient in blood transfusion belongs to the group:
(a) A (b) O
(c) AB (d) B

42. Haemophilia is a disease caused by deficiency of:
(a) water in plasma (b) RBCS
(c) WBCS (d) thromboplastin

43. Mangolism or Down's syndrome is the result of:
(a) 47 chromosomes instead of 46
(b) 45 chromosomes instead of 46
(c) 23^{rd} pair of chromosomes in three doses
(d) 21 st pair of chromosomes having a single dose

44. Eugenics pertains to:
(a) improvement of mankind by improving his heredity
(b) prescribing human sperms for artificial insemination

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(c) study of human genetics
(d) controlling size of human family

45. Sickle-cell anaemia is due to:
(a) hormones (b) viruses
(c)genes (d) bacteria

46. Sex linked inheritance was discovered by:
(a) Mendel (b) Landsteiner
(c) Morgan (d) Mc Clung

47. Chromosomal pattern of Turner's syndrome:
(a) 22 A + XXV (b) 22 A + XXX
(c) 22 A + X (d) 22 A + Y

48. Chromosomes of Klkinefelter's syndromes usually have:
(a) one X (b) XXV
(c) 2 X only (d) no Y

49. Autotrophic component of ecosystem is:
(a) sunlight (b) green plants
(c) herbivorous (d) bacteria and fungi

50. Which of the following is the main factor of water pollution?
(a) smoke (b) ammonia
(c) getergents (d) industrial wastes

51. The main air pollutant is:
(a) Co (b) Co_2
(c) N_2 (d) sulphur

52. Which of the following-is non-renewable source of energy?
(a) coal (b) forest
(c) H_2O (d) wild life

53. Loss of air exchange capacity by deterioration of alveoli in lung tissues called:
(a) emphysema (b) necrosis
(c) effluent (d) eutrophication

54. Majorfood crop of the world belongs to:
(a) leguminosae (b) solanaceae
(c) gramineae/poaceae (d) cruciferae

55. the most important foods are derived from:
(a) roots (b) fruits
(c) leaves (d) stem

56. A cell became turgid when placed in:
(a) isotonic solution (b) hypertonic solution
(c) hyportonic solution (d) any acrated water

57. When the contents of a cell are in the shrinkage state the process is called:
(a) hypotonic (b) plasmolysis
(c) endosmosis (d) osmosis

58. Which of the following statements is true?
(a) the plasma is the liquid part of blood (b) RBC is smaller than WBC
(c) haemoglobin is stored in RBC (d) all are true

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59. The blood coming from the heart is carried to liver by:
(a) aorta (b) renal artery
(c) renal vein (d) hepatic artery

60. Ammonia is the chief nitrogenous excretory material in:
(a) cartilaginous fishes (b) fowl
(c) freshwater fishes (d) mosquitoes

61. Urea is produced from 'ammonia in the body of rabbit or man in:
(a) liver (b) kidneys
(c) spleen (d) heart

62. Kidney of a mammal resembles contractile vacuole of amoeba in expelling out:
(a) salt (b) glucose
(c) excess water (d) urea and uric acid

63. Which of these will completely be reabsorbed under normal condition in the nephrons?
(a) glucose (b) urea
(c) salts (d) uric acid

64. Aquatic animal are mostly ammonotelic because:
(a) ammonia helps in checking inflow of water into body
(b) excretion of ammonia requires large amount of water which is available to these animals
(c) water contains less nitrogen
(d) they get less light

65. Which part of mammalian brain controls the muscular co-ordination?
(a) cerebellum (b) cerebrum
(c) corpus callosum (d) medulla

66. The central nervous system consists of:
(a) brain and the spinal cord (b) spinal cord and spinal nerves
(c) brain, spinal nerves and cranial nerves (d) brain and the cranial nerves

67. Acetylcholine is responsible for transmission of nerve impulses through:
(a) soma (b) dendrites
(c) axons (d) synapses

68. Cerebellum of brain is concerned with:
(a) static balance
(b) regulation of body posture and equilibrium
(c) initiation of muscular contraction
(d) co-ordination of muscular movements

69. Which part of the brain is responsible for sensation, memory and emotions?
(a) thaiamus (b) medulla oblongata
(c) cerebrum (d) cerebellum

70. Which of the following statements is incorrect?
(a) a gynoecium is the female part of the flower

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(b) the style receives pollens
(c) stamens collectively are named as androecium
(d) in marchantia, eggs develop inside archegonium

ANSWER FULL LENGTH PRACTICE EXAM NO. 3

1.	A	**11.**	B	**21.**	C	**31.**	A	**41.**	C	**51.**	A	**61.**	A
2.	A	**12.**	D	**22.**	D	**32.**	B	**42.**	D	**52.**	A	**62.**	C
3.	C	**13.**	A	**23.**	A	**33.**	B	**43.**	A	**53.**	A	**63.**	A
4.	A	**14.**	C	**24.**	B	**34.**	B	**44.**	A	**54.**	C	**64.**	B
5.	B	**15.**	D	**25.**	B	**35.**	A	**45.**	C	**55.**	B	**65.**	A
6.	A	**16.**	A	**26.**	B	**36.**	D	**46.**	C	**56.**	C	**66.**	A
7.	A	**17.**	B	**27.**	A	**37.**	A	**47.**	C	**57.**	B	**67.**	D
8.	C	**18.**	C	**28.**	C	**38.**	D	**48.**	B	**58.**	D	**68.**	D
9.	A	**19.**	A	**29.**	C	**39.**	C	**49.**	B	**59.**	D	**69.**	C
10.	D	**20.**	D	**30.**	A	**40.**	C	**50.**	D	**60.**	C	**70.**	B

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FULL LENGTH PRACTICE EXAMS NO. 4

1. During the process of fertilization, it is usually found that of the two male gametes. One fuses with the egg and the second with the secondary nucleus this is known as:
   (a) simple fertilization
   (b) double fertilization
   (c) fusion
   (d) zygospore formation
2. The nutritive status of slime mould is:
   (a) producer
   (b) consumer
   (c) decomposer
   (d) consumer/decomposer

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3. Sexual reproduction is uncommon in:
   (a) deuteromycota (b) zygornycota
   (c) ascomycota (d) basidiomycota
4. Fertilization of ovum takes place in man and other placental mammals in:
   (a) ovary (b) uterus
   (c) fallopian tubes (d) vagina
5. Corpus luteum in mammals occurs in:
   (a) brain and connects the two cerebral hemispheres
   (b) ovaries and produces progesterone hormone
   (c) heart and initiates atrial contraction
   (d) skin and acts as a pain receptor
6. Bread mold is used to manufacture:
   (a) lactic acid (b) acetic acid
   (c) fumaric acid (d) all of these
7. Which one of the following substances is released into the blood stream of a normal individual to increase the concentration of blood sugar?
   (a) vitamins (b) insulin
   (c) glucagon (d) enzyme
8. A plant cell has the potential to develop into an entire plant. This property of the plant cells is known as:
   (a) totipotency (b) nucleopotency
   (c) tissue culture (d) gene cloning
9. Outer covering of cartilage is known as:
   (a) endostium (b) perichondrium
   (c) periostium (d) serous coat
10. Germs cells in the vertebrate gonads form by:
   (a) mitosis (b) meiosis
   (c) both meiosis and mitosis (d) maturation without cell division
11. Which one is called the king of genetics due to the excessive use for genetic research?
   (a) neurospora (b) penicillium
   (c) saccharomyces (d) aspergillus
12. Smallest insect is:
   (a) house fly (b) fairy fly
   (c) cockroach (d) small beetle
13. After ovulation in female rabbit, the collapsed ovarian follicle shrinks and becomes filled with cells to from:
   (a) corpus luteum (b) endothelium
   (c) epittelium (d) follicle
14. Medicines from fungi are used extensively:
   (a) exogenously (b) endogenously
   (c) exogenously and endogenously (d) on animals only
15. Polar bodies are formed during:
   (a) oogenousis (b) spermatogenousis
   (c) gematogenousis (d) sporogenousis

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16. Natural parthenogenesis occurs in:
(a) earthworms (b) all insects
(c) honey bee (d) protozoans
17. Main function of corpus lutcum is to:
(a) facilitate fertilization (b) facilitate ovulation
(c) secrete progesterone (d) facilitate passage of ova a in oviducts
18. In a spontaneous reaction the free energy of a system:
(a) decreases (b) increases
(c) becomes equal to zero (d) remain unchanged
19. Placenta acts like a:
(a) semipermeable membrane (b) fully" permeable
(c) impermeable membrane (d) none of these
20. Which of the following structure are protective in function?
(a) amnion and yolk sac (b) amnion and allantois
(c) amnion and chorion (d) chorion and allantois
21. Which types of division occurs in cleavage?
(a) amitotic (b) mitotic
(c) meiotic (d) mitotic and meiotic
22. What is site of the fertilization in human being?
(a) vazina (b) uterus
(c) fallopian tube (d) ovary
23. Which layer forms liver, pancreas thymus and thyroid?
(a) endodenn (b) mesoderm
(c) lctoderm (d) epiblast
24. Sedimentation coefficient is:
(a) svedberg unit (b) centrifugation
(c) ultracentrifugation (d) density gradient centrifugation
25. Which group exclusively consists of polysaccharides?
(a) starch, glycogen lactose (b) lactose, cellulose, starch
(c) glycogen, maltose, starch (d) glycogen, cellulose, starch
26. The most diverse molecules in a cell are:
(a) mineral salts (b) lipids
(c) proteins (d) carbohydrates
27. Which one is correctly matched?
(a) vitamin A-thiamine (b) vitamin B-calciferol
(c) vitamin E-ribof1avin (d) vitamin E-tocopherol
28. Which of the following is not function of liver?
(a) detoxification (b) glycogen storage
(c) production of insulin (d) production of bile

29. Vitamin k is required for:
(a) formation of prothrombin (b) conversion of prothrombins
(c) synthesis of prothrombin (d) formation of thromboplastin
30. Vitamin D is synthesized in skin by the action of sunlight on:

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(a) 7-dehydrocholesterol (b) cephalocholes
(c) cholesterol (d) all of these

31. Which of the following trace element is significant for maintenance of teeth?
(a) manganese (b) copper
(c) line (d) fluoride

32. Feeding on dead and decaying organism represent what type of nutrition:
(a) autotrophic (b) parasitic
(c) saprotrophic (d) holozoic

33. We take food rich in lime juice then:
(a) action of ptyalin on starch stops (b) action of ptyalin on starch is unaffected
(c) action of ptyalin on starch is reduced (d) action of ptyalin on starch is enhanced

34. Which part of the body secretes the hormone secretin?
(a) oesophagus (b) stomach
(c) duodenum (d) ileum

35. Enterokinase converts:
(a) starch → maltose (b) proteins → dipeptides → amino acids
(c) trypsinogen → trypsin (d) fats → glycerol

36. Which one of the following vitamins can be synthesized by bacteria inside the gut?
(a) K (b) D
(c) B (d) C

37. Which of the following are absorbed in the elementary canal as such?
(a) proteins (b) fat soluble vitamins
(c) polysaccharides (d) albumen of egg

38. Strongest part in the body is:
(a) muscle (b) enamel
(c) bone (d) cartilage

39. Gall bladder of a man is stimulated by:
(a) enterokinase (b) cholecystokinin
(c) secretin (d) enterogastrone

40. When gall bladder of a man is removed:
(a) effect of pancreatic juice upon food is impaired
(b) acidity continues in duodenum
(c) fat digestion is not possible
(d) all of these

41. Taste buds of bitter taste are located in our tongue:
(a) on upper surface in posterior (b) on lower surface
(c) on lower sides (d) at tip

42. Maximum absorption takes places in:
(a) rectum (b) colon
(c) stomach (d) ileum

43. Which of the following is unpaired bone of face?
(a) maxilla (b) lacrimal

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(c) palatine (d) vomer

44. Seed coat and nut shells only contain _____ type of sclerenchyma cells.
(a) fibers (b) sclereides
(c) tracheids (d) vessels

45. Rectal glands remove the excessive salt to outside by:
(a) diffusion (b) active transport
(c) facilitated (d) both (a) and (b)

46. In marine environment, internal salt concentration will be lower in the cast of:
(a) most cartilaginous fishes (b) hag fishes
(c) most marine invertebrates (d) all of these

47. The covalent bound between two amino acids is called as:
(a) amide (b) protein
(c) protoamide (d) peptide

48. The two families of nitrogenous bases of nucleotides are:
(a) adinine and guanine (b) thymine and cytosine
(c)purine and pyrimidine (d) uracil and purine

49. Endoplasmic reticulum is not found in:
(a) mammalian WBC (b) mammalian RBC
(c) adipose cells (d) cardiac dells

50. The science of improving physical and mental qualities of humans, through control of the factors influencing heredity, is called:
(a) genetics (b) genetic engineering
(c) gene therapy (d) phycology

51. Study of the external character of organisms is called:
(a) history (b) biogeography
(c) paleontology (d) morphology

52. hypothesis is:
(a) a reasoned explanation
(b) an educated guess
(c) idea given on the basis of previous Knowledge
(d) all of these

53. Nanometer (nm) is other name of:
(a) mill micron (mμ) (b) micron (μ)
(c) micrometer (μm) (d) angstrom (A^o)

54. Which of the following cannot be grown on artificial culture medium?
(a) E.coil (b) T.M.V
(e) yeast (d) aspergillus

55. Secretion of the sweat glands of mammals are primarily meant for:
(a) regulation of body temperature (b) removal of excess salt
(c) removal of excess water (d) killing of bacteria on skin

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56. According to fluid-mosaic model, plasma membrane is made of:
(a) cellulose and hemicellulose
(b) phospholipids and hemicellulose
(c) phospholipids and intrinsic proteins
(d) phospholipids, intrinsic proteins and extrinsic proteins

57. Osmosis through semipermeable membrane is a flow of:
(a) solutes from low concentration to higher concentration
(b) phospholipids and gemicellulose
(c) phospholipids and intrinsic proteins
(d) phospholipids, intrinsic proteins and extrinsic proteins

58. How many molecules of oxygen gas (O_2) are used during the glycolysis of one glycolysis of one glucose molecule?
(a) 0 (b) 1
(c) 16 (d) 38

59. Which of the following substances do not pass across membranes by simple diffusion?
(a) O_2 (b) CO_2
(c) H_2O (d) H^+

60. In the conversion of pyruvic acid to acetyl coenzyme A, pyruvic acid is:
(a) oxidized (b) reduced
(c) isomerized (d) broken into one carbon fragments

61. Which of the following structure is not found in prokaryotic cell?
(a) plasma membrane (b) nuclear envelop
(c) ribosome (d) cell wall

62. Which of the following is a testcross?
(a) AABB × AABB (b) AABD × AABB
(c) AABB × AABB (d) AABB × AABB

63. Which of the following taxonomic categories contain organisms least similar to ea. h other?
(a) class (b)genus
(c) family (d) species

64. Maximum mitochondria in the cells of:
(a) human liver (b) bird's wing
(c) human kidney (d) air bladder of a fish

65. Which one is false nucleus?
(a) nucleoid (b) nucleolus
(c) chromosome (d) coenocytic condition

66. Identification + nomenclature + classification + interrelationship =
(a) systematics (b) organic evolution
(c) phonetics (d) taxonomy

67. Which of the following molecules moves regularly from the nucleus to the cytoplasm?
(a) glycogen (b) RNA
(c) DNA (d) cholesterol

68. Of all the texa, the only one that exists in nature as a biologically cohesive unit is the:
(a) species (b) genus

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(c) phylum or division (d) kingdom

69. Bacteria that get their energy by fermentation and for whom oxygen is lethal are called:
(a) obligate an aerobs (b) obligate aerobs
(c) facultative aerobs (d) facultative an aerobs

70. When the fluid outside a cell has a greater concentration of a given molecule than the fluid inside the cell, the external fluid is:
(a) isotonic (b) hypertonic
(c) hypotonic (d) ultra-tonic

ANSWER FULL LENGTH PRACTICE EXAM NO. 3

1.	B	**11.**	C	**21.**	B	**31.**	D	**41.**	A	**51.**	D	**61.**	B
2.	D	**12.**	B	**22.**	C	**32.**	C	**42.**	D	**52.**	D	**62.**	D
3.	A	**13.**	A	**23.**	A	**33.**	C	**43.**	D	**53.**	A	**63.**	A
4.	C	**14.**	C	**24.**	A	**34.**	C	**44.**	B	**54.**	B	**64.**	B
5.	B	**15.**	A	**25.**	D	**35.**	C	**45.**	B	**55.**	A	**65.**	A
6.	B	**16.**	C	**26.**	C	**36.**	A	**46.**	A	**56.**	D	**66.**	A
7.	C	**17.**	C	**27.**	D	**37.**	B	**47.**	D	**57.**	B	**67.**	B
8.	A	**18.**	A	**28.**	C	**38.**	B	**48.**	C	**58.**	A	**68.**	A
9.	B	**19.**	A	**29.**	C	**39.**	B	**49.**	B	**59.**	D	**69.**	A
10.	B	**20.**	C	**30.**	A	**40.**	D	**50.**	C	**60.**	A	**70.**	B

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