CHAPTER **01**

Reproduction in Organisms

1. Life Cycle

The life cycle of an animal or plant is the series of changes or developments that it passes through from the beginning of its life until its death.

2. Lifespan

It is the time period from the birth to the natural death of an organism. It is not necessary that the lifespan of an organism is related to their body size.

3. Reproduction

It is a biological process in which an organism gives rise to young ones or offspring similar to itself. Reproduction is essential for organisms because it

(i) maintains life on earth.

(ii) enables continuity of a species.

(iii) creates variations among populations.

It can be categorised as asexual and sexual reproduction.

4. Asexual Reproduction

It is the phenomenon of production of an offspring by a single parent without the formation and fusion of gametes. It involves only mitotic cell division. Thus, the offspring produced by this method are identical and exact copies of their parents. They are called as **clones**.

A. **Asexual Reproduction in Animals** It is the primary means of reproduction among the protists, cnidarians and tunicates. It occurs through following methods

(i) **Binary fission** is the division of parent body into two equal halves, *e.g. Amoeba, Paramecium,* etc.

(ii) **Budding** is the process in which an outgrowth is produced from parent's body that separates to give rise to a new individual, *e.g.* yeast, *Hydra*, etc.

If bud grows externally on the surface of the body, it is known as **external** (exogenous) **budding**, *e.g.* yeast. If bud grows within the parental body, it is known as **internal** (endogenous) **budding** or gemmule formation, *e.g.* sponges, *Marchantia*.

(iii) **Sporogenesis/Sporulation** Spores are the reproductive cells of many multicellular organisms. Spores are capable of producing daughter cells by their growth.

Algae and fungi have different types of spores like

(a) **Zoospores** (motile and flagellated endogenous spores, *e.g. Chlamydomonas)*.

(b) **Conidia** (non-motile exogenous spores are formed, *e.g. Penicillium*).

(iv) **Fragmentation** is the breaking of parent body into several fragments. Each of these fragments develop into mature individuals, *e.g. Spirogyra*, sea star, etc.

(v) **Regeneration** is the formation of a whole new body of an organism from a cut or broken part of the parent's body, *e.g. Hydra*, *Planaria*, etc.

B. **Asexual Reproduction in Plants** In some plants, vegetative units possess the capability of producing new plant, *e.g.* roots, stems, leaves and meristematic tissues which grow to form new plants. This method is called as **vegetative propagation** or **vegetative reproduction**.

(i) **Natural Vegetative Propagation** It is the natural method of propagation. The vegetative propagules of plants develop into new plants under suitable conditions. It is done by **roots** (sweet potato), **underground stems** include rhizomes, *e.g.* banana, ginger; **bulbs**, *e.g.* garlic, onion; **tubers**, *e.g.* potato; **corms**, *e.g*. *Colocasia*; **creeping stems** include **suckers**, *e.g. Chrysanthemum;* **runners**, *e.g.* lawn grass or *Cynodon*; **stolons**, *e.g. Vallisneria*; **offsets**, *e.g. Pistia*, **aerial stems,** e.g. *Opuntia,* **leaves** *e.g. Bryophyllum, Kalanchoe, Begonia*, etc, **bulbils** *e.g. Agave, Oxalis, Allium sativum*, lily, etc.

(ii) **Artificial Vegetative Propagation** It is of four types, i.e. cutting, layering, grafting and micropropagation.

Plant Parts for Artificial Propagation

Artificial Method	Examples (Plant Name/Plant Part)
Cutting	Leaves (*Bryophyllum*), roots (tamarind), stem (grapes, sugarcane and rose), etc.
Layering	Jasmine, grapes, litchi, orange, etc.
Grafting	Rose, apple, pear, mango, etc.
Micropropagation	Banana, orchid and ornamental plants.

5. Sexual Reproduction

The mode of reproduction which involves the formation of male and female gametes either by the same individual or by different individuals of opposite sex is known as **sexual reproduction**.

6. Phases in Life Cycle

All organisms grow and mature in their life, to be able to reproduce sexually. On this basis, their life cycle can be divided into three phases, i.e. juvenile phase, reproductive phase and senescent phase.

Note

- Some animals remain reproductively active throughout their reproductive phase; such animals are called **continuous breeders**, *e.g.* human. On the other hand, some animals become reproductively active only during the favourable seasons; such animals are called **seasonal breeders**, *e.g.* dog, birds, frog, lizard, etc.
- During the reproductive phase in non-primate animals, **oestrous cycle** occurs, while in the primates **menstrual cycle** occurs.

7. Events in Sexual Reproduction

The sequential events in sexual reproduction are grouped under three main events. These are pre-fertilisation, fertilisation and post-fertilisation events.

(i) **Pre-fertilisation Events** The events taking place before fertilisation are called pre-fertilisation events. These include gametogenesis and gamete transfer.
Gametogenesis is the process of formation of haploid gametes.

When two gametes (*i.e.* male and female) are morphologically similar, they are called **isogametes** or **homogametes**, while morphologically dissimilar gametes are called **heterogametes**.

To facilitate fusion of gametes, they should come in physical association with each other. This phenomenon is called **gamete transfer**.

In flowering plants, male gamete reaches the female gamete, through the process of pollination (transfer of pollen grain to stigma).

(ii) **Fertilisation** The complete and permanent fusion of male and female gametes is known as **fertilisation** or **syngamy** or **amphimixis**. It results in the formation of a diploid structure called **zygote**.

- The process of fertilisation may occur outside the body of organisms, *i.e.* **external fertilisation** (*e.g.* algae, amphibians, fishes, etc.) or inside the body of organisms, *i.e.* **internal fertilisation** (*e.g.* fungi, reptiles, birds, higher animals and plants).
- **Parthenogenesis** is the development of an embryo from an unfertilised egg. In organisms like rotifers, honeybees, lizards and some birds, the female gametes form new organisms without fertilisation.

(iii) **Post-fertilisation Events** These are the events which take place after the formation of zygote in all sexually reproducing organisms. These events include the development of zygote and embryo after fertilisation.

Further, the development of zygote depends upon the type of life cycle and the environment of organism. The process of development of embryo from this zygote is called **embryogenesis** which involves cell division, cell enlargement or growth and cell differentiation.

Embryogenesis in animals and plants occurs differently as follows

(a) **Embryogenesis in Animals** It occurs on the basis of whether the development of zygote is taking place outside or inside the body of female parent. Animals are divided into two types

- **Oviparous** Animals laying eggs, *e.g.* reptiles.
- **Viviparous** Animals giving birth to young ones, *e.g.* mammals.

(b) **Embryogenesis in Plants** In flowering plants, the zygote is formed inside the ovule. Afterwards the sepals, petals and stamens of flower wither and fall off.

After fertilisation, the zygote develops into embryo, ovules into seed and ovary into the fruit. The seed after dispersal in favourable condition germinates to produce new plants.

Practice Questions

1. Single-celled animals are said to be immortal because
(a) they grow indefinitely in size
(b) they can tolerate any degree of change in temperature
(c) they can reproduce throughout their lifespan
(d) they continue to live as their daughter cells

2. Reproduction can be considered as
(a) a biological process
(b) a cycle of birth, growth and death
(c) a process that enables continuity of species
(d) All of the above

3. Asexual reproduction is a method of reproduction in which participation of …… takes place.
(a) one individual
(b) two individuals (same species)
(c) multi-individuals
(d) two individuals (different species)

4. Cell division is the mode of reproduction in
(a) monerans (b) protists
(c) Both (a) and (b) (d) None of these

5. Zoospores are
(a) motile gametes of *Chlamydomonas*
(b) non-motile gametes of sponges
(c) motile gametes of *Hydra*
(d) non-motile gametes of *Penicillium*

6. Gemmule formation is a common mode of reproduction in
(a) *Hydra* (b) sponge
(c) *Penicillium* (d) *Amoeba*

7. The site of origin of the new plantlets in potato, *Dahlia,* ginger and banana is
(a) floral buds present on stem
(b) internodes of modified stem
(c) nodes of modified stem
(d) adventitious buds present on root

8. Some organisms are capable of asexual or sexual reproduction. Under favourable conditions, reproduction proceeds asexually. When conditions become more stressful reproduction switches to a sexual mode. Why?
(a) Sexual reproduction is simple and more rapid allowing larger numbers of offspring to be produced
(b) Sexual reproduction requires two separate individuals, who can mutually provide nutrient support during stress
(c) Sexual reproduction produces individuals with new combinations of recombined chromosomes increasing diversity
(d) Asexual reproduction requires more energy

9. Sexual reproduction involves formation of male and female gametes by
(a) same individual
(b) different individual of opposite sex
(c) Both (a) and (b)
(d) All of the above

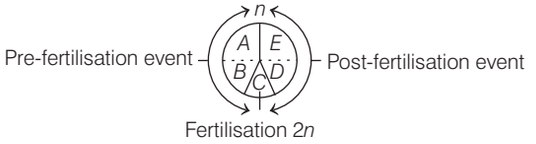
10. Select the correct sequence from the following.
I. Juvenile phase → Senescent phase → Reproductive phase
II. Juvenile phase → Reproductive phase → Senescent phase
III. Reproductive phase → Juvenile phase → Senescent phase
IV. Pre-reproductive phase → Reproductive phase → Senescent phase
(a) I and II (b) I and IV (c) III and IV (d) II and IV

11. *Strobilanthes kunthiana* is also called
(a) Neelakurinji (b) Peela kuranji
(c) Hara kuranji (d) Kala kuranji

12. Oestrus cycle is cyclic change in the activities of ovaries and accessory duct in non-primates during
(a) reproductive (seasonal) period
(b) maturation period
(c) ageing period
(d) juvenile period

13. Organisms reproducing throughout the year are called …… breeders, e.g. … and those who show recurring sexual activity are called …… breeders, e.g. … .
(a) continuous, sparrow, seasonal, hen
(b) seasonal, lizard, continuous, hen
(c) continuous, man, seasonal, tiger
(d) seasonal, hen, continuous, tiger

14. Identify the events (*A, B, D* and *E*) of sexual reproduction given below.



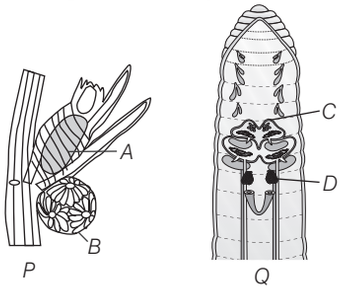
Choose the correct option.
(a) A–Gamete transfer, B–Gametogeneis, D–Zygote formation, E–Embryogenesis
(b) A–Gametogeneis, B–Gamete transfer, D–Zygote formation, E–Embryogenesis
(c) A–Gametogeneis, B–Zygote formation, D–Gamete transfer, E–Embryogenesis
(d) A–Gametogeneis, B–Gamete transfer, D–Embryogenesis, E–Zygote formation

15. What is male gamete called in heterogametic condition?
(a) Antherozoid (b) Sperm
(c) Egg (d) Both (a) and (b)

16. 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)

17. Figure *P* represents the reproductive organs of a plant, *Chara* and figure *Q* represents the reproductive organs of an animal, earthworm. Select the option which correctly identifies male reproductive organs of the two organisms.



(a) A and D (b) B and C (c) A and C (d) B and D

18. In flowering plants, the unisexual male flower is called …*A*… while the female is called …*B*… . Flowering plants may be monoecious, e.g. …*C*… or dioecious, e.g. …*D*… .

Complete the paragraph by filling up the blanks.

(a) A–staminate, B–pistillate, C–date palm, D–coconut
(b) A–pistillate, B–staminate, C–date palm, D–papaya
(c) A–pistillate, B–staminate, C–*Cucurbita*, D–coconut
(d) A–staminate, B–pistillate, C–*Cucurbita*, D–papaya

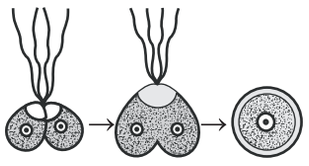
19. If the parent body is haploid then the gametes are

(a) haploid (b) diploid
(c) triploid (d) None of these

20. In diploid organism the gamete producing cells are called

(a) gamete mother cell (b) meiocytes
(c) Both (a) and (b) (d) None of these

21. Identify the sequence of events shown in the diagram below.



(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

22. Which of the following options is/are correct about pollination?

(a) Occurs in almost all flowering plants
(b) Facilitates pollen transfer to stigma
(c) Both (a) and (b)
(d) None of the above

23. Essential and most critical event in sexual reproduction is

(a) fertilisation
(b) division in male and female gametes
(c) Both (a) and (b)
(d) None of the above

24. Syngamy may occur in ..... .

(a) external medium (b) internal medium
(c) Both (a) and (b) (d) None of these

25. Internal fertilisation is the one in which syngamy

(a) occur outside the body
(b) occur inside the body
(c) is followed by meiosis
(d) None of the above

26. Diploid zygote is universal in

(a) All sexually reproducing organisms
(b) All asexually reproducing organisms
(c) All sexually and asexually reproducing organisms
(d) Only plants and animals

27. Life begins in all sexually reproducing organism from a

(a) single-celled zygote (b) double-celled zygote
(c) thick-walled zygote (d) All of these

28. Choose the incorrect pair.

(a) Cell division in embryo – Increase the number of cells
(b) Cell differentiation – Form specialised tissues and organs
(c) Eggs covered by hard calcareous shell – Oviparous animals
(d) Zygote develops outside the body –Viviparous animals

29. Chances of survival of young ones are more in the case of..... individuals.

(a) oviparous (b) viviparous
(c) ovoviviparous (d) None of these

30. Offsprings of oviparous animals have less chances of survival as compared to those of viviparous animals because

(a) proper embryonic care and protection is absent
(b) embryo does not develop completely
(c) progenies are of smaller size
(d) genetic variations do not occur

31. 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

32. *Amoeba* and yeast reproduce asexually by fission and budding, respectively because they are

(a) microscopic organisms
(b) heterotrophic organisms
(c) unicellular organisms
(d) uninucleate organisms

ANSWERS

1.	(d)	**2.**	(d)	**3.**	(a)	**4.**	(c)	**5.**	(a)	**6.**	(b)	**7.**	(c)	**8.**	(c)	**9.**	(c)	**10.**	(d)
11.	(a)	**12.**	(a)	**13.**	(c)	**14.**	(b)	**15.**	(d)	**16.**	(d)	**17.**	(b)	**18.**	(d)	**19.**	(a)	**20.**	(c)
21.	(b)	**22.**	(c)	**23.**	(c)	**24.**	(c)	**25.**	(b)	**26.**	(a)	**27.**	(a)	**28.**	(d)	**29.**	(b)	**30.**	(a)
31.	(c)	**32.**	(c)																

Hints & Explanations

1. (***d***) No individual is immortal except some single-celled organisms (e.g. *Amoeba*). It is due to the fact that they divide and continue to live as their daughter cells.

4. (***c***) Cell division is the common mode of reproduction in Monera and Protista as these contain single-celled organisms. In this process, the cell divides by mitosis into two parts and each part continues to live on as a daughter cell.

5. (***a***) Zoospores are motile gametes. These are commonly found in the fungi and plant kingdom, e.g. *Chlamydomonas*.

6. (***b***) Gemmule formation is a common mode of asexual reproduction in sponges. In this, the buds are formed within the parent body and later get released into the environment to form a new organism.

8. (***c***) Sexual reproduction produces individuals with new combinations of recombined chromosomes. This produces variations among offspring. When conditions become more stressful, an organism switches to sexual mode of reproduction so as to produce offspring with variations. These enable the offspring to adapt to the stressful conditions and successfully survive and reproduce.

9. (***c***) Sexual reproduction involves formation of the male and female gametes, either by the same individual or by different individuals of the opposite sex.

10. (***d***) Before reproducing sexually, organisms reach a stage of growth and maturity in their life which is known as juvenile phase or pre-reproductive phase. The end of this phase, marks the beginning of the reproductive phase and this phase finally leads to old age or senescent phase.

12. (***a***) Generally, oestrus cycle takes place in the seasonal breeders, e.g. non-primates. It is the cyclic change in the activity of ovaries and accessory duct during the reproductive (seasonal) period.

15. (***d***) Male gametes are called antherozoids in case of lower organisms like fungi and algae, and in higher organisms like mammals, reptiles, etc., these are called sperms.

16. (***d***) Hermaphrodite/bisexual/ monoecious/homothallic are terms used when both the male and female reproductive organs are present in same organism. Hermaphrodite is used for animals. Bisexual and monoecious are used for both animal and plant. Homothallic is used for fungi.

17. (***b***) In figure P, B–represents the antheridium (male sex organ) of *Chara*. In figure Q, C–represents the testis sac with testis of earthworm.

19. (***a***) Irrespective of the fact, whether the organism is haploid or diploid, it has haploid gametes.
In haploid parents, mitosis produces haploid gametes. In diploid parents, meiosis produces haploid gametes.

20. (***c***) Gamete mother cells are called gamete producing cells. In these, meiotic cell division takes place for the production of haploid gametes. These are also called meiocytes (diploid).

21. (***b***) In the given diagram, three figures are shown. First figure indicates the fusion of male and female gametes.
Second figure indicates the formed zygote because there are two nuclei visible in completely fused condition.
Third figure indicates a complete new cell after fusion is completed. Now, it can be called as a new individual.

25. (***b***) In internal fertilisation, fusion of gametes (syngamy) takes place inside the female reproductive tract. This process provides direct protection from the environment to the developing progeny.

26. (***a***) The presence of diploid zygote is universal in all sexually reproducing organisms irrespective of the fact that, the parents are haploid or diploid.
In haploid parent condition, the diploid zygote undergoes meiosis and becomes haploid body again, while in diploid organisms, the diploid zygote changes to diploid individual after undergoing mitosis.

27. (***a***) During fertilisation two haploid cells, a female and a male gamete combine to form a single diploid cell (2*n*) called zygote, from where every sexually reproducing organism begin its life.

28. (***d***) Option (d) contains the incorrect match. It can be corrected as
In viviparous animals, zygote develops inside the body of female.
Rest of the pairs are correct.

29. (***b***) In viviparous animals, the zygote develops into a young one inside the body of female organism. Thus, the chances of survival of young ones are greater in these animals because these young ones are provided with proper embryo care and protection.

31. (***c***) In female gamete of rice plant the chromosome number will be same as that of the male gamete (12).
Zygote is formed by fertilisation of male and female gametes thus, the chromosome number will be 24 (2*n*).
A seedling is young plant sporophyte developing out of embryo. So, chromosome number will be 24 (2*n*).
Thus, option (c) is correct.

32. (***c***) Unicellular organisms (like *Amoeba* and yeast) have a relatively simple body organisation. So, asexual mode of reproduction is common in them because by asexual reproduction unicellular organisms can multiply very fast. In *Amoeba*, it occurs by binary fission and in yeast by budding.