CHAPTER 14

REPRODUCTION

MULTIPLE CHOICE QUESTIONS

Each question has four possible answers. Circle the correct answer

(1) If an organism divides into two organisms, this division is called:
(a) Multiple fission (b) Binary fission (c) Fragmentation (d) Buddding

(2) In which organism the bud is not detached from the parent body?
(a) Yeast (b) Hydra (c) Coral (d) Amoeba

(3) Spore formation takes place in:
(a) Planaria (b) Amoeba (c) Hydra (d) Rhizopus

(4) Vegetative propagation in onion:
(a) Corm (b) Stem tuber (c) Rhizome (d) Bulb

(5) Which plant has vegetative propagation through rhizome?
(a) Ginger (b) Colocacia (c) Potato (d) Onion

(6) An example of stem tubers:
(a) Mint (b) *Chrysanthemum* (c) *Bryophyllum* (d) Yams

(7) An example of suckers:
(a) Potato (b) Yams (c) Onion (d) Mint

(8) The sporophyte generation is:
(a) Haploid (b) Diploid (c) Triploid (d) Tetraploid

(9) The generation which produces gametes:
(a) Sporophyte (b) Gametophyte (c) Both a & b (d) None of these

(10) Sporophyte generation produces spores by:
(a) Meiosis (b) Mitosis (c) Budding (d) Fragmentation

(11) Which one is the reproductive part of the plant?
(a) Stem (b) Root (c) Flower (d) Leaf

(12) The outermost whorl of flower:
(a) Androecium (b) Gynoecium (c) Corolla (d) Calyx

(13) Male reproductive part of the flower:
(a) Sepal (b) Patel (c) Carpe. (d) Stamen

(14) The transfer of pollens from anther of stamen to stigma of carpel:
(a) Reproduction (b) Pollination (c) Budding (d) Respiration

(15) The leaflets of corolla are called:
(a) Stamens (b) Carpels (c) Sepals (d) Petals

(16) The carpel consists of:
(a) Stigma (b) Style (c) Ovary (d) All of these

(17) **The endosperm is:**
(a) Haploid (b) Diploid (c) Triploid (d) Tetraploid

(18) **Which part of carpel develops into fruit?**
(a) Stigma (b) Style (c) Ovary (d) None of these

(19) **Insect pollinated flowers:**
(a) Generally large (b) Generally small (c) Produce nectar (d) Both a & c

(20) **The scar on the seed coat where the seed is attached to the ovary wall:**
(a) Hilum (b) Hilus (c) Radicle (d) Plumule

(21) **Which one is an example of wind pollinated flower?**
(a) Buttercup (b) Rose (c) Sunflower (d) Willow

(22) **Angiosperm seeds consist of how many distinct parts:**
(a) 1 (b) 2 (c) 3 (d) 4

(23) **Which one part of the seed develops into root?**
(a) Plumule (b) Radicle (c) Endosperm (d) Testa

(24) **Which one is an example of epigeal germination?**
(a) Pea (b) Maize (c) Coconut (d) Cotton

(25) **Optimum temperature for the germination of seed:**
(a) 10-15°C (b) 25-30°C (c) 20-30°C (d) 15-25°C

(26) **The production of sperms in testes:**
(a) Spermatogenesis (b) Oogenesis (c) Reproduction (d) Fertilization

(27) **In which group of vertebrates external fertilization occurs?**
(a) Reptiles (b) Mammals (c) Amphibians (d) Birds

(28) **Testes are located in a bag of skin called:**
(a) Epididimys (b) Urethra (c) Scrotum (d) Semen

(29) **Pakistan's population in the year 2007-2008:**
(a) 163,000,000 (b) 163,775,000 (c) 163,075,000 (d) 173,775,000

(30) **In how many countries UNFPA works:**
(a) 130 (b) 135 (c) 140 (d) 145

ANSWER KEY

Q.No.	Ans	Q.No.	Ans	Q.No.	Ans	Q.No.	Ans	Q.No.	Ans
1	b	2	c	3	d	4	d	5	a
6	d	7	d	8	b	9	b	10	a
11	c	12	d	13	d	14	b	15	d
16	d	17	c	18	c	19	c	20	a
21	d	22	c	23	b	24	d	25	b
26	a	27	c	28	c	29	b	30	c

SHORT QUESTIONS

Q. No. 1 Define reproduction

REPRODUCTION

The production of individuals of the same species i. e. the next generation of species is called reproduction.

Q. No. 2 Is reproduction essential for life processes?

REPRODUCTION FOR LIFE PROCESSES

Reproduction is not essential for life processes, it is one of the fundamental characteristics of the living things.

Q. No. 3 What is the difference of survival between individual and species?

An individual can live without reproduction, but a species can not survive without reproduction.

Q. No. 4 What is the importance of reproduction?

IMPORTANCE OF REPRODUCTION

- Reproduction is essential for the continuation of species.
- It ensures that the genetic material of one generation is transmitted to the next.

Q. No. 5 How advantageous characteristics are transmitted to the next generation?

TRANSMISSION OF ADVANTAGEOUS CHARACTERISTICS

Each generation produces more offsprings than the next generation. Many individuals die before reaching the reproductive age due to various reasons like:

- Diseases
- Competition
- Genetic factors

Survival of the Fittest:

Only the fittest and the best survive reach the reproductive age. In this way the advantageous characteristics are transmitted to the next generation.

Q. No. 6 Differentiate between sexual and asexual reproduction.

DIFFERENCE BETWEEN SEXUAL AND ASEXUAL REPRODUCTION

Sexual Reproduction	Asexual Reproduction
• The simple cell division that produces an exact duplicate of an organism is called asexual reproduction. • It does not involve the fusion of gametes.	• The process of reproduction that involves the fusion of male and female gametes is called sexual reproduction. • The male gametes are called sperms and female gametes are called eggs.

Q. No. 7 Write names of major plant groups.

MAJOR PLANT GROUPS

The major plants groups are:

1. Mosses
2. Ferns
3. Seed plants

The seed plants include:
Gymnosperms (naked seeds)
Angiosperms (flowering plants)

Q. No. 8 Why mosses and ferns require water for their sexual reproduction?

REQUIREMENT OF WATER FOR REPRODUCTION

In mosses and ferns sperms are motile and can swim to egg cells. Therefore, these plants require water in the form of dew or rain for sexual reproduction.

Q. No. 9 Why the method of reproduction is also called micro-propagation?

MICRO-PROPAGATION

The method of reproduction is also called micro-propagation sine it uses only a small part of plant.

Q. No. 10 What is a whorl of the flower?

WHORL OF FLOWER

All the structures present at one are collectively called the whorl of the flower.

Q. No. 11 What is the contribution of Theophrastus?

CONTRIBUTION OF THEOPHRASTUS

He was the successor of Aristotle. He was great philosopher.

- He laid a solid foundation of botany including the morphology and functions of the flowers.
- He recognized the male and female sex parts of the flowers and described the pollination and fertilization in flowers.

Q. No. 12 What is parthenocarpy?

PARTHENOCARPY

In some plants, ovaries develop into fruit without the fertilization inside their ovules. This process is known as parthenocarpy and it results in seedless fruits.

Examples:

- Bananas
- Seedless varieties of grapes

Q. No. 13 What is the reason of success of seed plants?

SUCCESS OF SEED PLANTS

The evolution of seed has been proved as an important step in the success and spread of flowering plants, as compared to the seed-less plants like mosses and ferns.

Q. No. 14 What is dormancy?

DORMANCY

Most seeds go through a period, during which there is no growth. This period is called the dormancy of the seed. Dormant seeds are ripe seeds but do not germinate. Under favourable conditions, the seeds break dormancy and begin to germinate.

Q. No. 15 What is the future of ovule and ovary after fertilization in flower?

FUTURE OF OVULE AND OVARY

After fertilization, the ovule develops into seed while ovary develops into fruit.

Q. No. 16 Why do rabbits reingest their faeces?

REINGESTION OF FAECES

Rabbits reingest their own pallet-like faeces to digest their food further and extract sufficient nutrients.

Q. No. 17 What do you know about The United Nations Population Fund?

THE UNITED NATIONS POPULATION FUND

UNFPA began operations in 1969. It is the largest international organization funding for population and health programmes. The UNFPA works in over 140 countries, for awareness about the consequences of overpopulation.

Q. No. 18 What is the incidence of HIV in Pakistan?

INCIDENCE OF HIV IN PAKISTAN

According to the United Nations Programme on AIDS i.e. UNAIDS estimates, some 70,000 to 80,000 persons, or 0.1 percent of the adult population in Pakistan, are infected with HIV.

Q. No. 19 What is the number of drug addicts in Pakistan?

DRUG ADDICTS IN PAKISTAN

The number of drug addicts in Pakistan is currently estimated to be about 500,000 of whom 60,000 inject drugs.

LONG QUESTIONS

Q. No. 1 Write a note on binary fission.

BINARY FISSION

Meaning:

Binary fission means "division into two".

Definition:

The simplest and most common method of asexual reproduction in which an organism divides into two by simple cell division is called binary fission.

Examples:

- It occurs in prokaryotes (bacteria)
- Many unicellular eukaryotes e.g. protozoa
- Some invertebrates

Binary Fission in Bacteria:

During binary fission in bacteria, the DNA is duplicated and so two copies of DNA are formed. The two copies move towards the opposite poles of cell. The cell membrane invaginates in centre and divides the cytoplasm into two. New cell wall is deposited between two cross membranes. It results in the formation of two daughter bacteria, which grow in size and divide again.

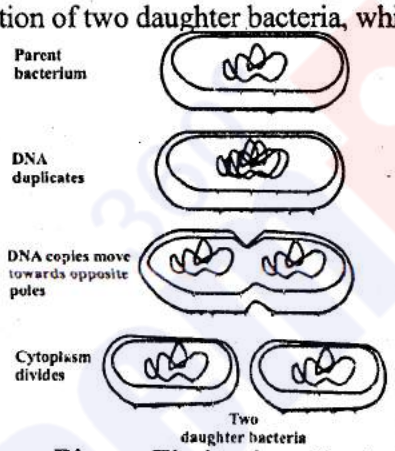


Figure: Binary Fission in a Bacterium

Binary Fission in Unicellular Eukaryotes:

During binary fission in unicellular eukaryotes, the nucleus of parent organism divides into two by mitosis. It is followed by the division of cytoplasm. So two daughter cells of almost equal size, are formed. Daughter cells grow in size and then divide again.

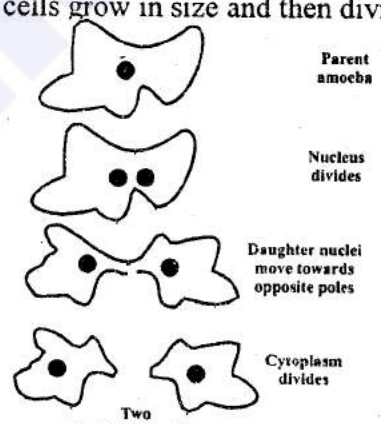


Figure: Binary Fission in an *Amoeba*

Binary Fission in Invertebrates:

Some invertebrates also reproduce asexually through binary fission. During this reproduction, body is cut into two halves (fission) and the missing body parts are regenerated in both halves. This type of asexual reproduction is common in:

- Planarian
- *Many echinoderms*

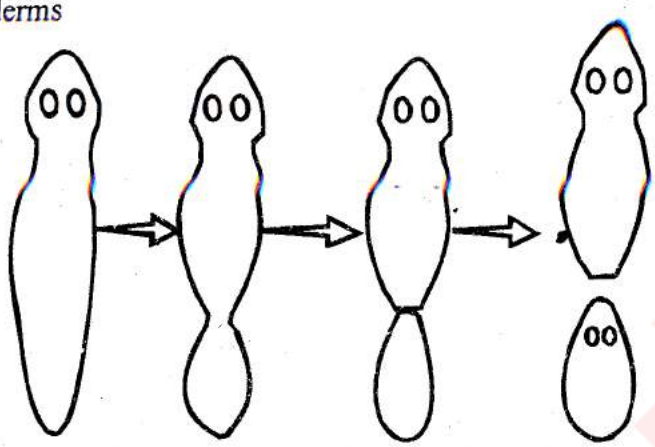


Figure: Binary Fission in a Planarian

Q. No. 2 Write a note on multiple fission.

MULTIPLE FISSION

Definition:

The kind of asexual reproduction in which one unicellular organism divided into many daughter cells is called multiple fission.

Example:

- Amoeba

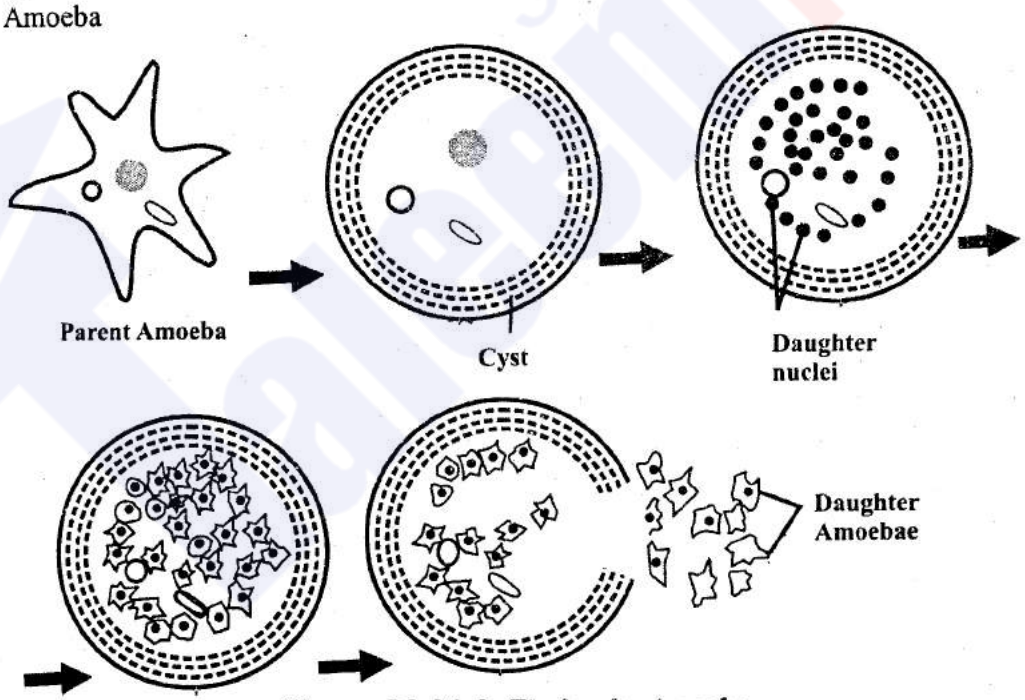


Figure: Multiple Fission in *Amoeba*

Mechanism:

Formation of Cyst:

Some unicellular organisms form hard walls called cysts around them, under unfavourable conditions.

Division of Nucleus:

When favourable conditions return, the nucleus of parent divides into many daughter *nuclei by repeated divisions.*

Division of Cytoplasm:

This is followed by the division of cytoplasm into several parts. Each new part of cytoplasm encloses one nucleus.

Formation of Daughter Cells:

So a number of daughter cells are formed from a single parent at the same time. This kind of fission in known as multiple fission.

Q. No. 3 Write a note on fragmentation.

FRAGMENTATION

Definition:

A kind of asexual reproduction in which the detached parts of the organism develop into new organism is called fragmentation:

Examples:

Worms:

As certain worms grow to full size, they spontaneously break up into 8 or 9 pieces. Each piece (fragment) develops into a mature worm, and the process is repeated.

Planaria:

If a planarian breaks into many pieces instead of two, it will also be called as fragmentation.

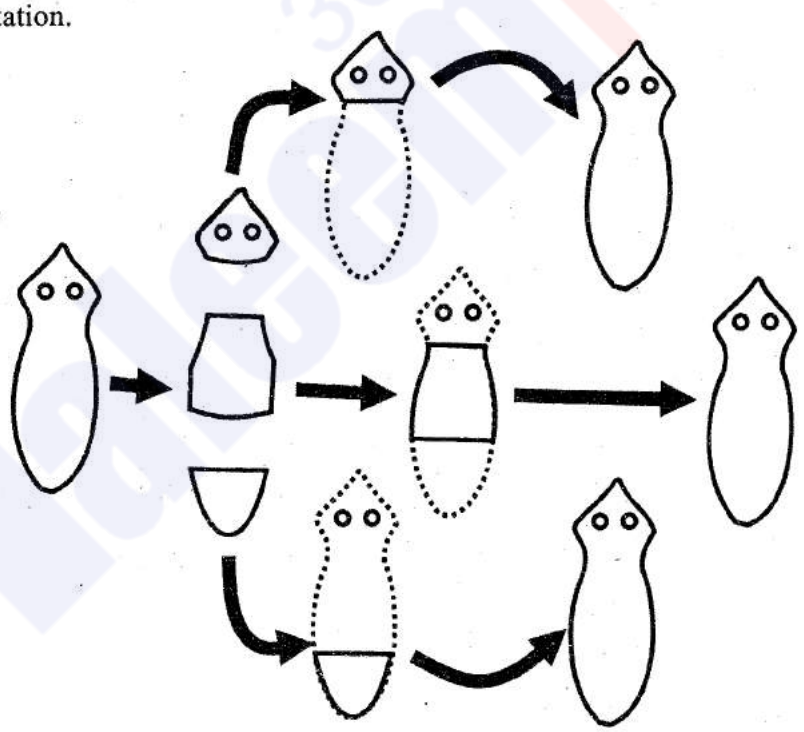


Figure: Fragmentation in a Planarian

Q. No. 4 Write a note on budding.

BUDDING

Definition:

A type of asexual reproduction in which an outgrowth on the body of an organism develops into a new complete organism is called budding.

Bud:

The developed outgrowth on the body of an organism is called bud.

Explanation:

In this type of asexual reproduction, a bud develops as a small outgrowth on parent's body. The bud may separate from parent body. In some cases, the buds never separate and as a result, colonies of individuals are formed.

Examples:

- Yeasts
- Sponges
- Hydra
- Corals

Budding in Yeast:

Yeast is a unicellular fungus. A small bud is formed on one side of cell. The nucleus of cell divides and one of the daughter nuclei is passed into the bud. Parent cell may form more than one bud at a time. Each bud enlarges and develops the characteristics of parent organism.

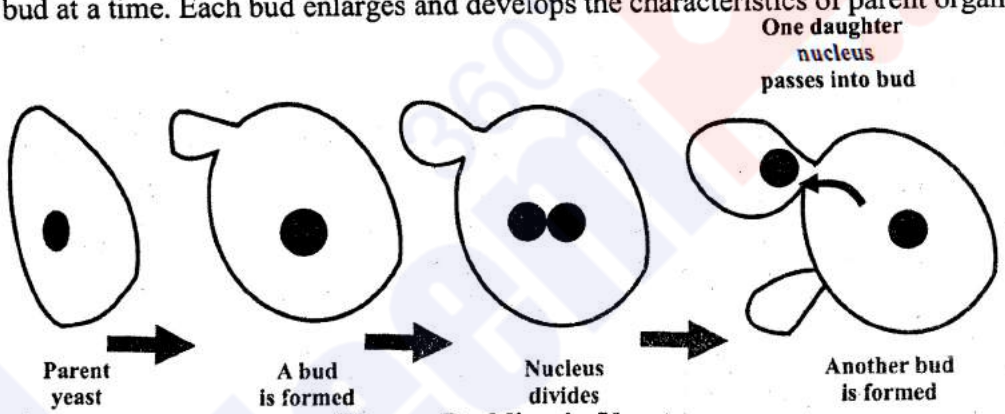


Figure: Budding in Yeast

Budding in Hydra:

A small bud is formed on the side of body of hydra, by mitosis. This bud enlarges by the formation of more cells. It then detaches from the parent body and grows into new organism.

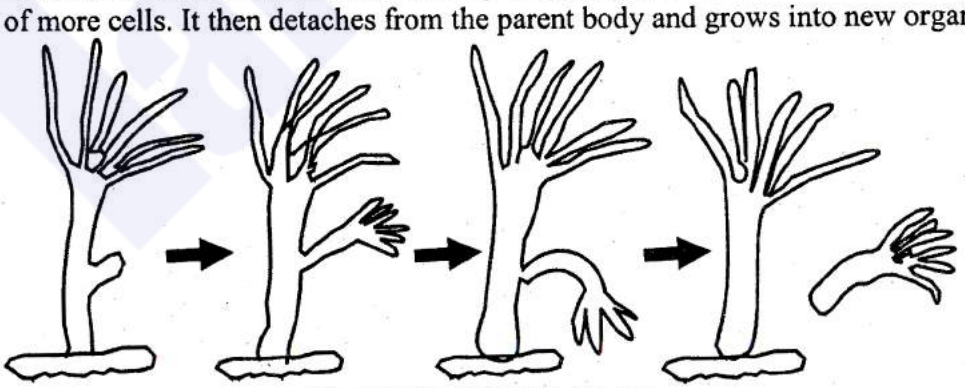


Figure: Budding in *Hydra*

Budding in Corals:

In corals, the buds do not detach from the parent body. Corals form big colonies, because the buds grow into new organisms by remaining attached to the parent body.

Q. No. 5 Write a note on spore formation.

SPORE FORMATION

Spore:

An asexual reproductive structure that gives rise to new plant body directly is called as spore.

Example:

- It is generally seen in most fungi e.g. *Rhizopus*.

Spore Formation in *Rhizopus*:

When *Rhizopus* reaches reproductive age, its body cells form thick walled spore sacs called sporangia (sing. Sporangium). Inside each sporangium, a cell divides many times and forms many daughter cells called spores. Each spore is covered with a thick wall called cyst and it can survive unfavourable conditions. When sporangia are mature, they burst and release spores. Under favourable conditions, the spores germinate and develop into new *Rhizopus*.

Endospore Formation in Bacteria:

Under unfavourable conditions, some species of bacteria reproduce by forming spores. The bacterial spores are also thick walled. They are formed inside bacterial cells, so are called endospores. For example, the bacteria of the following species form endospores:

- *Clostridium*
- *Bacillus*

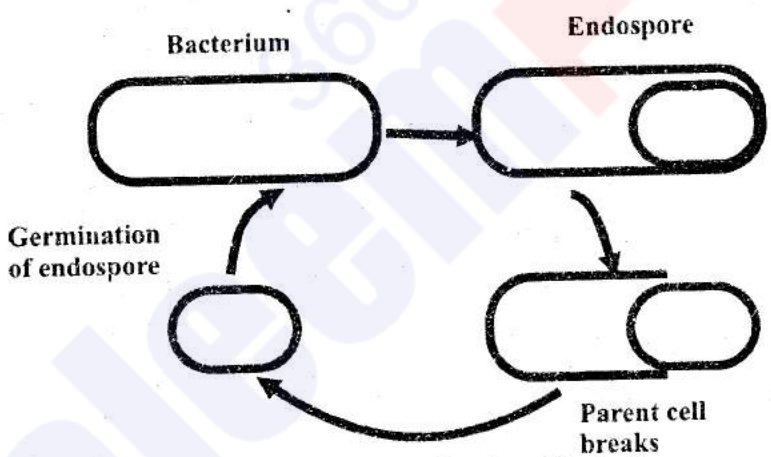


Figure: Spore Formation in a Bacterium

Q. No. 6 Write a note on parthenogenesis.

PARTHENOGENESIS

Definition:

A type of asexual reproduction in which an unfertilized egg develops into a new individual is called parthenogenesis.

Examples:

The phenomenon of parthenogenesis is observed in some:

- Fishes
- Frogs
- Insects

Parthenogenesis in Honey Bees:

Queen honeybee lays eggs in the cells of honeycomb. Many eggs remain unfertilized and develop into haploid males called drones by parthenogenesis. At the same time, some eggs are fertilized by male bees and these develop into diploid females and new queen and worker bees are formed.

Q. No. 7 Write a note on natural vegetative propagation.

VEGETATIVE PROPAGATION

Definition:

The process in which vegetative parts of plants i.e. roots, stems or leaves give rise to new plants, is called vegetative propagation.

- It is also called vegetative reproduction.

NATURAL VEGETATIVE PROPAGATION:

If the process of vegetative propagation occurs naturally then it is called natural vegetative propagation.

Types of Natural Vegetative Propagation:

Vegetative propagation occurs naturally is several ways:

1. Bulbs
2. Corms
3. Rhizomes
4. Stem Tubers
5. Suckers
6. Leaves

1. Bulbs:

Bulbs are short underground stems surrounded by thick, fleshy leaves that contain stored food. Adventitious roots emerge under the base of bulb while shoots emerge from the top of the base.

Examples:

- Tulips
- Onions
- Lilies

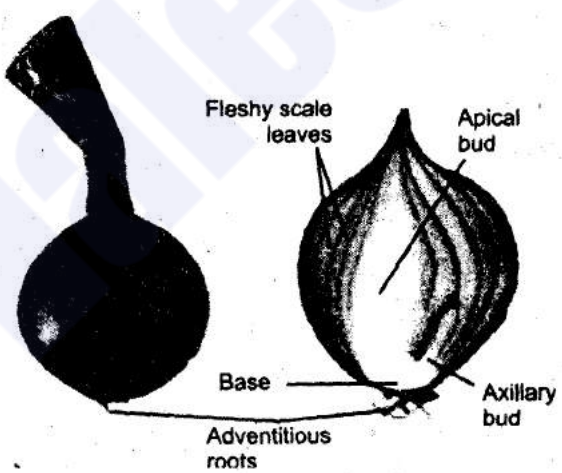


Figure: Bulb of Onion

2. **Corms:**

Corms are short and swollen underground stems containing stored food. Buds are present at the top of corm. From a bud, shoot grows and forms a new plant.

Examples:

- Dasheen
- Garlic

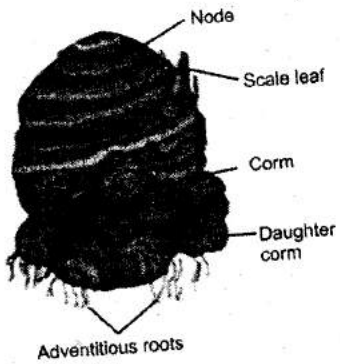


Figure: Corm of *Colocacia*

3. **Rhizomes:**

Rhizomes are horizontal underground stems with scale leaves. There are enlarged portions called nodes on rhizome. Buds are produced at nodes. The buds present on the upper surface of rhizome give rise to shoot. The lower surface of rhizome produces adventitious roots.

Examples:

- Ginger
- Ferns
- Water lilies

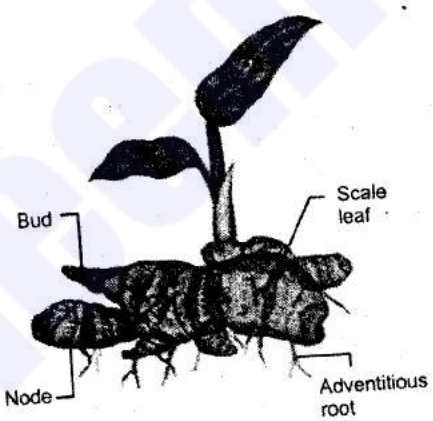


Figure: Rhizome of Ginger

4. **Stem Tubers:**

Stem Tubers are the enlarged portions of an underground stem (rhizome). There are aggregations of tiny buds in the form of "eyes" along the surface of tuber. Each bud develops into shoot that grows upward and also produces roots.

Examples:

- Potatoes
- Yams

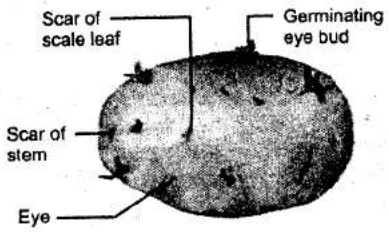


Figure: Stem Tuber of Potato

5. **Suckers:**

Suckers are lateral stems close to ground level. A sucker grows underground form some distance and then turns up, producing the new plant.

Examples:

- Mint
- *Chrysanthemum*

6. **Leaves:**

Vegetative propagation by leaves is not common and is seen in plants such as:

- *Bryophyllum* (Pather chut)

This plant has fleshy leaves and adventitious buds are present at the margins of leaves. When leaf falls on ground, the buds grow into new plants

Figure: *Bryophyllum* Leaf with Buds

Q. No. 8 Write a note on artificial vegetative propagation.

VEGETATIVE PROPAGATION

Definition:

The process in which vegetative parts of plants i.e. roots, stems or leaves give rise to new plants, is called vegetative propagation.

- It is also called vegetative reproduction.

ARTIFICIAL VEGETATIVE PROPAGATION

If the process of vegetative propagation occurs artificially by gardeners and farmers then it is called artificial vegetative propagation.

Types of Artificial Vegetative Propagation:

The following two are the most common methods of artificial vegetative propagation:

1. Cuttings
2. Graftin

1. **Cuttings:**

In this method, cuttings may be taken mainly from the stems or roots of parent plant. These cuttings must have a meristematic region from which growth can occur. The cuttings will form roots and shoots when they are placed in a suitable soil and under right conditions like:

- Sufficient nutrients
- Water
- Sunlight

Roots and shoots grow and develop into a plant identical to the parent plant from which the cuttings were taken.

Stem Cuttings:

The following plants are artificially propagated through stem cuttings:

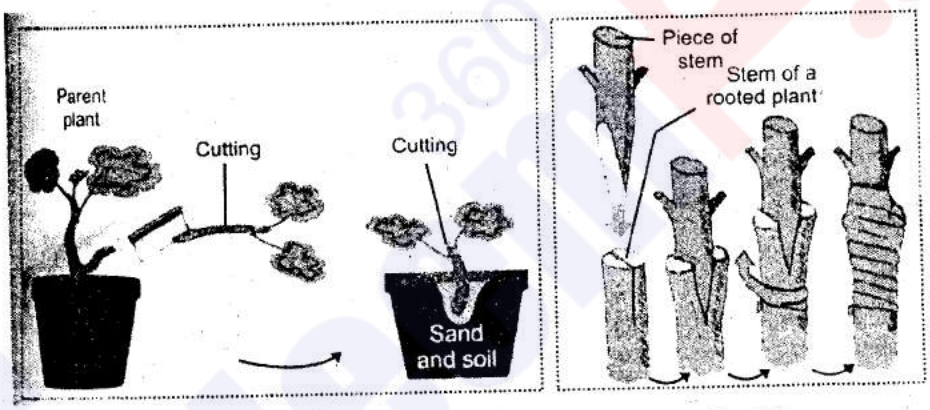
- Roses
- Ivy
- Grapevines

Root Cuttings:

Sweet potato is an enlarged root. Farmers place it in moist sand or soil until it produces several plantlets. Then the plantlets are removed and planted.

Advantages:

- This process is used to produce many plants from a single plant.
- All new plants are exactly the same.
- This artificial vegetative propagation has been very beneficial on sugar cane plantation.



Cutting **Grafting**

Figure: Artificial Vegetative propagation

2. **Grafting:**

In grafting, a piece of stem is cut from the plant and is attached with another plant with established root system. After a while, the vascular bundles of the attached stem piece and the host plant are connected to each other. The stem piece and the plant begin to grow together.

Examples:

This method is used to propagate:

- Many roses
- Peach trees
- Plum trees
- Various seedless fruits including grapes

Q. No. 9 **Describe the advantages and disadvantages of vegetative propagation of plants.**

VEGETATIVE PROPAGATION

Definition:

The process in which vegetative parts of plants i.e. roots, stems or leaves give rise to new plants, is called vegetative propagation.

- It is also called vegetative reproduction.

ADVANTAGES OF VEGETATIVE PROPAGATION

Genetically Identical Offsprings:

The offsprings produced through vegetative propagation are genetically identical. Therefore beneficial characteristics can be preserved.

No Need of Pollination:

In vegetative propagation, there is no need of any mechanism of pollination. It helps to increase number of plants at a rapid rate.

Survival in Unfavourable Conditions:

The organs of vegetative propagation enable many plants to pass over unfavourable conditions.

Reproduction of Seedless Plants:

Plants bearing seedless fruits can be grown only by vegetative propagation.

DISADVANTAGES OF VEGETATIVE PROPAGATION

No Genetic Variations:

The plants do not have genetic variations.

Diseases Attack:

Species specific diseases can attack and this can result in the destruction of an entire crop.

Q. No. 10 **Write a note on tissue culture and cloning.**

TISSUE CULTURE AND CLONING

Cloning:

The process in which identical offsprings are produced from a single parent using its vegetative tissue or cell is called cloning.

Latest Method:

Cloning is the latest method of vegetative propagation.

Technique:

Tissue culture is the technique applied in this method.

Mechanism:

Extraction of Tissues:

Tissues are taken from any part of plant and are put in a suitable nutrient medium.

Formation of Calluses:

The tissue cells start mitosis and produce masses of cells called calluses are transferred to other medium that contains different hormones for the formation of:

- Roots
- Stem
- Leaves

Formation of New Plant:

Calluses make these structures and grow into new small plants. The small plants are then planted in pots and then in fields.

Q. No. 11 Explain the phenomenon of alternation of generations.

ALTERNATION OF GENERATIONS

Definition:

The phenomenon in which two different generations alternate with each other during life cycle is known as alternation of generations.

Explanation:

In the life cycle of plants, two different generations alternate with each other.

Sporophyte Generation:

One generation is diploid and produces spores. It is called sporophyte generation. In most plants, sporophyte generation is dominant. It means that it is big in size and is independent.

Gametophyte Generation:

The other generation is haploid and produces gametes. It is called gametophyte generation. It is small in size and depends upon sporophyte. It produces gametes by mitosis.

Formation of Gametophyte:

Sporophyte produces haploid spores by meiosis. The spores develop into gametophyte.

Formation of Sporophyte:

The male and female gametes fuse and form diploid zygote. The zygote undergoes repeated mitosis and develops into a new diploid sporophyte.

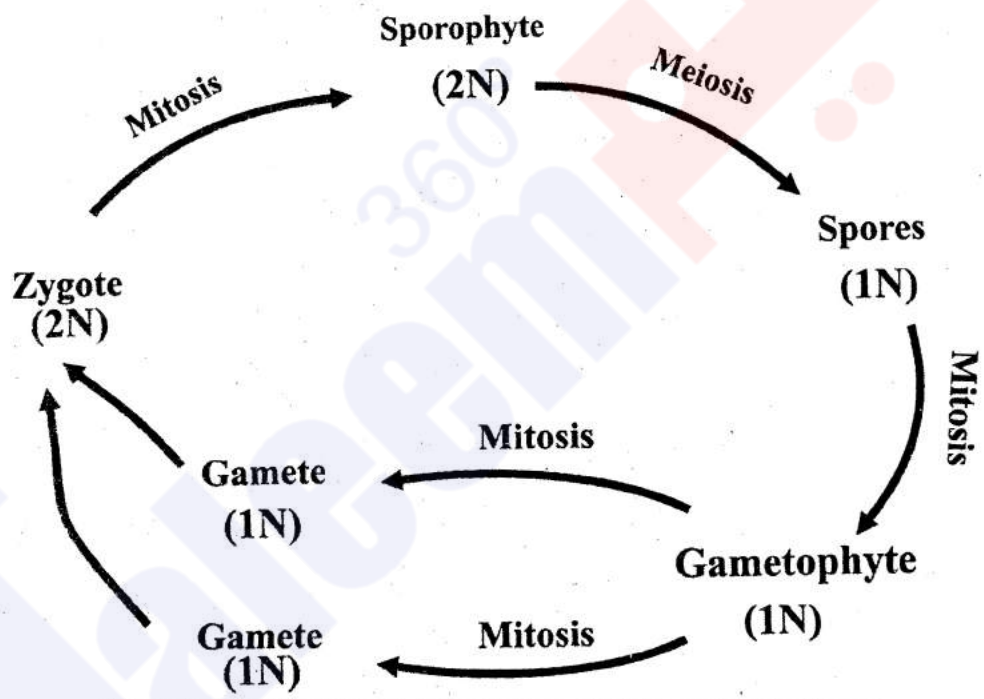


Figure: An overview of Alternation of Generations in Plants

Q. No. 12 Describe sexual reproduction in flowering plants.

SEXUAL REPRODUCTION IN FLOWERING PLANTS

In angiosperms, parent plant is diploid sporophyte generation. Flower is the reproductive structure in this generation. The flower components are arranged in the form of whorls. The outer two whorls in a flower are the non-reproductive whorls while the inner two whorls are the reproductive whorls.

STRUCTURE OF A FLOWER

The following four whorls are present in the flower:

1. Calyx
2. Corolla
3. Androecium
4. Gynoecium

1. **Calyx:**

Calyx is the outermost whorl.

Colour:

It usually green in colour.

Sepals:

Its individual units (leaflets) are called sepals.

Function:

Sepals protect the inner whorls at bud stage.

2. **Corolla:**

Corolla is the next inner whorl.

Colour:

It is brightly coloured.

Petals:

Its individual units (leaflets) are called petals.

Function:

They serve to attract bees, birds etc. which are the agents of pollination.

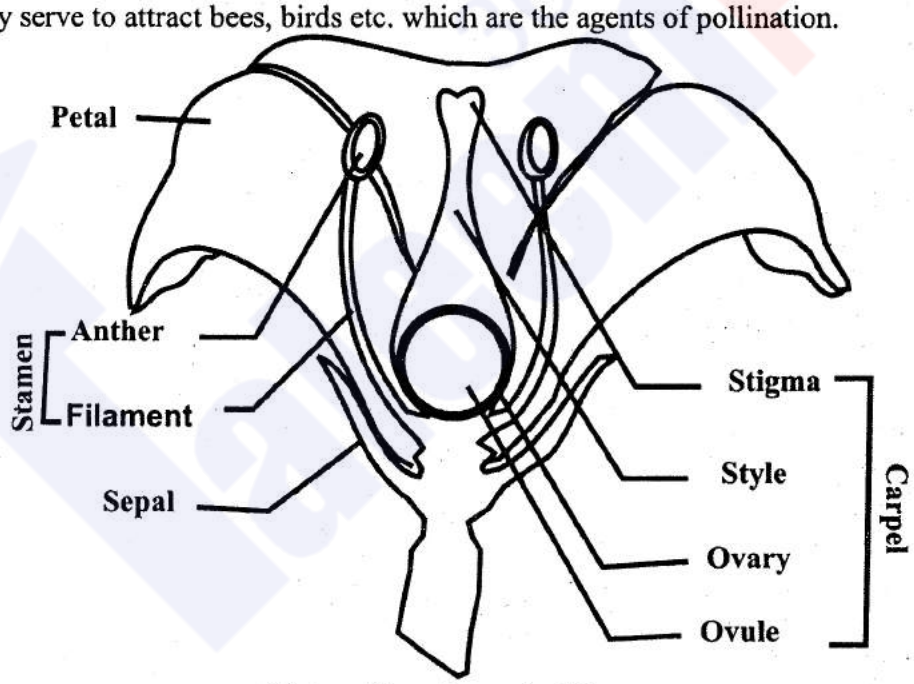


Figure: Structure of a Flower

3. **Androecium:**

Androecium is the third whorl and the male reproductive part of flower.

Stamens:

Its units are called stamens.

Filament:

Each stamen has a thread-like filament at the free end of which anther is attached.

Anther:

Anther has pollen-sacs in which haploid microspores (pollen grains) are produced through meiosis. Each microspore germinates into the male gametophyte generation.

Formation of Male Gametophyte:

The nucleus of microspore undergoes mitosis and produces two nuclei:

- Tube nucleus
- Generative nucleus

The generative nucleus again undergoes mitosis and produces two sperms. So, a germinated microspore has a tube nucleus and two sperms. All these structures are the male gametophyte generation of plant.

4. Gynoecium:

Fourth whorl i.e. gynoecium is the female reproductive part of flower.

Carpels:

Its units are called carpels or pistils.

Structure of Carpel:

Each carpel is made up of:

- Basal ovary
- Middle style
- Upper stigma

Ovules:

Inside ovary, there are one to many ovules. Inside each ovule, one haploid macrospore produced through meiosis. Macrospore germinates into the female gametophyte generation.

Formation of Female Gametophyte:

The macrospore undergoes mitosis and produces an egg cell and some associate structures e.g. fusion nucleus. Egg cell and associated structures are the female gametophyt generation of plant.

Pollination:

When pollen grains mature, they are transferred to stigma. It is called pollination.

Formation of Pollen Tube:

On reaching the stigma, the tube nucleus of pollen grain constructs a pollen tube. Th pollen tube contains a tube nucleus and two sperms. The tube grows through style and ovary an enters ovule. Here, it bursts and releases the sperms. Both sperms enter the female gametophyte.

Formation of Zygote:

One sperm fuses with egg and forms a diploid (2N) zygote.

Formation of Endosperm Nucleus:

The other sperm fuses with diploid fusion nucleus and forms a triploid (3N) nucle called endosperm nucleus.

Double Fertilization:

The process of fertilization involves two fusions, it is called double fertilization.

Developmental Process:

Zygote develops into embryo and endosperm nucleus develops into endosperm tis (food of the growing embryo). Ovule then becomes seed and ovary changes into fruit.

Dispersal of Seeds:

When seeds mature, they are dispersed. If seeds get suitable conditions, their embryos develop into new plants i. e. the diploid saprophytes of the next generation.

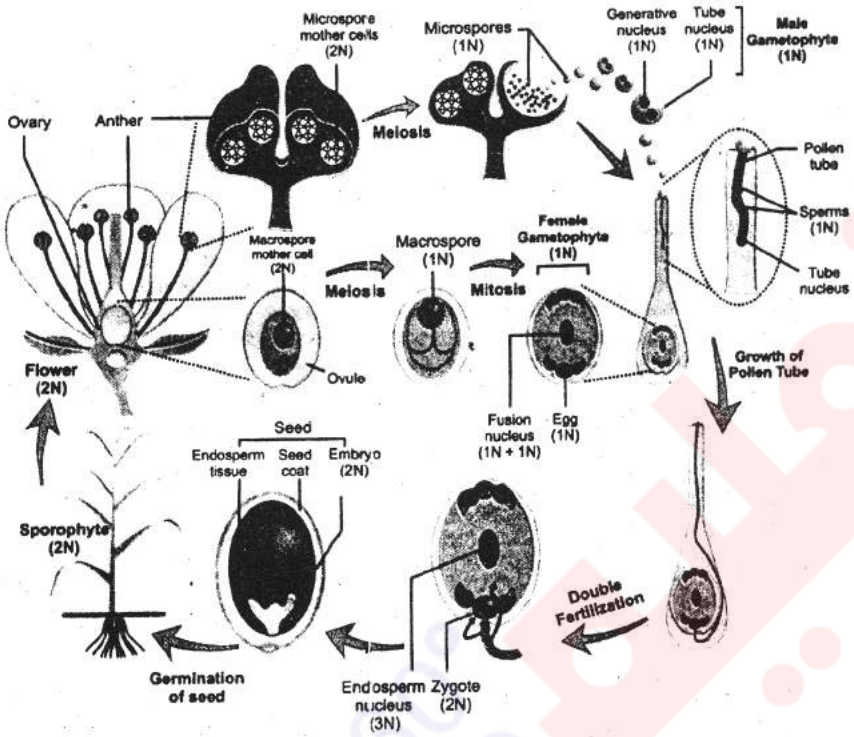


Figure: Life Cycle of a Flowering Plant

Q. No. 13 Define pollination. Explain its types. Discuss the adaptations in insect and wind pollinated flowers.

POLLINATION

Definition:

The transfer of pollen grains from anther of the stamen to stigma of carpel is called pollination.

Types of Pollination:

The following two types of pollination are recognized:

1. Self Pollination
2. Cross Pollination

1. Self Pollination:

The transfer of pollen grains from the anther of stamen to the stigma of the carpel of the same flower or other flower of the same plant is called self pollination.

2. Cross Pollination:

The transfer of pollen grains from anther of stamen to the stigma of the carpel of one plant to the flower on other plant of the same species is called cross pollination.

Cross pollination is brought about by various agencies like:

- Wind
- Water
- Bees
- Birds
- Bats
- Other animals including man

ADAPTATIONS IN INSECT-POLLINATED AND WIND-POLLINATED FLOWERS

Feature	Insect Pollinated Flowers	Wind Pollinated Flowers
Flowers	Generally large	Generally small
Colour	Petals brightly coloured	Petals green or dull in colour
Nectar	Produce nectar	Do not produce nectar
Floral Arrangement	Flowers face upwards	Flowers hang down for easy shaking
Stamens and Stigmas	Enclosed inside ring of petals	Hang out of ring of petals
Pollen Grains	Small number produced /heavy and sticky	Large number produced / light with smooth surface
Stigma	Pinhead shaped with no branches	Feathery branches for catching pollen
Examples	• Buttercup • Rose • Wallflower • Sunflower • Orchid	• Grasses • Hazel • Willow • Corn

Q. No. 14 Describe the development and structure of seed.

DEVELOPMENT OF SEED

After fertilization in the female gametophyte, zygote divides repeatedly by mitosis and develops into an embryo. At this stage (in gymnosperms and angiosperms), ovule changes into seed. The formation of seed completes the process of sexual reproduction in seed plants.

STRUCTURE OF SEED

Angiosperm seeds consist of three distinct parts:

- The embryo formed from zygote
- The endosperm tissue formed from endosperm nucleus
- The seed coat which develops from the wall of ovule called integument

Seed Coat:

The other name of seed coat is testa. Seed coat develops from the integument, originally surrounding the ovule.

Thickness:

It may be a paper-thin layer, for example:

- Peanut

It may be thick and hard, for example

- Coconut

Function:

Seed coat protects embryo from mechanical injury and from drying out.

Hilum:

There is a scar on seed coat, called hilum. It is where the seed is attached to ovary wall (fruit).

Micropyle:

At one end of hilum, there is micropyle. This is the same opening through which the pollen tube entered ovule.

Function:

Seed uses it for the absorption of water.

Embryo:

Embryo is actually an immature plant. It consists of:

- A radicle
- A plumule
- One or two cotyledons

Radicle:

The radicle of embryo develops into new root.

Plumule:

The plumule develops into new shoot.

Epicotyl:

The embryonic stem above the point of attachment of cotyledons is called epicotyl.

Hypocotyl:

The embryonic stem below the point of attachment of cotyledons is called hypocotyl.

Endosperm:

Within seed, there is a store of nutrients for the seedling that will grow from embryo. In angiosperms, the stored food is derived from the endosperm tissue. This tissue is rich in oil or starch and protein. In many seeds, the food of the endosperm is absorbed and stored by cotyledons.

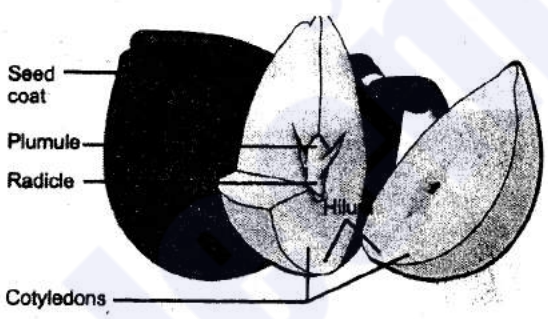


Figure: The Structure of a Dicot Seed

Q. No. 15 Define germination. Explain its types. What conditions are necessary for seed germination?

GERMINATION OF SEED

Definition:

The process by which a. seed embryo develops into a seedling is called seed germination.

Mechanism:

Absorption of water:

During germination, embryo soaks up water which causes it to swell, splitting the seed coat.

Formation of Root:

Root is the first structure that emerges from the radicle present in seed. It grows rapidly and absorbs water and nutrients from soil.

Formation of Shoot:

In the next phase, plumule develops into tiny shoot which elongates and comes out of soil.

TYPES OF GERMINATION

On the basis of the elongation of hypocotyl and epicotyl, there are two types of germination:

1. Epigeal Germination
2. Hypogeal Germination

1. Epigeal Germination:

In epigeal germination, the hypocotyl elongates and forms a hook, pulling the cotyledons above ground. The examples of seeds that germinate this way are:

- Beans
- Cotton
- Papaya

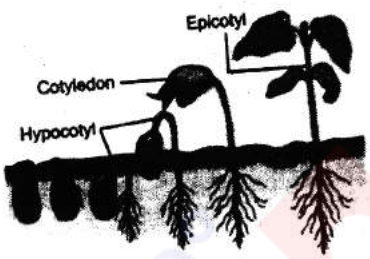


Figure: Epigeal Germination

2. Hypogeal Germination:

In hypogeal germination, the epicotyl elongates and forms the hook. In this type of germination, the cotyledons stay underground. The examples of seeds that germinate this way are:

- Pea
- Maize
- Coconut

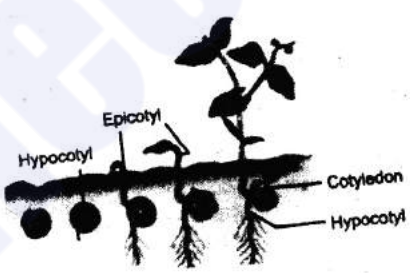


Figure: Hypogeal Germination

CONDITIONS FOR SEED GERMINATION

Seed germination depends on both internal and external conditions.

Internal Conditions:

The internal conditions include:

- A live embryo
- Sufficient food storage

External Conditions:

The most important external conditions include:

1. Water
2. Oxygen
3. Favorable temperature

1. **Water (moisture):**

Seeds of most plants have low water content, and germination cannot occur until seed coat or other tissues have imbibed (taken in) water. The absorbed water is used in the digestion of the stored food and it also helps in elongation of hypocotyl and epicotyl.

2. **Oxygen:**

Oxygen is essential for the respiration in the cells of embryo.

3. **Temperature:**

Seeds differ greatly in their temperature requirements for germination. The optimum temperature for the germination of the seeds of most plants ranges from 25-30°C.

Q. No. 16 Write a note on gametogenesis in animals.

GAMETOGENESIS

Definition:

The formation of gametes is called gametogenesis.

Cell Division:

In this process, diploid (2N) gamete-mother cells undergo meiosis and form haploid (1N) gametes.

Gonads:

The male gametes (sperms) and female gametes (egg cells or ova) are produced in specialized organs called gonads.

Testes:

Male gonads are called testes. The singular of testes is testis.

Ovaries:

Female gonads are called ovaries.

SPERMATOGENESIS

Definition:

The process of production of sperms in testes is called spermatogenesis

Formation of Spermatogonia:

Some cells present in the walls of the seminiferous tubules of testes divide repeatedly by mitosis to form large number of diploid spermatogonia.

Formation of Primary Spermatocyte:

Some spermatogonia produce primary spermatocytes.

Formation of Secondary Spermatocyte:

Each primary spermatocyte undergoes meiosis-I and produces two haploid daughter cells called secondary spermatocytes.

Formation of Spermatids:

These cells undergo meiosis-II. In this way four haploid spermatids are produced from each primary spermatocyte. The spermatids are non-motile and many changes occur in them to convert them into motile cells.

Formation of Sperms:

Their nuclei shrink and the following structures are formed:

- A corner called acrosome
- A tail
- A mitochondrial ring

After these changes, the spermatids are called sperms.

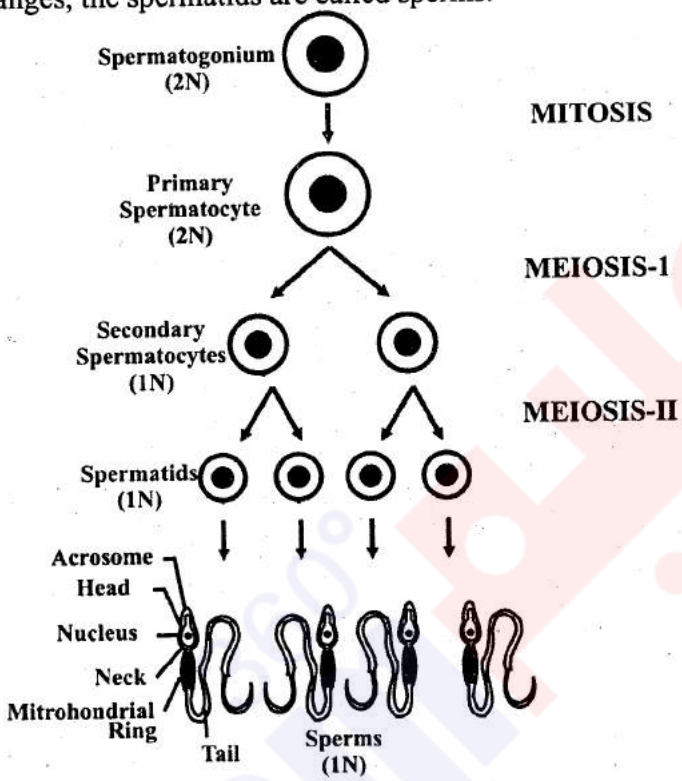


Figure: Spermatogenesis

OOGENESIS

Definition:

The process of production of egg cells in ovaries is called oogenesis.

Formation of Follicles:

Some cells of ovary prepare structures called follicles, in which many diploid oogonia are present. Some oogonia produce diploid primary oocytes.

Meiosis-I:

One of the primary oocytes completes meiosis-I and produces two haploid cells. The smaller cell is called first polar body and the larger one is called secondary oocyte.

Meiosis-II:

The secondary oocyte completes meiosis-II and produces two haploid cells i.e. a second polar body and an egg cell.

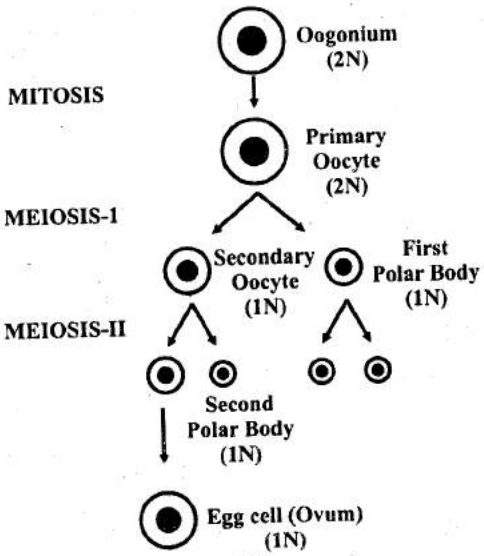


Figure: Oogenesis

Q. No. 17 Define fertilization. Explain its mechanisms.

FERTILIZATION

After the formation of gametes, fertilization occurs.

Definition:

The fusion of male gamete (sperm) and female gamete (egg or ovum) to form diploid zygote is called fertilization.

MECHANISMS OF FERTILIZATION

There are two mechanisms by which fertilization can take place:

1. External Fertilization
2. Internal Fertilization

1. External Fertilization:

In external fertilization, egg cells are fertilized outside of body. External fertilization occurs mostly in aquatic environment.

Release of Gametes:

It requires both the male and the female animals to release their gametes into their surroundings at almost the same time. For external fertilization, the animals have to release great number of gametes.

Disadvantage:

In external fertilization, there is risk of loss of gametes due to environmental hazards such as predators.

Examples:

External fertilization occurs in many invertebrates and the first two groups of vertebrates:

- Fishes
- Amphibians

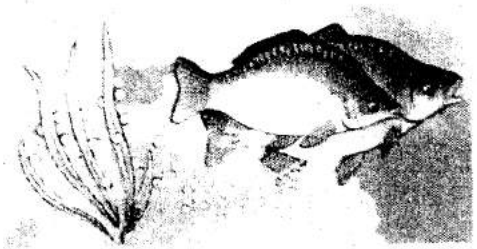


Figure: External Fertilization in Fish

2. **Internal Fertilization:**

In internal fertilization, egg cells are fertilized within the reproductive tract of female. Such animals provide protection to the developing embryo.

Examples:

It occurs in:

- Reptiles
- Birds
- Mammals

Reptiles and Birds:

After fertilization, reptiles and birds make protective shells around their egg cells and then lay them. The shell is resistant to water loss and damage.

Mammals:

In mammals (with the exception of egg-laying mammals) the development of fertilized egg into new baby takes place within mother body. In this case, there is extra protection to the embryo and mother also supplies everything that embryo needs.

Figure: Reptiles and Bird's Egg provides Protection and Food to Embryo

Q. No. 18 Describe male reproductive system of rabbit.

MALE REPRODUCTIVE SYSTEM OF RABBIT

Introduction:

Rabbits are small mammals found in several parts of the world. They are used in research as experimental animals.

Parts:

The male reproductive system of rabbit consists of a pair of testes that produce sperms, the associated ducts that transport sperms to external genitalia and glands that add secretions to sperms.

Scrotum:
Testes are located in a bag of skin called the scrotum that hangs below the body.

Seminiferous Tubules:
Each testis consists of a mass of coiled tubes called the seminiferous tubules. In these tubules, the sperms are formed.

Epididimys:
When sperm are mature, they accumulate in the collecting ducts of testes and then pass to epididimys.

Vas Deferens:
From epididimys, sperms move to a sperm duct called vas deferens.

Sperm Duct:
Both sperm ducts join urethra just below urinary bladder.

Urethra:
The urethra transports both sperm and urine.

Semen:
Semen is the material containing sperms in a fluid. It consists of 10% sperms and 90% fluid.

Associated Glands:
As the sperms pass down the ducts from testes to urethra, the associated glands add various secretions.

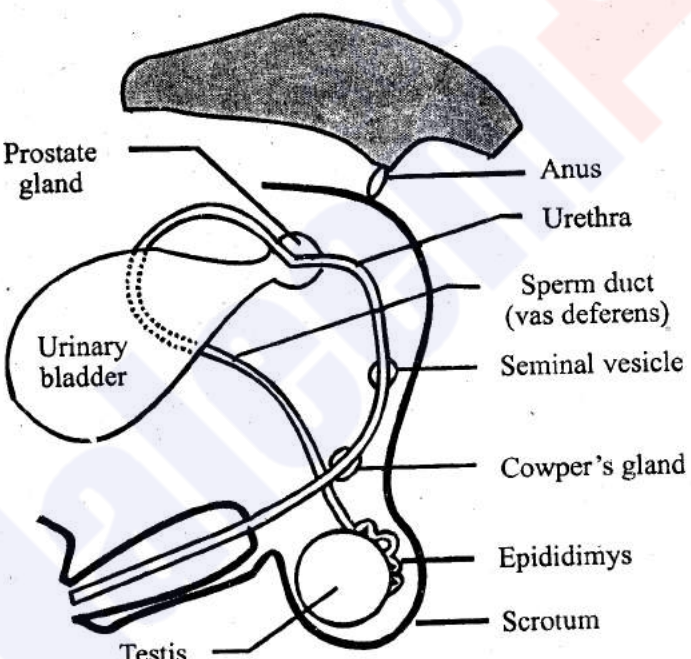


Figure: Male Reproductive System of Rabbit

Seminal Vesicles:
Seminal vesicles produce secretions that provide nutrients for sperms.

Prostate Gland:
Prostate gland produces a secretion that neutralizes the acidity of the fluid.

Cowper's Gland:
Cowper's glands produce secretions that lubricate the ducts.

Q. No. 19 Describe female reproductive system of rabbit.

FEMALE REPRODUCTIVE SYSTEM OF RABBIT

Introduction:

Rabbits are small mammals found in several parts of the world. They are used in research as experimental animals.

Parts:

The female reproductive system of rabbit consists of ovaries and associated ducts.

Ovaries:

Ovaries are small oval organs situated in abdominal cavity just ventral to kidneys. Like most animals, female rabbits have a pair of ovaries. The outer region of ovary produces egg cells.

Follicles:

A cluster of specialized cells called follicle surrounds and nourishes each egg cell. From ovaries, egg cells are released in fallopian tubes.

Fallopian Tube:

The opening of fallopian tube lies close to ovary. Fertilization occurs in fallopian tubes.

Uterus:

The fertilized egg (zygote) is carried to uterus. The uterus of rabbit is divided into two separate parts or horns.

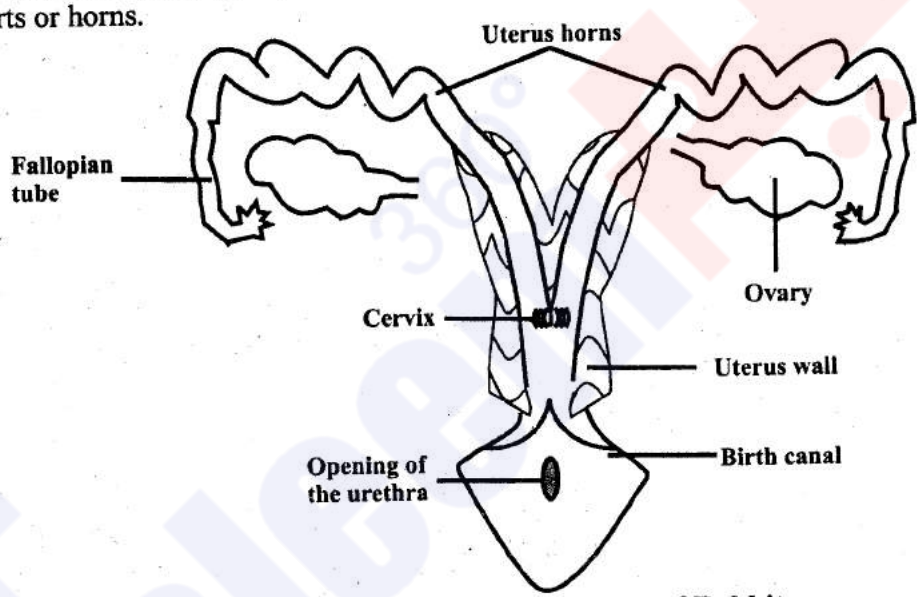


Figure: Female Reproductive System of Rabbit

Birth Canal:

The uterus horns join and open into vagina or birth canal.

Cervix:

Cervix is the portion of uterus, which separates it from birth canal, where sperms of male are deposited.

Q. No. 20 Describe fertilization and development in rabbit.

FERTILIZATION AND DEVELOPMENT IN RABBIT

Breeding Season:

Rabbits can breed throughout the year but male rabbits are commonly sterile during the summer months.

Ejaculation of Sperms:

Male rabbit deposits its sperms in the vagina (birth canal) of female.

Fertilization:

Sperms swim through cervix and uterus to fallopian tubes where they fertilize the egg cells, released from ovary.

Embryo Formation:

After fertilization, zygote is carried to uterus. By this time, the zygote has started dividing and is now called embryo.

Placenta:

The embryo is implanted in uterus walls. A connection, called placenta, is established between embryo and uterus wall.

Gestation Period:

Embryo develops into new offspring (rabbit kit) in 30-32 days, after which it is born

Q. No. 21 Discuss growth in human population and its consequences.

GROWTH IN HUMAN POPULATION

Population Growth:

Pakistan's population in the year 2007-2008 was 163,775,000. By the end of this decade, our population is expected to exceed 176 million. Pakistan's population had a relatively high growth rate in past.

Overpopulation:

When population growth exceeds the carrying capacity of an area or environment, it results in overpopulation.

CONSEQUENCES OF OVERPOPULATION

Many problems are associated with human overpopulation.

Shortage of Resources:

The overpopulated areas face severe shortage of fresh water and natural resources.

Loss of Ecosystems:

Overpopulation results in deforestation and loss of ecosystems.

Pollution:

It leads to more pollution and global warming.

Mortality Rate:

There is high infant and child mortality rate in overpopulated areas due to poverty.

Increased Demands:

Overpopulation raises demands for more:

- Housing units
- Hospitals
- Jobs
- Educational institutions
- Food crops

CHECKING OVERPOPULATION

The overpopulation should be checked otherwise we will have to face huge problems because of our limited resources.

Education:

People should be educated about the problems of overpopulation.

Role of Ministry of Population Welfare:

Pakistan's Ministry of Population Welfare has taken a number of steps to make people aware of the hazards of overpopulation and to stabilize the population to match our resource:

Q. No. 22 Write a note on AIDS.

AIDS: A Sexually Transmitted Disease

Sexually Transmitted Diseases (STDs):

The diseases that are transmitted through sexual act are called sexually transmitted diseases.

Leading Problem:

The most serious and challenging health problem faced by the world today is AIDS. It is also a sexually transmitted disease.

Abbreviation:

AIDS stands for Acquired Immune Deficiency Syndrome.

Causative Pathogen:

It is caused by Human Immuno Deficiency Virus (HIV).

Mode of Action:

The virus destroys white blood cells, which results in loss of resistance against infections.

Fatal Disease:

It is a fatal disease.

Spread of Disease:

It spreads through transfer of body fluids such as blood and semen.

Causes:

The main causes are:

- Unprotected sexual activities
- Use of infected needles
- Transfusion of infected blood

Q. No. 23 Describe the role of National AIDS Control Programme (NACP) and Non-Government Organizations in controlling AIDS.

ROLE OF NATIONAL AIDS CONTROL PROGRAMME (NACP)

Introduction:

Pakistan's Federal Ministry of Health established NACP in 1987.

Objective:

The main objective of this programme is to help the public for the prevention of HIV transmission, safe blood transfusions and reduction of STDs.

Incidence:

The frequency of HIV infection in Pakistan is still low. But, the country is at risk of epidemic due to various risk factors:

- Exposure to infected blood or blood products
- Homo-sex
- Injecting drug users

Campaign:

For improved prevention by the general public, the NACP started services through TV and radio channels and print media in 2005. The objectives of this activity were to:

- Change public attitude for safe sexual activities
- Create demand for information on HIV and AIDS
- Improve attitudes and behaviour among healthcare workers

ROLE OF NON GOVERNMENT ORGANIZATIONS

According to the latest data by the World Bank, at least 54 NGOs are working in Pakistan for HIV/AIDS public awareness and for the care and support of persons living with HIV/AIDS.

- These NGOs also work on AIDS education and prevention for sex workers and other high-risk groups.
- NGOs serve as members of the Provincial Consortium on H IV/AIDS, which has been set up in all the provinces of Pakistan.

Access to Victims:

Although NGOs are very busy in HIV/AIDS prevention activities, it is believed that they are reaching less than 5 percent of the vulnerable population.

REVIEW QUESTION:

MULTIPLE CHOICE QUESITONS

1. **Growing an entire new plant from part of the original plant is called:**
   (a) Budding (b) Regeneration
   (c) Fragmentation (d) Vegetative propagation
2. ***Rhizopus* reproduces asexually by:**
   (a) Binary fission (b) Budding
   (c) Spore formation (d) Endospore formation
3. **A corm develops into new garlic plant. This is the process of:**
   (a) Vegetative propagation (b) Regeneration
   (c) Meiosis (d) Gametogenesis
4. **Which is not an advantage of grafting?**
   (a) The graft is identical to the parent plant
   (b) Grafting allows the propagation of seedless fruits
   (c) The graft combines the characteristics of two plants
   (d) Grafting may allow for the faster production of desirable fruits
5. **Pollination is the transfer of pollens from:**
   (a) Anther to stigma (b) Stigma to anther
   (c) Sepal to petal (d) Petal to sepal
6. **Double fertilization in plants means:**
   (a) Fusion of two sperms with two egg cells
   (b) Fusion of one sperm with egg cell and other sperm with fusion nucleus
   (c) Fusion of two sperms with a single egg cell
   (d) Fusion of tube nucleus with fusion nucleus and sperm with egg cell
7. **After fertilization in plants, the fruit develops from:**
   (a) Ovule wall (b) Ovary wall
   (c) Petals (d) Anther
8. **Which part of the female reproductive system receives egg cells from the ovary?**
   (a) Fallopian tube (b) Uterus
   (c) Vagina (d) Cervix
9. **Inside testes, the sperms are produced in:**
   (a) Vas deferens (d) Sperm duct
   (c) Seminiferous tubules (d) Collecting ducts
10. **Which of these cells has haploid number of chromosomes?**
    (a) Spermatogonium (b) Primary spermatocyte
    (c) Secondary spermatocyte (d) AII of these

ANSWER KEY

Q.No.	Ans	Q.No.	Ans	Q.No.	Ans	Q.No.	Ans	Q.No.	Ans
1	d	2	c	3	a	4	b	5	a
6	b	7	b	8	a	9	c	10	c

SHORT QUESTIONS

1. How are the natural and artificial vegetative propagations the methods of asexual reproduction in plants?

Consult Long Question No. 7 and 8

2. Why do gardeners use the methods of cutting and grafting?

Consult Long Question No. 8

3. "Parthenogenesis is a type of asexual reproduction". Give comments on this statement.

Consult Long Question No. 6

4. Outline the life cycle of a flowering plant.

Consult Long Question No. 12

5. What structural adaptations will you find in a wind-pollinated flower?

Consult Long Question No. 13

6. Give an introduction of Pakistan's National AIDS Control Program.

Consult Long Question No. 23

UNDERSTANDING THE CONCEPT

1. What are the different ways by which prokaryotes, protozoans and fungi reproduce asexually?

Consult Long Question No. 1 and 4

2. Explain the different parts of the plant that help in natural vegetative propagation.

Consult Long Question No. 7

3. Explain, how the epigeal and hypogeal germinations are different?

Consult Long Question No. 15

4. What conditions are necessary for the germination of seeds?

Consult Long Question No. 15

5. Outline the methods of asexual reproduction in animals.
6. Write a note on the male and female reproductive systems of rabbit.

Consult Long Question No. 18 and 19

7. Describe the processes of spermatogenesis and oogenesis.

Consult Long Question No. 16

8. Why do we consider that overpopulation is a global problem?

Consult Long Question No. 21

THE TERMS TO KNOW

Acrosome:
Cap-like head of sperm cell which helps it in penetrating the egg cell

Alternation of generations:
In plants, the phenomenon in which the sporophyte and gametophyte generations alternate with each other.

Androecium:
The male reproductive whorl of the flower; consists of stamens.

Anther:
The sac-like structure of a stamen in which pollen grains are produced.

Binary fission:
Division into two; the simplest method of asexual reproduction in prokaryotes and many unicellular eukaryotes.

Budding:
A type of asexual reproduction in which a bud develops as a small outgrowth on parent's body and forms the new individual.

Bulb:
Underground vertical shots which have modified leaves.

Calyx:
The outer whorl of flowers; consists of sepals

Carpel:
Part of the gynoecium of the flower; consists of stigma, style and ovary

Cervix:
In female reproductive system. The part which separates uterus from the vagina

Cloning:
Method of asexual reproduction in which identical off springs are produced from a vegetative tissue or cell of the parent.

Corm:
Short, swollen underground stem; has bud (s) at the top; gives rise to new plants by vegetative propagation.

Corolla:
The second whorl of flower, consisting of petals.

Cotyledon:
A modified leaf present in seeds; often gives nourishment to the developing seeding.

Cowperm gland:
An accessory gland in rabbits male reproductive system; provides lubrication to the ducts.

Endosperm nucleus:
In the female gametophyte, the triploid nucleus formed by the fusion of sperm and the fusion nucleus.

Endosperm tissue:
The tissues that develops from endosperm nucleus; often serves as a food supply for developing embryo.

Endospore:
The spore formed inside the bacterial cell

Epicotyl:
The embryonic stem above the point of attachment of the cotyledon(s)

Epididimys:
A storage area for sperms on the upper part of the testes.

Epigeal germination:
A type of seed germination in which the hypocotyle elongates and forms a hook, pulling the cotyledons above the ground.

Fallopian tube:
A part of the female reproductive system; receives egg cell discharged from the ovary.

Follicle:

A structure in the ovary in which the mature egg develops.

Fragmentation:

A type of asexual reproduction in which the animal breaks up into many pieces and each piece develops into a mature animal

Fusion nucleus:

A part of the female gametophyte in plant: formed by the fusion of two nuclei; gives rise to endosperm nucleus when fertilized by a sperm

Gametogenesis:

The process of the formation of gametes

Gametophyte:

The haploid generation in plant life cycle; produces gametes

Grafting:

A type of artificial vegetative propagation in which a piece of stem in cut from the plant and is inserted into another plant with established root system.

Gynoecium:

The central whorl in the flower; consists of carpels.

Hilum:

A scar on the seed coat; the point where the seed is attached to the ovary wall.

Hypocotyl:

The embroyonic stem below the pint of attachment of cotyledon

Hypogeal germination:

A type of seed germination in which the epicotyle elongates and forms the hook while the cotyledons stay underground

Macrospore:

Haploid cell produced in the ovule; divides mitotically and produces the female gametophyte

Micropyle:

The opening in the ovule through which the pollen tube enters; seed uses it for the absorption of water.

Microspore:

Pollen grain; the haploid cells produced in the pollen sac; divi9de mitotically to produce male gametophyte.

Multiple fission:

Division into many; a method of asexual reproduction used by many unicellular paganisms organisms.

Oogonium:

The formation of ovum (egg cell)

Ovary:

The female gonad; produces egg cells and female sex hormones.

Spermatogenesis:
The formation of sperms.

Spermatogonia:
The diploid cells in somniferous tubules of the testes; divide mitotically and produced primary spermatocytes.

Sporophyte:
The diploid generation in plant life cycle; produces spores.

Stamen:
The part of the androcium; consists of anther and filament.

Stigma:
The upper part of the carpel

Style:
The middle portion of the carpel

Testa:
See Seed coat

Testis:
The male gonads; produces sperms and male sex hormones.

Tuber:
The swollen ends of slender rhizomes (underground stem); new plants develop from buds on the stem tubers (vegetative propagation).

Uterus horn:
The two separate parts of the uterus in the female rabbit.

Vas deferens:
The tubes that carry sperms from each testis to the urethra

Vegetative propagation:
A type of asexual reproduction in which the vegetative parts of the plants i.e. roots, stems or leaves produce new generation.

Ovule:

In seed plants, a structure present in the ovary; constains macrospore that develops into female gametophyte; ovule develops into seed after fertilization.

Parthenocarpy:

The process in which ovaries develop into fruit without the fertilization in the ovules present in them, results in seedless fruits e.g. bananas.

Parthenogenesis:

A form of asexual reproduction in which an unfertilized egg develops into new offspring.

Plumule:

The part of the plant embryo that develops into new shoot.

Pollen grain:

See Microspore

Pollen tube:

A tube formed by the tube nucleus of the pollen grain; carries sperms to the ovule.

Pollination:

The transfer of pollen grains from flower's anther to stigma.

Prostate gland:

An accessory gland in the male reproductive system; produces a secretion that neutralizes the acidity.

Radicle:

The part of the plant embryo that develops into new root.

Rhizomes:

Horizontal underground stems; have scale leaves with buds; shoots of the new plant develop and grow form buds (vegetative propagation)

Seed dormancy:

A period, during which there is no growth in the seed; seeds in dormancy are ripe seeds but do not germinate; under favorable conditions, the seeds break dormancy and begin to germinate.

Semen:

The material containing sperms in a fluid.

Seminal vesicle:

The associated gland in male reproductive system; produces secretions having nutrients for the sperms.

Seminiferous tubule:

The coiled tubes present in testes; sperms are formed in these tubules.

Sperm:

The male gamete

Spermatid:

The immature non-motile forms of sperms; are converted into sperms after many changes.