XII

1

REPRODUCTION IN ORGANISMS

SYLLABUS

Reproduction, a characteristic feature of all organisms for continuation of species; Modes of reproduction – Asexual and sexual; Asexual reproduction; Modes-Binary fission, sporulation, budding, gemmule, fragmentation; vegetative propagation in plants.

KEY CONCEPTS

LIFE SPAN

* Life span can be defined as the period from birth to the natural death of an organism.
* It can vary from as short as few days to as long as a number of years.
* It will be a misconception to say that smaller organisms have shorter life span and larger organisms have longer life span.
* Maximum Life Span is the maximum number of years survived or the greatest age reached by any member of a species.
* The average life span means, the average number of years survived or age reached by members of a population.
* Life expectancy, the number of years an individual can expect to live, is based on average life spans.
* The maximum life span of wild animals is very difficult to estimate because signs of senility, or extreme old age are seldom seen in the wild.
* Animals living under natural conditions rarely approach their maximum possible age because of very high death rates due to infant mortality, diseases, predators, bad weather, accidents or competition for food and shelter.
* Limited life span means death of every individual organism is inevitable i.e. all individual are mortal except single celled organisms.
* The limited life span, mortality of organisms, a variety of plant and animal species are well maintained on earth through the process-reproduction.
* Reproduction ensures the continuity of the different species.
* Approximate life span of some organisms are as follows:

S.N.		Life span
1.	Rice plant	3-4 months
2.	Rose	5-7 years
3.	Banana	20-25 years
4.	Parrot	140 years
5.	Banyan tree	200-300 years
6.	Crow	15 years
7.	Cow	15-25 years
8.	Butter fly	1-2 weeks
9.	Fruit fly	20-30 days
10.	Dog	20-30 years
11.	Crocodile	60 years
12.	Horse	60 years
13.	Elephant	60-90 years
14.	Tortoise	100-150 years

REPRODUCTION

* Reproduction is one of the important processes by which every living organism make a copy of itself. It is the means of multiplication of species because the older individual of each species undergo senescence (Period between sexual maturity and death) and die.

Basic features of reproduction :

All organisms reproduce. Modes of reproduction vary in different organisms. However, all modes have certain common basic features. These are

(i) Replication of DNA. This is the molecular basis of reproduction.

(ii) Cell division, only mitotic, or both mitotic and meiotic. This is cytological basis of reproduction.

(iii) Formation of reproductive bodies or units.

(iv) Development of reproductive bodies into offspring.

All the reproductive methods are broadly categorised into two types :

(a) Asexual Reproduction

(b) Sexual Reproduction

ASEXUAL REPRODUCTION

* In asexual reproduction, the new individual are produced by any means other than the fusion of sex gametes, It means a "reproduction in which new individuals are formed without meiotic division and fusion of gametes is called asexual reproduction." In this way asexual reproduction is also known as apomixis.

[Greek - Apo = without; mixis = mixing] Apomixis term suggested by Winkler.

* The Apomixis is characterised by quick multiplication and reproduction of genetically similar plants from the single parent. Such a population produced from single individual is called "**clone**" and each member of the clone is called ramet.

* Asexual reproduction is common among single-celled organisms, and in plants and animals with relatively simple organisations.

* It is also called **somatogenic reproduction** because propagules are formed from somatic cells of the parent.

* Asexual reproduction brings multiplication of the species only. It does not play a role in evolution as no variation is introduced into the new individuals formed by it. Asexual reproduction is theoretically most advantageous in stable, favourable environment because it perpetuates successful genotypes precisely.

Characteristics of asexual reproduction

All forms of asexual reproduction have certain common basic features. These are under :

(i) A single parent produces offspring, that is, asexual reproduction is uniparental.

(ii) Gametes are not formed.

(iii) Cell divisions are only mitotic.

(iv) The new individuals formed are usually genetically identical to the parent. Variability, if it occurs, is restricted to mutation only.

(v) Multiplication occurs rapidly.

(vi) The offspring are often formed in large numbers near the parent.

Methods of Asexual reproduction

1. Binary fission :

* In this process, the parent organism divides into two halves, each half forming an independent daughter organism.

* It means, the parent body as a whole forms the reproductive unit and the parent continues living as two daughter individuals.

* Therefore, the organisms that undergo binary fission are said to be **immortal**.

* It occurs in Bacteria (Moneran), *Amoeba* and *Paramecium* (Protists).

* There are three modes of binary fission.

(a) Simple binary fission : If the plane of cytoplasmic division passes through any direction, the fission is called simple fission. Example - *Amoeba*.

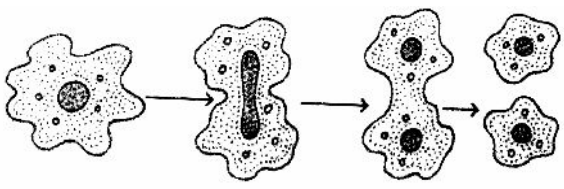


Fig : Simple binary fission in amoeba

(b) Transverse binary fission : If the plane of cytoplasmic division coincides with the transverse axis of the individual, the fission is termed transverse binary division.
Example - *Paramecium* and Planaria.

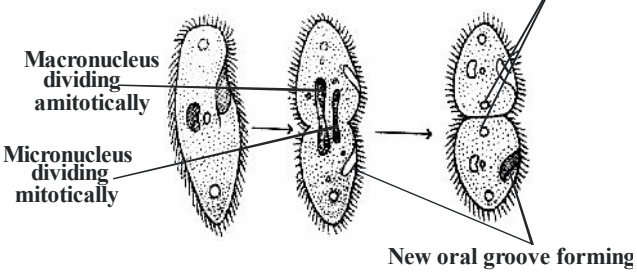


Figure: Transverse binary fission in paramecium

(c) Longitudinal binary fission : If the plane of cytoplasmic division concides with the longitudinal axis of the individual. This kind of fission is designated as longitudinal binary fission. Example *Euglena and vorticella.*

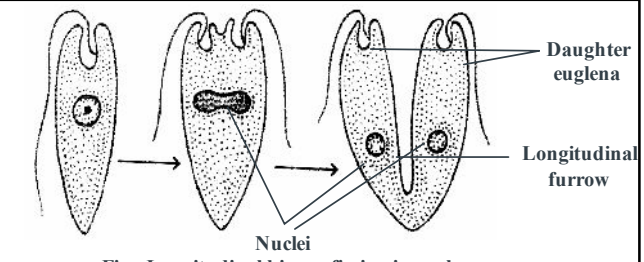


Fig : Longitudinal binary fission in euglena

Binary fission involves mitosis only and consequently, the resultant offspring's are genetically identical to the parent and each other.

2. Multiple fission :

* Multiple fission is the division of the parent into many small daughter individuals simultaneously.
* Examples - Multiple fission occurs in many protozoans such as *Plasmodium.*

3. Budding :

* Formation of a daughter individual from a small projection, the bud, arising on the parent body is called budding.
* It is a common method of asexual reproduction.
* In budding new individual form by mitosis.
* In yeast, the division is unequal and a small bud (protuberance) is produced that remains attached initially to the parent cell, later on the bud gets separated and mature into new yeast (cells).

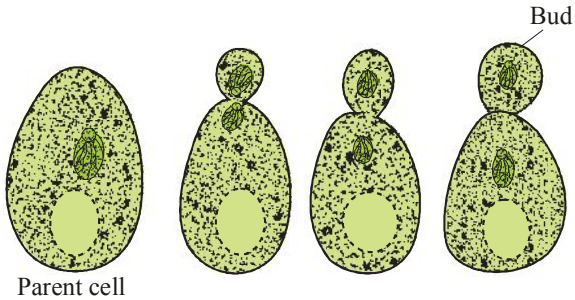


Figure : Budding in yeast

* Examples - Budding occurs in some protozoans and certain lower animals such as sponges *(Scypha)*, coelenterates *(Hydra)*, annelids *(Chaetopterus)* and tunicates *(Salpa)*.

Types of budding

There are two types of budding

(a) Exogenous or External budding : Initially, a small outgrowth of the parent's body develops into a miniature individual. It then separates from the mother to lead a free life. This type of budding is recognised as exogenous budding. Example - *Hydra*.

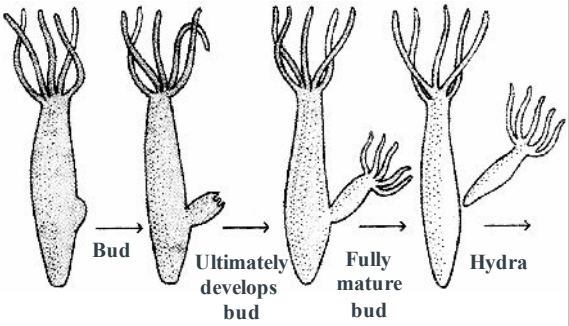


Figure : External budding in hydra

(b) Endogenous or Internal budding : In fresh water sponges (e.g., *Spongilla*) and marine sponge (e.g., *Sycon*), the parent individual releases a specialised mass of cells enclosed in a common opaque envelope, called the gemmule, on **germination**. Each gemmule gives rise to an offspring gemmules are thought to be internal buds. This type of budding recognised as endogenous budding. Example - *Sycon and Spongilla*.

4. Fragmentation :

* It is the breaking up of an animal's body into two or more pieces, each of which grows into a new individual.
* Examples - It occurs in the flatworm, microstomum.

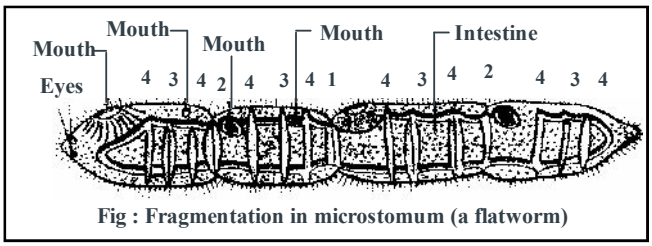


Fig : Fragmentation in microstomum (a flatworm)

5. Regeneration :

* It is a mode of asexual reproduction in which the missing parts of an organism is repaired by ..... *Planaria*.

6. Spore formation :

* Members of the kingdom fungi and simple plants such as algae reproduce through special asexual reproductive structure.
* The most commonly produced structures are **conidia** and **zoospores.**

(i) Zoospores :

* These are endogenously produced unicellular, naked and motile spores with one or two flagella. Zoospores are produced in a sac-like structure called zoosporangium, e.g., *Chalmydomonas*
* In *Chlamydomonas(n)*, the protoplast of cell divides to form 8-16 zoospores.
* They are pyramid shaped and anteriorly biflagellated, resembling the parent cell.
* The parent cell wall breaks and the zoospores are liberated in water.
* They enlarge and behave as adult individuals.
* Zoospores are also produced in the asexual life cycle of Achlya, Saprolegnia, Phytophthora *and* Ulothrix.
* Zoospores of *Cladophora glomerata* are diploid.

(ii) Conidia :

* Asexual non-motile spores cut off externally either singly (e.g., *Phytophthora*) or in chains (e.g. *Penicillium*) from the tip of a special hyphae called conidiophore.
* There are two types of conidiophores :
  a. Unbranched/monoverticillate
  b. Branched/biverticillate
* The branches of conidiophores are called **rami** and branches of rami are called **metulae.**
* Each metula bears 2-6 flask shaped structures called **sterigmata (phialides).** Each sterigma produces a chain of conidia.
* **Features of Conidia:**
  a. Pigmented
  b. Uni or multinucleated
  c. The conidia in the chain are arranged in basipetal manner.

(iii) Gemmules :

* Internal asexual reproductive units or buds are called gemmules, e.g., *Sponges*. These develop within the parental body are released during germination.

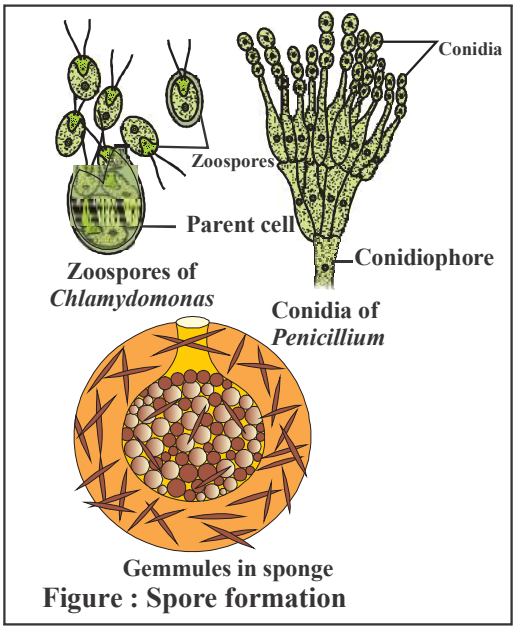


Figure : Spore formation

7. Vegetative reproduction/Propagation :

* Plants belonging to this category propagate by a part of their body other than a seed.
* The structural unit that is employed in place of seed for the propagation of new plants is called propagule.
* In Angiosperms any parts of the plants - roots, stems and leaves used for vegetative propagation.

* Generally method of vegetative propagation have been further divided into two types :

(i) Natural vegetative propagation

(a) By roots : Modified tuberous root of Sweet ..... *(Ipomoea batatas), Asparagus, Tapioca, Yam, Dahlia and Tinospora* can be propagated vegetatively when planted in soil.

In some plants adventitious buds develop on the ordinary roots like-*Dalbergia sisso*, Populus, Guava, Murraya, *Albizzia lebbek* etc. which grow to form new plants. The buds present on the roots grow into leafy shoot above the ground is called Slips.

(b) Under ground Stem : Different types of underground stems like tuber, germinating rhizome, bulb and corm can take part in young shoot vegetative propagation.

A portion of underground stem bearing bud roots forms a new plant.

* **Tuber :** It is terminal portion of underground stem branch which is swollen on account of accumulation of food. *e.g.,* Potato, Artichoke.
* **Rhizome:** It grows obliquely or horizontally under soil surface. It is well branched and bears nodes, internodes, buds and scale leaves. *e.g.,* Banana, Turmeric, *Aspidium, Adiantum,* Ginger.
* **Bulb:** Stem is unbranched, highly reduced and disc shaped. The bud is surrounded by many concentric scale leaves. Leaf bases of inner ones are fleshy and edible and outer ones are dry known as **tunic**. *e.g.,* Onion, Garlic, *Narcissus.*
* **Corm:** It grows vertically beneath the soil surface. It bears nodes, internodes, buds and scale leaves. *e.g., Colocasia, Gladiolus, Freesia., Crocus, Amorphophallus*

(c) Creepers: In creeping stem of the plants adventitious root are developed from the nodes and to form a aerial shoots such as

* **Runner:** It is elongated, prostrate, sub-aerial branch with long internodes and roots at nodes. *e.g.,* Grasses
* **Offset:** Short horizontal branch which is one internode long and produces a cluster of leaves above and the cluster of roots below is called **offset**. *e.g., Eichhornia* (Water hyacinth), *Pistia.*

Water hyacinth or 'terror of Bengal' was introduced in Bengal because of its beautiful flowers and shape of leaves. However, it turned out to be highly invasive aquatic weed that not only spread to all water bodies of Bengal but also throughout India. It drains oxygen from the water,which leads to death of fishes and other animals. It is very difficult to get rid off them since it can propagate vegetatively by offset at a phenomenal rate and spread all over the water body in a short period of time.

* **Stolon** : It is subterranean long lateral branch arising from base of stem. It first grows obliquely upward and then bends down to the ground surface. *e.g.,* Strawberry, *Vallisneria* Leaflets
* **Sucker :** It arises by axillary bud of underground part of stem. This lateral branch creeps below the soil surface, grows obliquely upward and produces new shoot.

e.g., Chrysanthemum, Pineapple, Banana

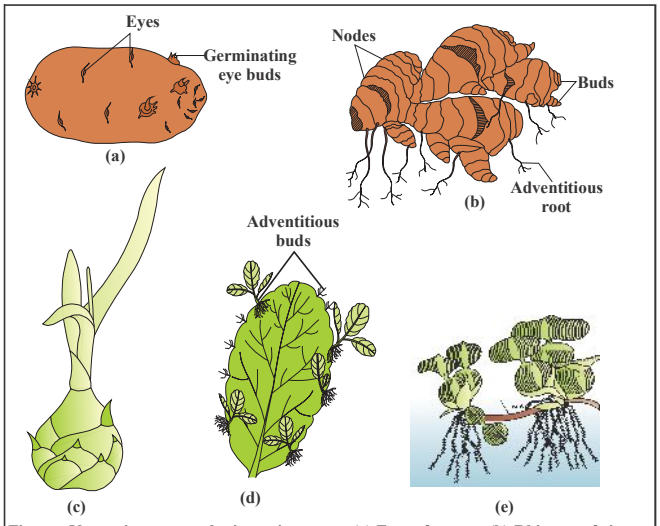


Figure : Vegetative propagules in angiosperms: (a) Eyes of potato; (b) Rhizome of ginger; (c) Bulbil of *Agave*; (d) Leaf buds of *Bryophyllum*; (e) Offset of water hyacinth

(d) Aerial shoots : Each segment of stem having at least one node can form a new plant.

e.g., Sugarcane, *Opuntia*

(e) Leaves: Leaves of several plants having adventitious buds help in vegetative reproduction. In *Bryophyllum* adventitious buds arise from the notches present at margins of leaves.*e.g., Adiantum* (walking fern), *Begonia, Streptocarpus, Saintpaulia and Kalanchoe.*

(f) **Bulbils:** These are fleshy buds which produce new plant. *e.g., Agave, Oxalis, Ananas, Dioscorea,* Lily, *Chlorophytum*

(g) **Turions :** Fleshy buds in aquatic plants helping in perennation, *e.g., Potamogeton, Utricularia.*

(ii) Artificial propagation :

* Gardeners and Horticulturist have employed the various method of vegetative propagation for economic production.
* All the methods are man made so that their practices constitute artificial means of vegetative propagation. These are as follows

(a) Cutting :

* A cutting is separated portion of root, stem or leaf which is used for propagation, factors are taken into consideration for successful propagation such as
  - Age of the parent plant,
  - Length and diameter of the cutting,
  - Season
  - Type of plants.
* Some time the stem cuttings are treated with rooting hormone [IBA, IAA or NAA] for proper development of adventitious roots e.g., Sugar cane, Rose, Croton, Tapioca, Chinarose (Stem cutting) Lemon, Tamarind (Root Cutting) etc. [Favourable time for cutting - Rainy season]

(b) Grafting :

* It is the most common method of vegetative propagation described by ancient gardeners long before the science of horticulture became established.
* In this method, parts of two plants are joined in such a way that they grow as one plant.
* Grafting is done between two closely related dicotyledonous plants having vascular cambium.
* The rooted supported portion of one plant called Stock is joined with a twig of another plant called Scion.
* Generally, the root stock belong to wild variety which is resistant to disease & pest.
* The scion is derived from the plant possessing better characters.
* In grafting, the stock and scion cuts are marked in such a oblique manner so that they fix with each other. This joint covered with clay or a layer of wax.
* Within a few days, tissues of stock and scion combined together and to form a new plant. e.g., Grafted Mango, Roses, orange, Seedless Grapes and Guava, Apple, Pear.

Merits of Vegetative propagation

* It is good for the multiplication of seedless plants e.g. Banana, Sugarcane; Pineapple and seedless Orange and Grape.
* It is the fastest method of reproduction e.g., Potato crop requires more than one year with the help of seeds, however, it takes only 3 to 4 months with the help of tubers. Similarly, Lily takes 4 to 7 years through seeds, however, 1 to 2 years by bulbs.
* By grafting, desirable quality of fruit/flower/seed can be obtained.
* Disease free plants can be cultured by micropropagation and micrografting.
* Plants with long seed dormancy or poor seed viability or poor seed can be propagated vegetatively. e.g., Cynodon dactylon (Lawn. Doob or Bermuda grass).
* Good quality and better yield varieties can be preserved for a long duration in offsite collection, herbarium, botanical gardens etc.
* It gives 100% genetical similarity to their parents i.e., clone.

Demerits of Vegetative propagation

* Diseased parents always give diseased clone.
* Clone undergoes degeneration due to the absence of sexual reproduction.
* Vegetative organs can not be preserved for long duration like culms of Sugarcane.
* Vegetative propagatory organs or structures cannot be safely and easily stored as comparison to seeds. They are easily decomposed and attached by various pathogens like Bacteria, Virus, Fungi.

* Do not cause any variation in plantlets, thus decrease in the adaptation power.
* There is absence of dispersal mechanism. Vegetative propagation in a particular area causes overcrowding. It results in intraspecific competition.

Significance of Vegetative propagation

* It is the only method of reproduction in those plants which have lost their capacity to produce seeds. e.g. Banana, Seed less grapes, Orange etc.
* The plants which produce small quantities of seeds, poor viability of seed or prolonged seed dormancy, reproduce only by this method because it is more rapid, easier and less expensive.
* Production of these plants more as compared to seeded plants.
* The greatest advantage of this method is that a biotype of plant [Original plant] can be retained and multiplied indefinitely without any change or variation.

SEXUAL REPRODUCTION

* Sexual reproduction involves formation of the male and female gametes, either by the same individual or by different individuals of the opposite sex. These gametes fuse to form the zygote which develops to form the new organism.

* **Difference between asexual and sexual reproduction**

S.N.	Asexual Reproduction	Sexual Reproduction
1.	It does not involve the formation and fusion of gametes.	It involves the formation and fusion of two gametes, generally distinguished into male and female.
2.	New individual develops from one cell or a part of one parent.	New individual develops from zygote or fusion product of two gametes, which may or may not be produced by two parents.
3.	New individuals are genetically similar to the parents.	New individuals or offsprings are generally different from either of the two parents.
4.	It involves only mitotic divisions.	It involves meiosis at one or the other stage. In higher plants, it occurs at the time of sporogenesis.
5.	It does not require the formation of sex organs.	Formation of sex organs is a pre-requisite for sexual reproduction.
6.	It does not introduce variability. Hence, has no evolutionary importance.	It introduces variability and is, hence of evolutionary importance.

Phases in Life Cycle

Three phases are there in the organism's life cycle.

1. Juvenile phase/pre-reproductive phase

* During this phase organism will show growth so that it can attain certain maturity to perform the sexual reproduction.
* This phase is known as **vegetative phase** in plants. It is of variable durations in different organisms.

2. Reproductive phase :

* Reproductive organs develop and mature during this phase.

* In the higher plants, end of juvenile phase or onset of reproductive phase is easily marked.
* In the higher plants during this phase, there is formation of reproductive structures *i.e.,* flowers.
* The motto of this phase is to produce the offsprings which may be similar or dissimilar to parental generation. This phase is also of variable durations in different organisms.
* Based upon flowering and fruiting pattern there are two types of flowering plants, *i.e.,* monocarpic and polycarpic.

Monocarpic Plants :

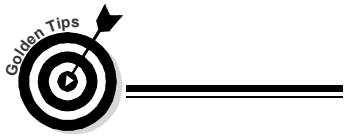
* They are plants which flower only once in their life. After flowering, they produce fruits and die.
* All annuals *(e.g.,* Wheat, Rice, Marigold) and biennial plants *(e.g.,* Radish, Carrot,Henbane), are monocarpic.
* A few perennial plants are also monocarpic. Certain bamboo species *(e.g., Bambusa tulda,Meloeanna bambusoides)* live vegetatively for 50-100 years, flower and fruit abundantly and then die.
* *Strobilanthus kunthiana* (vern. Neelakurinji) flowers once in 12 years.

Polycarpic Plants :

* They are perennial plants which after reaching maturity, flower repeatedly at intervals, *e.g.,* Mango, Apple, Jackfruit, Grape vine, Orange.
* Very few perennial plants bear flowers throughout the year, *e.g.,* China rose (Shoe Flower).
* The period between two flowering phases is called **Interflowering period** which is used for building up resources and is, therefore, a recovery phase. It is not the juvenile phase but is part of the mature phase.

3. Senescent Phase:

* It is a post-reproductive phase.
* It involves structural and functional deterioration of body by accumulation of waste metabolites which ultimately leads to death.
* In both plants and animals, hormones are responsible for the transitions between three phases.
* Interaction between hormones and certain environmental factors regulate the reproductive processes and the associated behavioural expressions of organisms.



* The females of placental mammals exhibit cyclical changes in the activities of ovaries and accessory ducts as well as hormones during the **reproductive phase**.
* In **non-primate** mammals like cows, sheep, rats, deers, dogs, tiger, etc., such cyclical changes during reproduction are called **oestrus cycle.** Where as in **primates** (monkeys, apes, and humans) it is called **menstrual cycle**.
* Many mammals, especially those living in natural, wild conditions exhibit such cycles only during favourable seasons in their reproductive phase and are therefore called **seasonal breeders**.
* Many other mammals are reproductively active throughout their reproductive phase and hence are called **continuous breeders**.

EVENTS IN SEXUAL REPRODUCTION

* Sexual reproduction is characterised by the fusion (or fertilisation) of the male and female gametes, the formation of zygote and embryogenesis.
* For convenience these sequential events may be grouped into three distinct stages namely, the pre-fertilisation, fertilisation and the post-fertilisation events.

Pre-fertilisation Events

* These include all the events of sexual reproduction prior to the fusion of gametes.
* The two main pre-fertilisation events are gametogenesis and gamete transfer.

Gametogenesis

* Gametogenesis refers to the process of formation of the two types of gametes – male and female.
* Gametes are haploid cells.

Categories of Gametes

(i) **Isogametes :** When the fusing gametes are morphologically similar they are known as **isogametes** or **homogametes**. *e.g.,* (i) Algae: *Chlamydomonas debaryana, Ulothrix*
(ii) Fungi : *Synehytrium, Rhizopus*

(ii) **Heterogametes:** When the fusing gametes are morphologically distinct types, they are known as **heterogametes.** It is the feature of majority of sexually reproducing organisms.*e.g.,* (i) Algae: *Volvox, Chara, Fucus* (ii) All Bryophytes, Pteridophytes, Gymnosperms and Angiosperms. In such organisms, male gamete is called **antherozoid or sperm** and the female gamete is called **egg or ovum.**

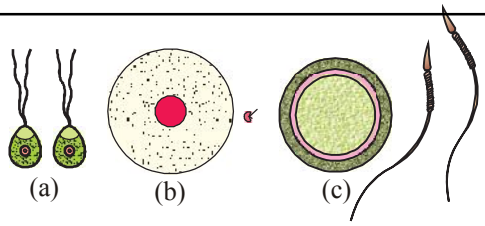


Figure : Types of gametes: (a) Isogametes of *Cladophora* (an alga); (b) Heterogametes of *Fucus* (an alga); (c) Heterogametes of *Homo sapiens* (Human beings)

Sexuality in organisms

* Sexual reproduction in organisms generally involves the fusion of gametes from two different individuals. But this is not always true.
* Plants may have both male and female reproductive structures in the same plant (**bisexual**) or on different plants (**unisexual**).
* In several fungi and plants, terms such as **homothallic** and **monoecious** are used to denote the **bisexual condition** and **heterothallic** and **dioecious** are the terms used to **describe unisexual condition**.

(A) **Sexuality in animals :**

* **Earthworms**, **sponge, tapeworm and leech**, typical examples of **bisexual animals** that possess both male and female reproductive organs, are **hermaphrodites**.
* **Cockroach** is an example of a **unisexual species**.

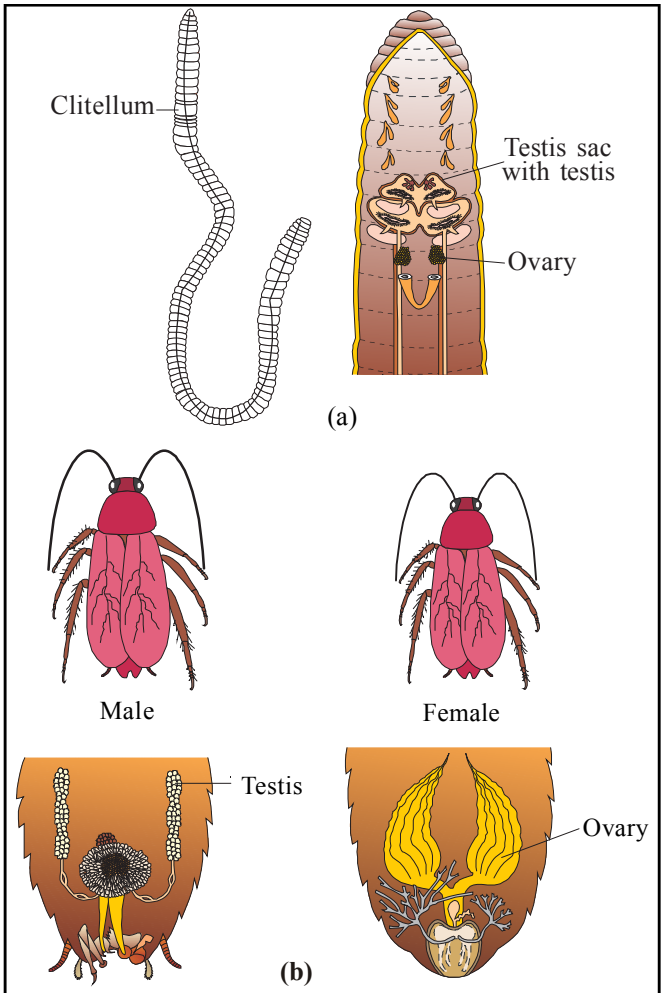


Figure : Diversity of sexuality in organisms
(a) Bisexual animal (Earthworm);
(b) Unisexual animal (Cockroach);

Table : Chromosome Numbers in Meiocytes (diploid, 2n) and Gametes (haploid, n) of Some Organisms.

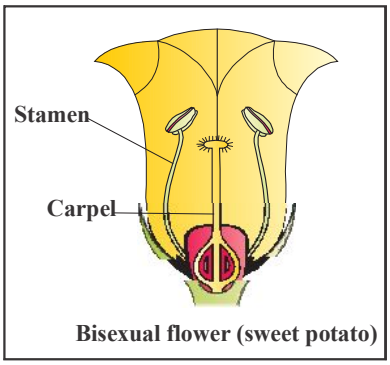
S.N.	Name of organism	Chromosome number in meiocyte (2n)	Chromosome number in gamete (n)
1.	Human beings	46	23
2.	House fly	12	6
3.	Rat	42	21
4.	Dog	78	39
5.	Cat	38	19
6.	Fruit fly	8	4
7.	Ophioglossum (a fern)	1260	630
8.	Apple	34	17
9.	Rice	24	12
10.	Maize	20	10
11.	Potato	48	24
12.	Butterfly	380	190
13.	Onion	32	16

(B) Sexuality in Plants

* In most of the lower sexually reproducing organisms, two fusing gametes are morphologically similar.
* If these gametes belong to the same parent then such organisms are called **homothallic,** *e.g.,* fungi *(Mucor mucedo).* When these gametes belong to different parents then these organisms are called **heterothallic.**

Higher Organisms:

* In higher plants there is well developed sex organs and there is clear distinction between male and female sex organs.
* Angiosperms possess flowers as reproductive structures. The male sex organ is called stamen and female sex organ is carpel or pistil.
* If male and female sex organs occur in the same flower then these plants are called **bisexual**, *e.g.,* China rose. If flowers possess only stamen or carpel then these plants are called **unisexual**.



Bisexual flower (sweet potato)

* When male flower **(staminate)** and female flower **(pistillate)** are present on same plant body such plants are monoecious, *e.g., Acalypha,* cucurbits, coconut and maize.
* However, if they are present on separate plant body then these plants are known as **dioecious,** *e.g.,* date palm, papaya and mulberry.
* In some of the lower plants also the monoecious and dioecious condition occur. For knowing this, we will study the sexuality in *Chara* and *Marchantia.*

Sexual Reproduction in *Chara* and *Marchantia* :

* The *Chara* is a green alga. It is oogamous. The sex organs are highly specialised. Some workers prefer to call the male sex organ as **antheridium** and female as **oogonium,** while others did not favour this terminology.
* They call the male sex organ as **globule** and the female as **nucule** and this terminology is largely followed in *Chara.* These sex organs are **exceptionally multicelled and covered by jacket.**
* The jacket of nucule is formed by **tube cells** and the jacket of globule is formed by **shield cells.** The nucule has a cap of 5 coronary cells.
* The sex organs are borne on the adaxial surface of the short lateral branch almost on each node. The nucule occupies an upper position than the globule.

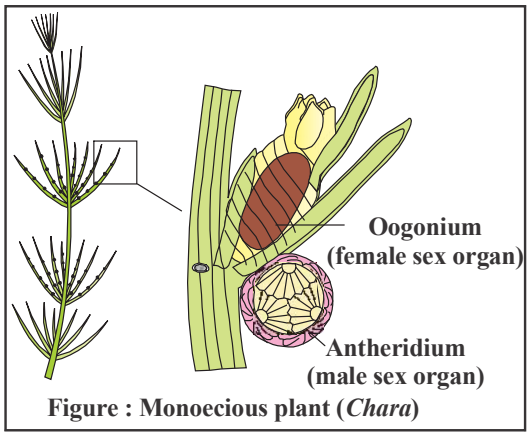


Figure : Monoecious plant (*Chara*)

* While most of the species of *Chara* are monoecious, *C. wallichii* is dioecious. The globule matures prior to nucule **(protandrous condition).**
* Each antheridium produces many band shaped, spirally coiled, biflagellate antherozoids. The oogonium contains a single egg. The egg is laden with starch and oil globules.
* In *Marchantia,* the archegonia are borne on special branches called **archegoniophores** or the **female receptacles**. The archegonia may be stalked or sessile.

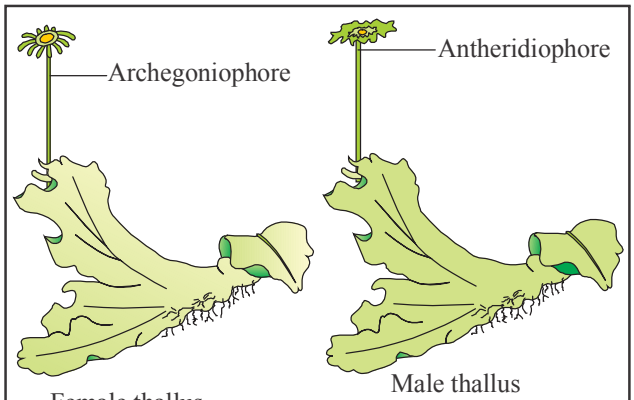


Figure : Dioecious plant (*Marchantia*)

Cell division during gamete formation

* Gametes are haploid though the parent plant body producing these gametes may be either haploid or diploid.
* A haploid parent produces the gametes by mitotic division however organisms having diploid body the gametes are formed through reductional division, *i.e.,* meiosis.
* In these organisms specialised cells called **meiocytes** or gamete mother cells undergo meiosis. At the end of meiosis only one set of chromosomes gets incorporated into each gamete.

Gamete transfer

* After the formation of male and female gametes, compatible gametes must be physically brought together to facilitate fusion (fertilisation or syngamy).
* In few fungi and algae, both types of gametes are motile. In heterogametic condition, the female gamete is non motile. So there is a need of a medium through which the male gametes move.
* Water is the medium for gamete transfer in algae, bryophytes and pteridophytes. A large number of the male gametes however, fail to reach the female gametes.
* To compensate this loss of gametes, the number of male gametes produced in several thousand times the number of female gametes produced.
* In seed plants, pollen grains are the carrier of male gametes and ovule has the egg.

FERTILISATION

* The most vital event of sexual reproduction is the fusion of gametes. This process is called syngamy or fertilisation which results in the formation of a diploid zygote.
* Syngamy can occur in external medium as well as inside the body of organism.
* On this basis syngamy can be distinguished into two types :

(a) External fertilisation :

* Syngamy occurs outside the body of organism in external medium (water).
* It is shown by majority of aquatic organisms like most of algae, fishes as well as amphibians.
* Organisms exhibiting external fertilisation show great synchrony between the sexes and release a large number of gametes into the surrounding medium in order to enhance the chances of syngamy.
* The disadvantage associated with it is that the offsprings are extremely vulnerable to predators.

(b) Internal fertilisation:

* Syngamy occurs Inside the body of organisms. It is present in majority of plants like bryophytes, pteridophytes, gymnosperms and angiosperms.
* It occurs in few algae like *Spirogyra.* In all these organisms egg is formed inside the female body where syngamy occurs.
* The male gamete is motile and has to reach the egg in order to fuse it. In order to enhance the chances of syngamy large number of sperms are produced in these organisms and to compensate for this there is significant reduction in number of eggs produced.

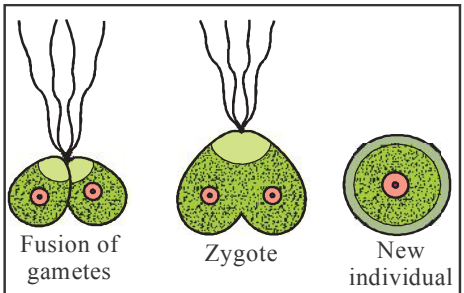


Figure : Homogametic contact in alga

Sexual reproduction is divided into two types.

(i) **Zooidiogamy** : It is a type of sexual reproduction in which transfer of male gamete occurs through the medium *i.e.*, **water.** It occurs in several simple plants like algae, bryophytes and pteridophytes.

(ii) **Siphonogamy *:***

It is a type of sexual reproduction in which male gamete carrier is **pollen grain** and transfer of male gamete occurs through pollen tube. It is the feature of seeded plants like gymnosperms and angiosperms. Pollen grains are produced in anthers, therefore have to be transferred to the stigma before it can lead to fertilisation.

External and internal fertilisation should not be confused with exogamy and endogamy.

* **Exogamy:** Two fusing gametes belong to different individuals. Also known as **cross fertilisation**.
* **Endogamy:** Two fusing gametes belong to same individual. Also known as **self-fertilisation**.

POST-FERTILISATION EVENTS

Events in sexual reproduction after the formation of zygote are called **post-fertilisation events**.

Zygote

* It is the first cell of the new generation in all sexually reproducing organisms. Zygote is always diploid.
* It is formed in the external aquatic medium in those organisms which perform external fertilization. Zygote is produced inside the body in cases where fertilization is internal.
* Zygote is a **vital link** between two successive generations. It ensures the continuity of race from generation to generation.
* The body of all multicellular organisms develops from the single-celled zygote. All the cells of the body, therefore, contain the same genetic traits as present in the zygote.

Embryogenesis

(i) In Plants :

* Embryogenesis is the process of development of embryo from zygote. Embryo is a multicellular stage in the life cycle of a plant or animal prior to formation of an independent individual.
* In embryogenesis, the zygote undergoes repeated cell divisions through mitosis. The divisions help in growth of the embryo.
* Cells undergo differentiation attaining specific shape, size and function. Cell differentiation occurs at specific locations resulting in production of different tissues, organs and organ systems.
* Development of different external and internal structures is called **morphogenesis.** In flowering plants, zygote develops into **embryo.**
* The food for development of embryo comes from a special tissue known as **endosperm**.Ultimately, the fertilized ovule matures into a **seed.**
* A number of seeds develop in an ovary depending upon the number of ovules. Meanwhile,wall of the ovary also proliferates. It produces pericarp. The pericarp can be dry or fleshy.
* The ripened ovary with pericarp and seeds is called **fruit**. As the fruit begins to develop,sepals, petals, stamens, style and stigma normally sheds. After dispersal, the seeds, upon reaching suitable substratum germinate and form new plants.

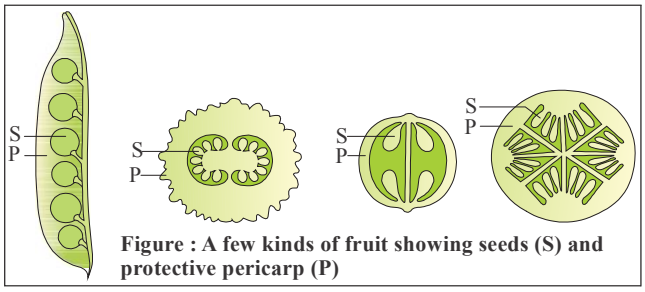


Figure : A few kinds of fruit showing seeds (S) and protective pericarp (P)

(ii) In Animals :

* Animals are categorised into **oviparous** and **viviparous** based on whether the development of the zygote take place outside the body of the female parent or inside.
* Whether they lay fertilised/unfertilised eggs or give birth to young ones.
* In **oviparous** animals like reptiles and birds, the fertilised eggs covered by hard **calcareous shell** are laid in a safe place in the **environment;** after a period of incubation young ones hatch out.
* On the other hand, in **viviparous** animals (majority of mammals including human beings), the zygote develops into a young one inside the body of the female organism.
* After attaining a certain stage of growth, the young ones are delivered out of the body of the female organism.
* Because of proper embryonic care and protection, the chances of survival of young ones is greater in viviparous organisms.

CONCEPT REVIEW

* Sexual reproduction involves the union of two gametes; the offspring produced by sexual reproduction are genetically variable. Asexual reproduction involves the formation of offspring without the fusion of gametes; the offspring are virtually genetically identical to the single parent.

* **asexual reproduction**, a single parent endows its offspring with a set of genes identical to its own (except for mutations). Asexual reproduction is energy efficient, and most successful in a stable environment.
* In **budding**, a part of the parent's body grows and separates from the rest of the body. In **fragmentation**, the parent's body may break into several pieces; each piece can develop into a new animal. In **parthenogenesis**, an unfertilized egg develops into an adult.
* In **sexual reproduction**, offspring are produced by the fusion of two types of **gametes**, ovum (egg) and **sperm**. When sperm and ovum fuse, a fertilized egg, or **zygote**, forms. Sexual reproduction promotes genetic variety and is especially adaptive in an unstable, changing environment.
* In **external fertilization**, mating partners typically release eggs and sperm into the water simultaneously. In **internal fertilization**, the male delivers sperm into the female's body.
* In **hermaphroditism**, a single individual produces both eggs and sperm.
* Haploid-parent (n) produces haploid gametes (n) by mitotic division, eg. Monera,fungi, algae and bryophytes.
* Diploid parent (2n) produces haploid gametes(n) by meiosis division (possess only one set of chromosomes)and such specialized parent cell is called meiocyte or gamete mother cell.

IMPORTANT POINTS

* Apoximis is development of a new plant without fusion of gametes.
* Young pollen grains produce androgenic haploids in anther cultures.
* Virus free plants can be obtained by shoot tip culture.
* Grafting is not possible in monocots as they lack cambium.
* Haploid plant cultures are got from pollen grain.
* Plants developed in vitro culture from pollen grains are androgenic haploids.
* In tissue/bacterial culture glassware and nutrients are sterilised through autoclave
* Mango and Guava are propagated through grafting.
* Potatoes are cultivted by buds on tubers.
* Ginger is multiplied vegetatively by rhizome.
* Piece of plant tissued used in tissue culture is explant.
* Seedless fruits in banana are produced through parthenogenesis.
* Gemmule = Sponges, Leaf buds = *Bryophyllum*
  Bulbil = Agave, Offset = Water Hyacinth
  Conidia = *Penicillium*
* Accessory membranes are absent in sperm but present in egg.
* Difference between zoospore and conidia:

	Zoospore	**Conidia**
1.	Flagellated	Non-flagellated
2.	Motile	Non-motile
3.	Formed inside sporangia, e.g., *Chlamydomonas*	Formed outside over conidiophore e.g., *Penicillium*

Bud types

Nodal bud (Present at nodes)	Adventitious bud (Present other than nodes)
• Axillary bud – Axil of leaf • Extra-axillary bud – Away from axil	• Foliar bud – over leaf • Cauline bud – over stem • Radical bud – over root

*

Vegetative propagules	**Example**
1. Rhizome	Ginger
2. Tuber	Potato
3. Offset	*Eichhornia*
4. Bulbil	Agave
5. Leaf buds	*Bryophyllum*

*

Plant group	Types of gamete	Gamete transfer	Genetic fusion	Embryogenesis
Algae	Isogametes + Heterogametes	H_2O mainly	Internal or External	Absent
Byrophytes	Heterogametes	H_2O	Internal	Present
Pteridophytes	Heterogametes	H_2O	Internal	Present
Gymnosperms	Heterogametes	Pollen	Internal	Present
Angiosperms	Heterogametes	Pollen	Internal	Present

QUESTION BANK

EXERCISE - 1 (LEVEL-1) [NCERT EXTRACT]

SECTION - 1 (VOCABULARY BUILDER)

Choose one correct response for each question.

For Q.1-Q.4

Match the column I with column II.

Q.1

	Column I		Column II
(a)	Diploid	(i)	Organism with 'n' number chromosomes.
(b)	Haploid	(ii)	Organisms with '2n' number of chromosomes.
(c)	Heterogametes	(iii)	Gametes produced are of two morphologically distinct types.
(d)	Hermaphrodites	(iv)	Organisms possessing both male and female reproductive organs.

Codes :

(A) (a) - i, (b)-ii, (c)-iv, (d)-iii
(B) (a) - i, (b)-ii, (c)-iii, (d)-iv
(C) (a) - ii, (b)-i, (c)-iii, (d)-iv
(D) (a) - i, (b)-iii, (c)-ii, (d)-iv

Q.2

	Column I		Column II
(a)	Embryogenesis	(i)	Process of development of embryo from zygote.
(b)	Gametogenesis	(ii)	Process of formation of male and female gametes.
(c)	Oviparous	(iii)	When female lays fertilised or unfertilised eggs and the development of embryo takes place outside the body of female.
(d)	Viviparous	(iv)	The zygote develops into a young one in the body of female organism.

Codes :

(A) (a) - i, (b)-ii, (c)-iv, (d)-iii
(B) (a) - i, (b)-ii, (c)-iii, (d)-iv
(C) (a) - ii, (b)-i, (c)-iii, (d)-iv
(D) (a) - i, (b)-iii, (c)-ii, (d)-iv

Q.3

	Column I		Column II
(a)	Dioecious	(i)	Plants bearing only one type of flower either male or female *e.g.,* Papaya, Date Paln
(b)	Monoecious	(ii)	The plant that bear both male and female sex flowers.
(c)	Juvenile Phase	(iii)	Period between sexual maturity and death.
(d)	Senescence	(iv)	It is the period of growth before maturity when sex organs are not functional.

Codes :

(A) (a) - i, (b)-ii, (c)-iv, (d)-iii
(B) (a) - i, (b)-ii, (c)-iii, (d)-iv
(C) (a) - ii, (b)-i, (c)-iii, (d)-iv
(D) (a) - i, (b)-iii, (c)-ii, (d)-iv

Q.4

	Column I		Column II
(a)	Pistillate	(i)	Unisexual flowers with female sex organs only (pistil).
(b)	Pollination	(ii)	Fusion of male and female gamete.
(c)	Staminate	(iii)	Unisexual flowers with make sex organs only (stamens).
(d)	Syngamy	(iv)	Transfer of pollen grains from anther to stigma.

Codes :

(A) (a) - i, (b)-ii, (c)-iv, (d)-iii
(B) (a) - i, (b)-ii, (c)-iii, (d)-iv
(C) (a) - ii, (b)-i, (c)-iii, (d)-iv
(D) (a) - i, (b)-iv, (c)-iii, (d)-ii

SECTION - 2 (BASIC CONCEPTS BUILDER)

For Q.5 to Q.40 :

Choose one word for the given statement from the list.

Haploid, Diploid, Micropropagation, True, False, Neela Kuranji, Zoospores, Zygote, Inside, Increase, reduction, Outside, Equal daughter cells, With, Without, Meiosis, External, Embryo, Endosperm, Parthenogenesis, Inter-flowering phase, Amoeba, Juvenile, Growth, Karyokinesis, Embryo, Embryogenesis, Node/eyes, Adventitious / leaf bud

Q.5 The technique of obtaining large number of plantlets by tissue culture method is called ____.

Q.6 In Parthenogenesis new organism is formed ____ (with / without) fertilisation

Q.7 If the parent body is haploid then the gametes are _____.

Q.8 *Strobilanthus kunthiana* is also called ____.

Q.9 Life begin in all sexually reproducing organism from single celled _____.

Q.10 In oviparous individuals development of zygote takes place ____ (inside / outside) the body.

Q.11 Embryogenesis is the process of development of ____.

Q.12 Development of unfertilised ovum into fully formed organism is called _____.

Q.13 Asexual, motile, microscopic reproductive structures in case of several algae and fungi is called _____.

Q.14 The type of cell division that takes place in the zygote of an organism exhibiting haplontic life cycle is _____.

Q.15 The phase all organisms have to pass through before they can reproduce sexually is _____.

Q.16 An organism where cell division in itself is a mode of reproduction is ___.

Q.17 Fill in the blanks w.r.t. ♂ and ♀ structures in *Marchantia*.

Feature	♂	♀
Name	Antheridium	A
Gamete	B	Non-motile

Q.18 Complete the sequence involved in binary fission in *Amoeba*.
Nucleus enlarges → __A__ → Cytokinesis → __B__

Q.19 Progenitor of next generation in seed is ____.

Q.20 Morphogenesis and differentiatian is part of ____.

Q.21 Complete the sequence involved in the life cycle of polycarpic plant.

Juvenile phase + Flowering → A → Flowering → Senescent phase

Q.22 Great synchrony between release of gametes is in _____ fertilisation.

Q.23 To enhance the chances of syngamy the number of ♂ gametes show ____ and ♀ gametes show _____.

Q.24 In potato tuber new plantlet arises from ____.

Q.25 Bryophyllum shows formation of _____ buds from leaf notches.

Q.26 'Gemmule formation is a common mode of reproduction in *Paramecium*.' **[True / False]**

Q.27 *Hydra* reproduces by binary fission. **[True / False]**

Q.28 'Unisexual male flower is called pistillate'. **[True / False]**

Q.29 'Bisexual animals that possess both male and female reproductive organs are called hermaphrodite'. **[True / False]**

Q.30 Asexual reproduction results in production of clone. **[True / False]**

Q.31 Meiosis is required for the formation of asexual reproductive structures. **[True / False]**

Q.32 Asexual reproduction is absent in higher plants. **[True / False]**

Q.33 Only internal factors regulate reproductive processes. **[True / False]**

Q.34 Juvenile phase can be known as vegetative phase in all plants. **[True / False]**

Q.35 Mango is polycarpic plant. **[True / False]**

Q.36 In few lower plants both gametes are motile. **[True / False]**

Q.37 Pollen tube can carry both male or female gamete. **[True / False]**

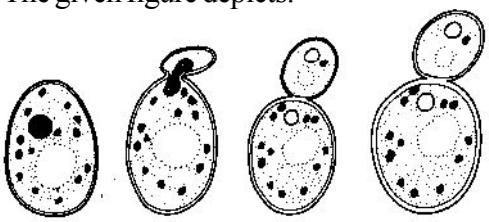
Q.38 Zygote is always formed inside the body. **[True / False]**

Q.39 Unisexual flowers occur in china rose. **[True / False]**

Q.40 Gametic fusion may or may not be present in reproduction which produces variations. **[True / False]**

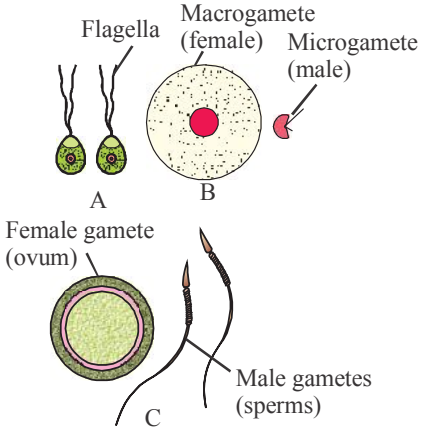
SECTION - 3 (ENHANCE DIAGRAM SKILLS)

Q.41 The given figure depicts.



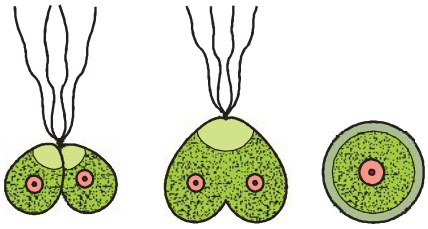
(A) Budding
(B) Binary fission
(C) Fission
(D) Zoospore

Q.42 Identify the gametes in figure A, B and C.



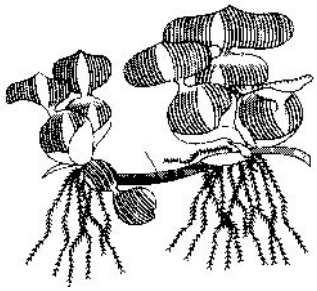
(A) A-Heterogametes, B-Isogametes, C-Homogametes
(B) A-Homogametes, B-Isogametes, C-Heterogametes
(C) A-Isogametes, B-Heterogametes, C-Heterogametes
(D) A-Heterogametes, B-Heterogametes, C-Isogametes

Q.43 Events in the diagram are (in sequential order)



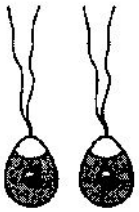
(A) fission of gametes → new individual → zygote
(B) fusion of gametes → zygote → new individual (cell 2n)
(C) fission of gametes → zygote → new individual (cell 2n)
(D) stages in the gametogenesis

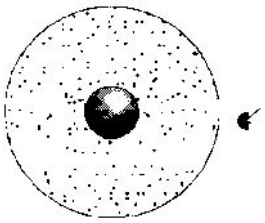
Q.44 Choose incorrect option for given below organism



(A) Scourge of the water bodies
(B) Reproduction through offset
(C) Found in running water
(D) Drains oxygen from water

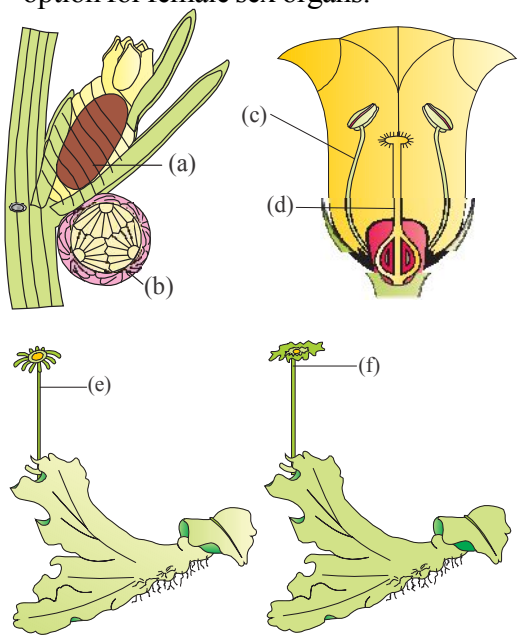
Q.45 Given figures represent





(A) Isogametes of fungi, heterogametes of algae
(B) Isogametes of algae, heterogametes of algae
(C) Isogametes of fungi, heterogametes of fungi
(D) Isogametes of algae, heterogametes of fungi

Q.46 Examine the given figures and select the right option for female sex organs.



(A) a, d & f (B) b, d & f
(C) a, c & e (D) a, d & e

SECTION - 4 (ENHANCE PROBLEM SOLVING SKILLS)

Choose one correct response for each question.

PART - 1 : ASEXUAL REPRODUCTION

Q.47 Reproduction takes place in which stage of life span
(A) juvenile stage (B) maturation stage
(C) reproductive stage (D) ageing phase

Q.48 Study the following statements and choose the correct option.
I. Life spans of organisms are correlated with sizes.
II. Death of all individuals is a certainty.
III. The organism habitat, internal physiology etc. are collectively responsible for how it reproduces.
IV. When offspring is produced by single parent with or without involvement of gamets formation is called Asexual reproduction.
(A) I, II are correct but III, IV are incorrect.
(B) III, IV are correct but I, II are incorrect.
(C) I, III are correct but II, IV are incorrect.
(D) II, IV are correct but I, III are incorrect.

Q.49 Zoospores are
(A) motile gametes
(B) female motile gametes
(C) sessile gametes
(D) female sessile gametes

Q.50 Common mode of reproduction in *Penicillium* is –
(A) conidia (B) buds
(C) gemmules (D) zoospore

Q.51 In the process of asexual reproduction
(A) Large number of individuals are produced due to involvement of reduction division.
(B) Individuals are genetically similar to one another but not to their parent.
(C) There is no need to search for a mate.
(D) Gametes are never formed.

Q.52 Cell division is the mode of reproduction in
(A) Monera (B) Protista
(C) Both (A) and (B) (D) Plants

Q.53 Asexual reproduction in plants is called
(A) vegetative reproduction (B) parthenocarpy
(C) parthenogenesis (D) syngamy

Q.54 Process of reproduction which results in production of identical offsprings is
(A) Complex, fast (B) Simple, slow
(C) Fast, simple (D) Fast, costlier

Q.55 Which of the following statement about vegetative reproduction is incorrect?
(A) Stem cutting is a common horticultural method of plant propagation.
(B) In trench layering, the basal branch is pegged at several places in soil at regular intervals.
(C) Stock has large diameter than scion in crown grafting.
(D) Gootee is an ancient method of propagation in subtropical trees and shrubs.

Q.56 Examples of vegetative propagation are
(A) rhizome (B) tuber
(C) offset (D) All of these

Q.57 [Zoospore,Conidia, Tuber, Offset, Pollen, Zygote] From the structures given how many are not associated with asexual reproduction?
(A) Three (B) Four
(C) Two (D) One

Q.58 Micropropagation is a technique for the production of
(A) new plant (B) haploid plants
(C) hybrid variety (D) somaclonal plants

Q.59 Most common asexual structure produced in algae is
(A) Thick walled (B) Multicellular
(C) Flagellated (D) Produced in chains

Q.60 Grafting method can be used
(A) In all tracheophytes.
(B) Only in gymnospermic plants.
(C) In cambium containing eustelic plants.
(D) Only in atactostelic plants.

Q.61 Binary fission is the mode of asexual reproduction in –
(A) Amoeba (B) *Paramecium*
(C) Both (A) and (B) (D) Yeast

Q.62 Division in a bacterial cell is carried out through
(A) multiple fission (B) binary fission
(C) budding (D) plasmotomy

Q.63 Vegetative reproduction by leaf is found in
(A) *Sansevieria* (Snake plant)
(B) *Kalanchoe*
(C) *Bryophyllum*
(D) All of these

Q.64 Terror of Bengal is
(A) freshwater plant called water lily
(B) marine plant called water propagules
(C) aquatic plant called water hyacinth
(D) None of the above

Q.65 Transverse binary fission occurs in
(A) *Euglena* (B) *Amoeba*
(C) *Hydra* (D) *Paramecium*

Q.66 Asexual reproduction is common in
(A) Single celled organisms
(B) Organisms having simple organisation
(C) Aquatic plants
(D) More than one option is correct

Q.67 An example of corm is
(A) ginger (B) *Colocasia*
(C) onion (D) potato

PART - 2 : SEXUAL REPRODUCTION

Q.68 Juvenile phase in plants, is
(A) vegetative phase (B) reproductive phase
(C) growth phase (D) senescence phase

Q.69 Menstrual cycle is
(A) seasonal hormonal ovarian change.
(B) conditional hormonal ovarian change.
(C) periodic hormonal ovarian change.
(D) habitual hormonal ovarian change.

Q.70 From the given below processes how many are associated with post-fertilisation event?
(A) Syngamy, gamete transfer
(B) Gametogenesis, cell division
(C) Cell differentiation, gametic fusion
(D) Embryogenesis, cell differentiation

Q.71 In which of the following organisms self fertilisation is seen?
(A) Fishes (B) Leech
(C) Earthworm (D) Liverfluke

Q.72 Events in the sexual reproduction.
I. Pre-fertilisation
II. Fertilisation
III. Post-fertilisation
The sequential order of their occurrence is
(A) I → III → II (B) II → I → III
(C) III → II → I (D) I → II → III

Q.73 Gametogenesis is the formation of
(A) male gamete (B) female gamete
(C) Both (A) and (B) (D) spore

Q.74 Male gametes are also called
(A) antherozoid (B) sperm
(C) egg (D) Both (A) and (B)

Q.75 Which of the following feature is universal in all sexually reproducing organisms?
(A) Embryo formation (B) Gametic meiosis
(C) Zygote formation (D) Pollen grain transfer

Q.76 In diploid organism the gamete producing cells are called –
(A) gamete mother cell (B) meiocytes
(C) Both (A) and (B) (D) None of these

Q.77 Pollination is
(A) transfer of gametes on stigma.
(B) transfer of male gametes on stigma.
(C) transfer of female gametes on stigma.
(D) fusion of male and female gametes.

Q.78 Self-fertilisation occurs in the
(A) bisexual flower (B) unisexual flower
(C) Both (A) and (B) (D) monoecious flower

Q.79 External fertilization is found in
(A) Algae and Fishes
(B) Amphibian and Reptiles
(C) Algae and Bryophytes
(D) Fishes and Pteridophyte

Q.80 Female gametes are also called
(A) egg (B) ovum
(C) Both (A) and (B) (D) antherozoid

Q.81 *Chara* shows/posses
(A) Sex organs above nodes
(B) Multicellular and jacketed sex organs
(C) ♂ structure - Globule, ♀ - Nucule
(D) Both (B) & (C)

Q.82 The condition in which male and female parts present on the different plant, is called
(A) heterothallic (B) dioecious
(C) unisexual (D) All of these

Q.83 Fusion of male and female gametes is called
(A) syngamy (B) fertilisation
(C) Both (A) and (B) (D) heterogamy

Q.84 In few fungi and algae
(A) ♂ gamete - motile, ♀ gamete - motile
(B) ♂ gamete-non-motile, ♀ gamete - non-motile
(C) ♂ gamete - non-motile, ♀ gamete - motile
(D) ♂ gamete - motile, ♀ gamete - non-motile

EXERCISE - 2 (LEVEL-2)

Choose one correct response for each question.

Q.1 During embryogenesis the zygote undergoes
(A) cell division (mitosis)
(B) cell division (meiosis)
(C) cell differentiation
(D) (A) followed by (C)

Q.2 Which of the following is hermaphrodite?
(A) Ant (B) Aphids
(C) Earthworm (D) Cockroach

Q.3 A few statements describing certain features of reproduction are given below:
i. Gametic fusion takes place
ii. Transfer of genetic material takes place
iii. Reduction division takes place
iv. Progeny have some resemblance with parents
Select the options that are true for both asexual and sexual reproduction from the options –
(A) i and ii (B) ii and iii
(C) ii and iv (D) i and iii

Q.4 A few statements with regard to sexual reproduction are given below:
i. Sexual reproduction does not always require two individuals
ii. Sexual reproduction generally involves gametic fusion
iii. Meiosis never occurs during sexual reproduction
iv. External fertilisation is a rule during sexual reproduction
Choose the correct statements –
(A) i and iv (B) i and ii
(C) ii and iii (D) i and iv

Q.5 The male gametes of rice plant have 12 chromosomes in their nucleus. The chromosome number in the female gamete, zygote and the cells of the seedling will be, respectively,
(A) 12, 24, 12 (B) 24, 12, 12
(C) 12, 24, 24 (D) 24, 12, 24.

Q.6 Choose the correct option w.r.t. chromosome number in meiocyte and gamete.

S.N.	Organism	Meiocyte	Gamete
1.	Potato	a	24
2.	Maize	20	b
3.	Rice	c	12

(A) a-48, b-10, c-24 (B) a-48, b-20, c-24
(C) a-48, b-10, c-12 (D) a-24, b-10, c-24

Q.7 Given below are a few statements related to external fertilization. Choose the correct statements.
i. The male and female gametes are formed and released simultaneously
ii. Only a few gametes are released into the medium
iii. Water is the medium in a majority of organisms exhibiting external fertilization
iv. Offspring formed as a result of external fertilization have better chance of survival than those formed inside an organism
(A) iii and iv (B) i and iii
(C) ii and iv (D) i and iv

Q.8 Choose odd one w.r.t. categories of plants where pollen tube is required for gamete transfer.
Angiosperm, Gymnosperms, Bryophytes, Algae
(A) Bryophytes, Algae
(B) Angiosperm, Gymnosperms
(C) Angiosperm, Bryophytes
(D) Gymnosperms, Bryophytes

Q.9 Synchrony between the maturity of sexes and release of large number of gametes is shown by
(A) All spermatophytes (B) All bryophytes
(C) Most of algae (D) Most land plants

Q.10 The statements given below describe certain features that are observed in the pistil of flowers.
i. Pistil may have many carpels
ii. Each carpel may have more than one ovule
iii. Each carpel has only one ovule
iv. Pistil have only one carpel
Choose the correct statements –
(A) i and ii (B) i and iii
(C) ii and iv (D) iii and iv

Q.11 Vegetative propagation in pineapple occurs by
(A) Sucker (B) Runner
(C) Offset (D) Rhizome

Q.12 Choose the correct option for the a, b, c, d

	External fertdisation	Internal fertilisation
Syngamy	Outside body	a
Vulnerability to predator	b	c
Example	Most of algae	d

(A) (a) – Inside body, (b) – Less, (c) – More (d) – All land plants
(B) (a) – Outside body, (b) – More, (c) – Less (d) – All land plants
(C) (a) – Inside body, (b) – More, (c) – Less (d) – All land plants
(D) (a) – Inside body, (b) – More, (c) – Less (d) – All aquatic plants

Q.13 Which of the following situations correctly describe the similarity between an angiosperm egg and a human egg?
i. Eggs of both are formed only once in a lifetime
ii. Both the angiosperm egg and human egg are stationary
iii. Both the angiosperm egg and human egg are motile transported
iv. Syngamy in both results in the formation of zygote
Choose the correct options :
(A) ii and iv (B) iv only
(C) iii and iv (D) i and iv

Q.14 In which one of the following pair both the plants can be vegetatively propagated by leaf buds?
(A) *Agave* and *Kalanchoe*
(B) *Bryophyllum* and *Kalanchoe*
(C) *Asparagus* and *Bryophyllum*
(D) *Chrysanthemum* and *Agave*

Q.15 Thick walled resistant zygote can be produced in the life cycle of –
(A) Algae, fungi
(B) Bryophytes, pteridophytes
(C) Gymnosperms, algae
(D) Angiosperms, fungi

Q.16 Appearance of vegetative propagules from the nodes of plants such as sugarcane and ginger is mainly because:
(A) Nodes are shorter than internodes
(B) Nodes have meristematic cells
(C) Nodes are located near the soil
(D) Nodes have non-photosynthetic cells

Q.17 Monoecious condition is seen in
(A) *Marchantia* (B) Maize
(C) Papaya (D) Date palm

Q.18 Offspring formed by sexual reproduction exhibit more variation than those formed by Asexual reproduction because:
(A) Sexual reproduction is a lengthy process
(B) Gametes of parents have qualitatively different genetic composition
(C) Genetic material comes from parents of two different species
(D) Greater amount of DNA is involved in sexual reproduction.

Q.19 In yeast during budding
(A) Cytokinesis is unequal
(B) Identity of parent is lost
(C) Clones are produced
(D) More than one option is correct

Q.20 Arrange the following organisms w.r.t. increasing life span : Crocodile, Tortoise, Banyan tree, Rose
(A) Rose < Crocodile < Tortoise < Banyan tree
(B) Crocodile < Rose < Tortoise < Banyan tree
(C) Rose < Crocodile < Banyan tree < Tortoise
(D) Banyan tree < Crocodile < Tortoise < Rose

Q.21 Banyan tree, Elephant, Fruit fly, Banana tree
From the above given organisms select the correct option –
(A) Minimum life span : Fruit fly
(B) Maximum life span : Banyan tree
(C) Both (A) and (B)
(D) None of these

Q.22 Members of which of the following groups reproduce through special asexual reproductive structures?
(A) Algae, Bryophytes
(B) Fungi, Algae
(C) Pteridophytes, Angiosperms
(D) Fungi, Pteridophytes

Q.23 Choose the correct statement from amongst the following:
(A) Dioecious (hermaphrodite) organisms are seen only in animals.
(B) Dioecious organisms are seen only in plants
(C) Dioecious organisms are seen in both plants and animals.
(D) Dioecious organisms are seen only in vertebrates.

Q.24 Choose odd one w.r.t. medium through which male gametes are transferred?
(A) Algae, Bryophytes
(B) Pteridophytes, Algae
(C) Simple plant, Bryophytes
(D) Gymnosperms, Angiosperms

Q.25 There is no natural death in single celled organisms like Amoeba and bacteria because:
(A) They cannot reproduce sexually.
(B) They reproduce by binary fission.
(C) Parental body is distributed among the offspring.
(D) They are microscopic.

Q.26 In vegetative propagule of potato and *Bryophyllum* new plants arise from respectively
(A) Axillary bud, Adventitious bud
(B) Adventitious bud, Axillary bud
(C) Axillary bud, Axillary bud
(D) Leaf bud, Axillary bud

Q.27 There are various types of reproduction. The type of reproduction adopted by an organism depends on:
(A) The habitat and morphology of the organism
(B) Morphology of the organism
(C) Morphology and physiology of the organism
(D) The organism's habitat, physiology and genetic makeup

Q.28 From the given below organisms, how many can show vegetative propagule formation?
Ginger, Potato, *Chlamydomonas*, Water hyacinth, *Agave*
(A) 4 (B) 3
(C) 2 (D) 1

Q.29 Which one of the following is common to multicellular fungi, filamentous algae and protonema of mosses?
(A) Mode of Nutrition
(B) Multiplication by fragmentation
(C) Diplontic life cycle
(D) Members of kingdom Plantae

Q.30 Identify the incorrect statement.
(A) In asexual reproduction, the offspring produced are morphologically and genetically identical to the parent.
(B) Zoospores are sexual reproductive structures.
(C) In asexual reproduction, a single parent produces offspring with or without the formation of gametes.
(D) Conidia are asexual structures in Penicillium

Q.31 Which of the following vegetative propagule represents large size fleshy bud?
(A) Bulbil (B) Bulb
(C) Sucker (D) Rhizome

Q.32 Which of the following is a post-fertilisation event in flowering plants?
(A) Transfer of pollen grains
(B) Embryo development
(C) Formation of flower
(D) Formation of pollen grains

Q.33 A portion of underground stem bearing bud forms a new plant in
(A) *Adiantum, Colocasia* and *Vallisneria*
(B) *Narcissus, Gladiolus* and *Freesia*
(C) Garlic, Onion and Water hyacinth
(D) Turmeric, Ginger and Strawberry

Q.34 The number of chromosomes in the shoot tip cells of a maize plant is 20. The number of chromosomes in the microspore mother cells of the same plant shall be:
(A) 20 (B) 10
(C) 40 (D) 15

Q.35 Parthenogenesis is found in –
(A) Honeybees (B) Ants
(C) Turkey (D) All of these

Q.36 A sea star was cut into two complete pieces; each developed into a complete sea star. This is an example of
(A) external fertilization (B) fission
(C) budding (D) fragmentation

Q.37 Which of the following is an advantage of asexual reproduction?
(A) independent assortment
(B) synchronization of gamete release
(C) genetic diversity
(D) finding a mate is not necessary

Q.38 Hermaphroditism
(A) is a form of asexual reproduction.
(B) occurs when an unfertilized egg develops into an adult animal
(C) involves cross-fertilization between two animals
(D) typically involves self-fertilization.

Q.39 Which are exclusively viviparous –
(A) Bony fishes (B)Cartilagenous fishes
(C) Sharks (D) Whales

Q.40 The asexual process replaced by the sexual method is known as –
(A) Semigamy (B) Amphimixis
(C) Apospory (D) Apomixis

Q.41 Differentiation in morphology of the two sexes of the same species is called –
(A) Hermaphrodite (B) Heteromorphosis
(C) Sexual dimorphism (D) Unisexual

Q.42 Gemmule formation in sponges is helpful in
(A) Parthenogenesis (B)Sexual reproduction
(C) Only dissemination (D) Asexual reproduction

Q.43 In some species parthenogenesis may alternate with sexual reproduction this process is called –
(A) Complete parthenogenesis
(B) Incomplete or cyclic parthenogenesis
(C) Both the above
(D) None of the above

Q.44 Which one of the following processes results in the formation of a clone of bacteria?
(A) Transformation (B) Transduction
(C) Binary fission (D) Conjugation

Q.45 *Marchantia* is considered as a heterothallic plant because it is –
(A) Heterogametic (B) Bisexual
(C) Monoecious (D) Dioecious

Q.46 The chromosome number in meiocyte is 34. The organism could be –
(A) Ophioglossum (B) Dog
(C) Onion (D) Apple

Q.47 Diploid zygote is universal in
(A) all sexually reproducing organisms.
(B) all asexually reproducing organisms.
(C) all sexually and asexually reproducing organisms.
(D) all plants and animals.

Q.48 The condition, in which, both male and female reproductive organs are found on the same plant, is called –
(A) unisexual (B) bisexual
(C) monoecious (D) Both B and C

Q.49 Majority of sexually reproducing organisms form
(A) Isogametes
(B) Homogametes
(C) Heterogametes
(D) More than one option is correct

Q.50 In oviparous individuals the fertilised egg is covered by
(A) calcareous shell (B) hard shell
(C) Both (A) and (B) (D) phosphorus shell

EXERCISE - 3 (LEVEL-3)

Choose one correct response for each question.

Q.1 Match the Column

Column I	Column II
(a) Multiple fission	(i) Asexual Reproduction
(b) Oestrous cycle	(ii) *Plasmodium*
(c) Menstrual cycle	(iii) Yeast
(d) Unequal budding	(iv) Cow, Deer, Tiger
(e) Uniparental reproduction	(v) Monkey, Apes, Humans

Codes :
(A) (a) - i, (b)-ii, (c)-iv, (d)-iii, (e)-(v)
(B) (a) - v, (b)-ii, (c)-iii, (d)-iv, (e)-(i)
(C) (a) - ii, (b)-iv, (c)-v, (d)-iii, (e)-(i)
(D) (a) - iii, (b)-ii, (c)-v, (d)-iv, (e)-(i)

Q.2 For commercial propagation of banana and ginger which of the following parts are utilised respectively?
(A) Rhizome, Sucker (B) Rhizome, Tuber
(C) Tuber, Bulb (D) Rhizome, Rhizome

Q.3 Study the following statement and choose the correct option –
I. Asexual reproduction is common among single celled organisms and organisms with relatively simple organisation.
II. Conidia, bud, gemmules are common sexual structures.
III. In plants Runner, Rhizome, Sucker, Tuber Offset, Bulb are called vegetative propagules.
IV. The invasive weeds found growing in water bodies and is called, 'Terror of Bengal', is Zostera.
(A) I, II are correct but III, IV are incorrect.
(B) III, IV are correct but I, II are incorrect.
(C) I, III are correct but II, IV are incorrect.
(D) II, IV are correct and I, III are incorrect.

Q.4 Which one of the following pairs is wrongly matched while the remaining three are correct?
(A) *Bryophyllum* - Leaf buds
(B) *Agave* - Bulbils
(C) *Penicillium* - Conidia
(D) Water hyacinth - Runner

Q.5 Choose incorrect match
(A) Bulbil - **Agave** (B) Rhizome - Ginger
(C) Tuber - *Bryophyllum* (D) Runner - Grasses

Q.6 Which of the following plant groups shows internal fertilisation only?
(a) Algae (b) Bryophytes
(c) Pteridophytes (d) Fungi
(A) (b) & (c) (B) (a) & (b)
(C) (c) & (d) (D) (a) & (c)

Q.7 Choose correct option w.r.t. features of different plant groups

	Group	Embryo	Gametes	Asexual spore
(A)	Bryophytes	Present	Homogamete	Absent
(B)	Pteridophytes	Present	Homogamete	Present
(C)	*Ulothrix*	Absent	Homogamete	Present
(D)	Gymnosperms	Absent	Heterogamete	Present

Q.8 Which of the following features cannot be shown by structure which is vital link between two generations ensuring continuity of species?
(a) Thick walled
(b) Multicelled
(c) One set of chromosomes
(d) Meiocyte
(e) Resting structure
(A) (a), (b) & (e) (B) (a), (b) & (d)
(C) (b) & (c) (D) (d) & (e)

Q.9 Choose correct option for asexual and sexual reproduction in organisms that have a relatively simple organisation.

	Feature	Asexual reproduction	Sexual reproduction
(a)	Condition	Favourable	Unfavourable
(b)	Occurrence	More	Less
(c)	Structures	Spore	Gamete
(d)	Division	Meiosis	Mitosis

(A) (a) & (d) (B) (b) & (c) only
(C) (a), (b) & (c) only (D) (c) & (d)

Q.10 Which of the following plants produce non-motile male gametes?
(A) *Ulothrix, Marchantia*
(B) *Strobilanthus, Chara*
(C) *Spirogyra, Ulothrix*
(D) *Mangifera, Pinus*

Q.11 Choose the correct option for number of chromosomes in Meiocytes.

	Column I	Column II
a.	Housefly	(i) 46
b.	Human	(ii) 8
c.	Fruit fly	(iii) 12
d.	Rice	(iv) 24

(A) a (ii), b(i), c(iii), d(iv)
(B) a(ii), b(i), c(iv), d(iii)
(C) a(iii), b(i), c(ii), d(iv)
(D) a(i), b(ii), c(iii), d(iv)

Q.12 The vital link that ensures continuity of species between organisms of one generation and next are all, except
(A) Zygospore (B) Oospore
(C) Zygote (D) Oosphere

Q.13 What is the carrier of ♂ gamete in the *Pinus*, *Marchantia*, Mango, *Chara*, *Funaria* respectively
[where A - Pollen tube, B - H_2O]
(A) A, B, B, A, A (B) A, B, A, B, B
(C) B, A, A, B, A (D) A, B, A, A, B

Q.14 What would be the number of chromosomes in the meiocyte and gamete of onion respectively?
(A) 24, 12 (B) 34, 17
(C) 32, 16 (D) 14, 17

Q.15 Choose correct sequence for different stages in the life cycle of Rice.
(A) Juvenile phase → Flowering phase → Recovery phase → Senescence
(B) Juvenile phase → Reproductive phase → Interflowering phase
(C) Juvenile phase → Reproductive phase → Senescence
(D) Juvenile phase → Interflowering phase → Senescence

Q.16 Choose the correct options
I. Gametes are always produced from diploid parent plant body.
II. Meiosis never occurs in plants which are haploid.
III. The Gymnosperm and Pteriodophytes have diploid parent body.
IV. In seed plants, pollen grains are carrier of male gametes.
(A) I, II are correct but III, IV are incorrect.
(B) III, IV are correct but I, II are incorrect.
(C) I, III are correct but II, IV are incorrect.
(D) II, IV are correct but I, III are incorrect.

Q.17 Arrange the following plants w.r.t. increasing number of chromosome
Apple, Onion, Rice, Maize
(A) Maize, Rice, Onion, Apple
(B) Apple, Onion, Rice, Maize
(C) Apple, Rice, Onion, Maize
(D) Rice, Maize, Apple, Onion

Q.18 Choose correct option w.r.t. following structures

		Cellular structure	Flagella	Wall
(a)	Zoospore	Unicellular	Absent	Thick
(b)	Conidia	Unicellular	Absent	Thin
(c)	Gamete	Unicellular	Can be present	Thick

(A) (a) & (b) (B) (b) & (c)
(C) (a) & (c) (D) (b)only

Q.19 Which of the following represents the correct sequence of phases in the life cycle of wheat?
[where J - Juvenile phase, R - Reproductive phase, I - Interflowering period, G - Gap phase, S - Senescence, V - Vegetative phase]
(A) V → R → I → R → S
(B) J → R → G → R → S
(C) J → R → S
(D) V → R → S → R

Note (Q.20-Q.23) :
Each questions contain STATEMENT-1 (Assertion) and STATEMENT-2 (Reason). Each question has 4 choices (A), (B), (C) and (D) out of which ONLY ONE is correct.
(A) Statement- 1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statement -1

(B) Statement -1 is True, Statement -2 is True ; Statement-2 is NOT a correct explanation for Statement - 1
(C) Statement - 1 is True, Statement- 2 is False
(D) Statement -1 is False, Statement -2 is False

Q.20 **Statement 1 :** Individuals produced by asexual reproduction are genetically simillar to parents.
Statement 2 : Asexual reproduction involves only mitotic divisions.

Q.21 **Statement 1 :** Amoeba shows multiple fission during unfavourable conditions.
Statement 2 : Chances of survival are less during unfavourable conditions.

Q.22 **Statement 1:** Asexual reproduction is also called blastogenesis.
Statement 2 : In asexual reproduction, there is no formation and fusion of gametes.

Q.23 **Statement 1 :** Sexual reproduction is advantageous than asexual reproduction.
Statement 2 : It is rapid mode of reproduction while asexual reproduction is slow mode of reproduction.

EXERCISE - 4 (PREVIOUS YEARS AIPMT/NEET EXAM QUESTIONS)

Choose one correct response for each question.

Q.1 Vegetative propagation in Pistia occurs by **[AIPMT 2010]**
(A) Stolon (B) Offset
(C) Runner (D) Sucker

Q.2 The "eyes" of the potato tuber are **[AIPMT 2011]**
(A) Root buds (B) Flower buds
(C) Shoot buds (D) Axillary buds

Q.3 Which one of the following is correctly matched? **[AIPMT 2012]**
(A) Onion-Bulb
(B) Ginger-Sucker
(C) *Chlamydomonas*-Conidia
(D) Yeast-Zoospores

Q.4 Meiosis takes place in – **[NEET 2013]**
(A) Megaspore (B) Meiocyte
(C) Conidia (D) Gemmule

Q.5 Product of sexual reproduction generally generates: **[NEET 2013]**
(A) Large biomass
(B) Longer viability of seeds
(C) Prolonged dormancy
(D) New genetic combination leading to variation

Q.6 Which one of the following shows isogamy with non-flagellated gametes? **[AIPMT 2014]**
(A) *Sargassum* (B) *Ectocarpus*
(C) *Ulothrix* (D) *Spirogyra*

Q.7 In ginger vegetative propagation occurs through: **[AIPMT 2015]**
(A) Offsets (B) Bulbils
(C) Runners (D) Rhizome

Q.8 Which of the following pairs is not correctly matched? **[RE-AIPMT 2015]**

Mode of reproduction	Example
(A) Rhizome	Banana
(B) Binary fission	*Sargassum*
(C) Conidia	*Penicillium*
(D) Offset	Water hyacinth

Q.9 Which one of the following statements is not correct? **[NEET 2016 PHASE 2]**
(A) Offspring produced by the asexual reproduction are called clone.
(B) Microscopic, motile asexual reproductive structures are called zoospores.
(C) In potato, banana and ginger, the plantlets arise from the internodes present in the modified stem.
(D) Water hyacinth, growing in the standing water, drains oxygen from water that leads to the death of fishes.

Q.10 Which of the following flowers only once in its life-time? **[NEET 2018]**
(A) Mango (B) Jackfruit
(C) Bamboo species (D) Papaya

Q.11 Offsets are produced by **[NEET 2018]**
(A) Parthenocarpy (B) Mitotic divisions
(C) Meiotic divisions (D) Parthenogenesis

Q.12 In some plants, the female gamete develops into embryo without fertilization. This phenomenon is known as **[NEET 2019]**
(A) Autogamy (B) Parthenocarpy
(C) Syngamy (D) Parthenogenesis

ANSWER KEY

EXERCISE-1 (SECTION-1&2)

(1) (C) **(2)** (B)
(3) (A) **(4)** (D)
(5) Micropropagation **(6)** Without
(7) Haploid **(8)** Neela Kuranji
(9) Zygote **(10)** Outside
(11) Embryo **(12)** Parthenogenesis
(13) Zoospores **(14)** Meiosis
(15) Juvenile / growth **(16)** Amoeba.
(17) A-Archegonium, B-Motile
(18) A (Karyokinesis), B (Equal daughter cells)
(19) Embryo **(20)** Embryogenesis
(21) Inter-flowering phase **(22)** External
(23) Increase, reduction **(24)** Node/eyes
(25) Adventitious / leaf bud **(26)** False
(27) False **(28)** False **(29)** True
(30) True **(31)** False **(32)** False
(33) False **(34)** True **(35)** True
(36) True **(37)** False **(38)** False
(39) False **(40)** False

EXERCISE - 1 [SECTION-3 & 4]

Q	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
A	A	C	B	C	B	D	B	B	A	A	C	C	A	C	B	D	C	D	C	C
Q	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
A	C	B	D	C	D	D	B	A	C	D	D	D	C	D	C	C	B	A	A	C
Q	81	82	83	84																
A	D	D	C	A																

EXERCISE - 2

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

EXERCISE - 3

Q	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A	C	D	C	D	C	A	C	C	C	D	C	D	B	C	C	B	A	D	C	A
Q	21	22	23																	
A	A	B	C																	

EXERCISE - 4

Q	1	2	3	4	5	6	7	8	9	10	11	12
A	B	D	A	B	D	D	D	B	C	C	B	D

SOLUTIONS

EXERCISE-1

(1) (C) **(2)** (B)
(3) (A) **(4)** (D)
(5) Micropropagation **(6)** Without
(7) Haploid **(8)** Neela Kuranji
(9) Zygote **(10)** Outside
(11) Embryo **(12)** Parthenogenesis
(13) Zoospores **(14)** Meiosis
(15) Juvenile / growth **(16)** Amoeba.
(17) A-Archegonium, B-Motile
(18) A (Karyokinesis), B (Equal daughter cells)
(19) Embryo **(20)** Embryogenesis
(21) Inter-flowering phase **(22)** External
(23) Increase, reduction **(24)** Node/eyes
(25) Adventitious / leaf bud

(26) **False.**Gemmule formation is the type of reproduction in which the buds are formed with in the parent body, e.g., Sponge.

(27) **False.** Because in *Hydra* the common -rnode of reproduction is bud formation which is the small outgrowth attach to parent body externally.

(28) **False.** Staminate are the unisexual male flower/ or plant which produces male gametes only, called staminate plant.

(29) **True.** When both the sexes are present on the same organism called hermaphrodite, e. g., Earthworm, leech, etc.

(30) True **(31)** False **(32)** False
(33) False **(34)** True **(35)** True
(36) True **(37)** False **(38)** False
(39) False **(40)** False

(41) **(A). Budding :** In this type of asexual reproduction the daughter individual is formed on the small outgrowth of parent body, e. g, Yeast, *Hydra*, etc.

(42) **(C).** A-clearly indicate the homogametes or isogametes because both gametes are identical.
B-Clearly indicates that, it is not homogametes because there is much size difference.
C-Indicate the two well defined gametes which are not similar, i.e., ovum (female) and sperm (male).

(43) **(B).** In the given diagram three figure are there first figure indicate the fusion of male and female gametes. Second figure indicate the zygote because there are two nuclei visible in completely fused condition. Third figure indicates the complete one cell after fusion is over. It can be called new individual.

(44) (C) **(45)** (B) **(46)** (D)
(47) (B) **(48)** (B) **(49)** (A)

(50) **(A).** Conidia are non-motile gametes found singly or in chain on the parent body, e.g., *Penicillium*.

(51) (C)

(52) **(C).** In cell division the cell divides into two parts having same genetic constituent. Only Monera and Protista are the organisms, which are single celled in five kingdom of classification.
That's why cell division is the common mode of reproduction in Monera and Protista.

(53) **(A).** Asexual reproduction in plants called vegetative reproduction. Rhizome, runner, sucker all are the examples of asexual reproduction.

(54) (C) **(55)** (B) **(56)** (D) **(57)** (C)

(58) **(D).** Production of plant by culturing the cells in laboratory is called micropropagation. It is also called tissue culture. In this technique the plants are genetically similar to parent one. That's why called somaclonal plants.

(59) (C) **(60)** (C)

(61) **(C).** Binary Fission is the mode of reproduction in which, the single organism divides into two parts, i.e., Amoeba, Paramecium.

(62) **(B).** Binary fission is the common mode of reproduction in bacteria and Protista. It may be of many types
Irregular binary fission : *Amoeba*
Longitudinal binary fission : *Euglena*
Transverse binary fission : *Paramecium.*

(63) (D)

(64) **(C).** 'Terror of Bengal' is the aquatic plant (water hyacinth) introduced in Bengal for its beautiful leaves and flower. But it grows

very fast and consumes O_2 from water. Due to which lot of fish died. That's why it was called Terror of Bengal.

(65) **(D).** Irregular binary fission – *Amoeba*
Longitudinal binary fission – *Euglena*
Transverse binary fission – *Paramecium*

(66) (D)

(67) **(B).** Corms are the unbranched rounded underground stems. They have buds for daughter plants.
Axillary buds occur at places. Their base contains a number of adventitious roots.

(68) **(A).** Juvenile phase is the phase of life span in which growth of body and full development of reproductive organ takes place. It is called vegetative phase in plants.

(69) **(C).** Menstrual cycle is the periodic hormonal ovarian change. It takes place in every month in the primates. Stopping of menstrual cycle is called menopause.

(70) (D)

(71) **(D).** Fishes are dioecious so no self-fertilisation. Earthworm, liverfluke, leech all are hermaphrodite but hermaphrodism is not necessary to give rise to self-fertilisation. In given options only liverfluke does self-fertilisation.

(72) (D)

(73) **(C).** Gametogenesis Process of formation of gametes (male and female) is called gametogenesis, Gametes are the haploid reproducing cells.

(74) **(D).** Male gametes are called antherozoids in case of lower organism like fungi and algae and in higher organism it is called sperm like mammals, reptiles, etc.

(75) (C)

(76) **(C).** Gamete mother cells are called gamete producing cells. In these the meiotic cell division takes place. Hence, they are also called meiocytes.

(77) **(B).** Transfer of male gametes (pollen) to the receptacle (stigma) of the female is called pollination. Generally, the pollination takes place by various means like air/water/animals/insects, etc.

(78) **(A).** Self-fertilisation is very common phenomenon in plants. This phenomenon takes place only when there is the presence of bisexual flower.

(79) (A)

(80) **(C).** Female gametes are called ovum in case of higher organism, The term egg is also used, Interchangeably Archegonia also used for female gametes containing organs but in case of lower organism, i.e., Bryophytes and pteridophytes.

(81) (D)

(82) **(D).** Heterothallic/dioecious/unisexual term used when the sexes are present on different organisms, called male and female.
The archegonia and antheridia term used in case of lower organism.

(83) **(C).** Syngamy and fertilisation both the terms are used interchangeabily, for the fusion of male and female gametes.

(84) (A)

EXERCISE-2

(1) (D)

(2) **(C).** Ant, aphids, cockroaches are unisexual only earthworm have both the sexes (hermaphrodite).

(3) **(C).** Reproduction is a biological process in which an organism produces young ones (offspring) similar to itself. In reproduction, offsprings have some resemblance with parents. Both sexual & asexual reproduction involve transfer of genetic material.

(4) **(B).** Meiosis is required for the production of haploid gametes during sexual reproduction. External fertilisation is not a rule during sexual reproduction, it can occur internally also.

(5) **(C).** Chromosome number in male gamete of rice plant is n = 12 therefore chromosome number in female gamete would also be 12. Zygote is diploid as it is the product of fertilization and the cells of the seedling would be meiocytes and other diploid cells. Hence, the chromosome number in both zygote and cells of seedling will be 2n= 24.

(6) (A)

(7) **(B).** A large number of gametes are released into the medium to increase the chance of fertilization. The chances of survival of offsprings from external fertilization are lesser than those of internal fertilization as they face more risk from predators.

(8) (A) **(9)** (C)

(10) **(A).** Gynoecium is the female part of the flower, a unit of which is called pistil. A pistil may have one or more than one carpels (monocarpellary, bicarpellary etc). Each carpel may have more than one ovules.

(11) (A) **(12)** (C)

(13) **(B).** Syngamy is the complete and permanent fusion of male and female gametes to form a zygote.

(14) (B) **(15)** (A) **(16)** (B) **(17)** (B)

(18) (B) **(19)** (D) **(20)** (A) **(21)** (C)

(22) (B) **(23)** (C) **(24)** (D)

(25) **(C).** These are no natural death in single celled organisms like Amoeba and bacteria. it is so, because of asexual reproduction, the body of parent is divided into daughter cells. So, in effect, there is no practical death in Amoeba and bacteria.

(26) (A)

(27) **(D).** There are various types of reproduction, both asexual (fission, budding, etc.) and sexual (internal and external). The type of reproduction, an organism undergoes depends ultimately on its genetic makeup which influences its physiology. Habitat also influences the type of reproduction, that organism undergoes.

(28) **(A).** Ginger, Potato, Water hyacinth, *Agave*

(29) (B)

(30) **(B).** Spores formation is also a type of asexual reproduction. Zoospores, conidia, oidia, etc. are all asexually reproducing structures. There is generally no gamete formation in asexual reproduction and the offsprings produced are called clones.

(31) (A) **(32)** (B) **(33)** (B)

(34) **(A).** Shoot tip cells and microspore mother cells both are diploid in maize plant. if number of chromosomes in shoot tip cell (2n) = 20, then number of chromosomes in microspore mother cell will be (2n) = 20.

(35) (D)

(36) **(D).** Fragmentation occurs when there are separate pieces of the parent.

(37) **(D).** The only advantage of asexual reproduction listed would be: not necessary to find a mate; all the other options are actually advantages of sexual reproduction.

(38) **(C).** A hermaphrodite is an organism that has reproductive organs normally associated with both male and female sexes.

(39) **(D).** Whales are mammals and viviparous, give birth to live young.

(40) **(D).** The apomixis is the formation of new individuals through asexual reproduction without involving the formation and fusion of gametes.

(41) **(C).** Sexual dimorphism is the systematic difference in form between individuals of different sex in the same species. For example, in some species, including many mammals, the male is larger than the female. In others, such as some spiders, the female is larger than the male.

(42) **(D).** Gemmules are internal buds found in sponges and are involved in asexual reproduction. It is an asexually reproduced mass of cells, that is capable of developing into a new organism i.e., an adult sponge.

(43) **(B). Parthenogenesis (Virgin Birth):** Development of an egg (ovum) into a complete individual without fertilization is known as parthenogenesis.

(44) **(C).** Binary fission is asexual mode reproduction. Progeny of the asexual mode of reproduction are genetically identical, transduction, transformation and conjugation are kind of sexual mode of reproduction, where genetic recombination.

(45) **(D).** *Marchantia* is dioecious where the male plant bears Antheriodiophore, female plants bears Archegonio-phore.

(46) **(D).** Apple (2n = 34) ;
Ophioglossum, 2n = 1260
Dog, 2n = 78 ; Onion 2n = 32

(47) **(A).** Presence of diploid zygote is universal in all sexually reproducing organism. Irrespective

of the fact that, the parents are haploid or diploid.

In haploid parent condition, the diploid zygote undergoes meiosis and become haploid body again, while in diploid organisms, the diploid zygote changes to diploid individual after undergoing mitosis.

(48) **(D).** Hermaphrodite/bisexual/monoecious/homothallic term used when both the sexes are present in same organism. Term 'hermaphrodite' is used in case of animals. Bisexual and monoecious used in both (animal/plant).

(49) (C)

(50) **(C).** As we know oviparous individuals lay eggs with white hard shell around it and this white hard shell is made up of calcium. A hard shell can be calcareous or made of some other elements also.

EXERCISE-3

(1)	(C)	**(2)**	(D)	**(3)**	(C)
(4)	(D)	**(5)**	(C)	**(6)**	(A)
(7)	(C)	**(8)**	(C)	**(9)**	(C)
(10)	(D)	**(11)**	(C)	**(12)**	(D)
(13)	(B)	**(14)**	(C)	**(15)**	(C)
(16)	(B)	**(17)**	(A)	**(18)**	(D)

(19) (C)

(20) **(A).** New individuals produced are genetically similar to the parent and also to each other as mitotic divisions produce no variations.

(21) **(A).** Amoeba shows multiple fission it is a type of asexual reproduction in which the parental body divides into many daughter cells simultaneously during the unfavourable conditions to increase the chances of survival of daughter cells.

(22) **(B).** Development of an organism from non-sexual reproductive units like buds fragments etc. is called blastogenesis. In asexual reproduction there is no formation and fusion of gametes.

(23) **(C).** Sexual reproduction is advantageous than asexual reproduction because in sexual reproduction progeny are genetically different from the parents as variations appear due to new combinations of genes during crossing over. Chance segregation of chromosomes and chance fusion of gametes. So it plays important role in evolution. Sexual reproduction is slow mode of reproduction while asexual reproduction is rapid mode of reproduction.

EXERCISE-4

(1) **(B).** In Pistia (water lettuce) vegetative propagation occurs by offset where one internode long runners grows horizontally along the soil surface and gives rise to new plants either from axillary or terminal buds.

(2) **(D).** Potato is the common example of stem-tuber. It stores starch as reserve food material. The potato-tubers are used for vegetative propagation. These possess axillary buds over their nodes or eyes. The buds produce new plantlets when a stem-tuber or a part of it having an eye is placed in the soil.

(3) **(A).** Yeast and other ascomycetes characteristically produce ascospores. Chlamydomonas is an alga that produces zoospores and conidia are not found in algae. Ginger propagates by rhizome not by sucker. Onion propagates by bulb which is an underground, modified stem.

(4) **(B).** Meiosis takes place in meiocyte while Conidia & Gemmule are asexual structures and megaspore is haploid.

(5) **(D).** Sexual reproduction leads to formation of new combinations & appearance of variations.

(6) **(D).** *Spirogyra* shows isogamy with non-lagellated gametes.

(7) **(D).** In ginger, vegetative propagation occurs through rhizome. Rhizomes are stems which grow horizontally under the ground. In ginger, the underground stems are swollen with food reserves. The terminal bud grows upward to produce the flowering shoot and the lateral buds grow out to form new plant.

(8) **(B).** Binary fission is usually found in amoeba, Paramoecium, euglena.

(9) **(C).** In potato, banana and ginger, the plantlets arise from the nodes present on modified stem.

(10) **(C).** Bamboo species are monocarpic i.e., flower generally only once in its life-time after 50-100 years. Jackfruit, papaya and mango are polycarpic i.e., produce flowers and fruits many times in their life-time.

(11) **(B).** Offset is a vegetative part of a plant, formed by mitosis.

– Meiotic divisions do not occur in somatic cells.

– Parthenogenesis is the formation of embryo from ovum or egg without fertilisation.

– Parthenocarpy is the fruit formed without fertilisation, (generally seedless)

(12) **(D).** The phenomenon in which female gamete develops into embryo without getting fused with male gamete (fertilisation) is called parthenogenesis.