

CHAPTER-1

REPRODUCTION IN ORGANISM

Each and every organism can live only for a certain period of time. The period from birth to the natural death of an organism represents its **life span**. For example – If a person is born in year 2000 and die in year 2050, it means the life span (time he/she survive or live) is of 50 years.

Question in mind- What is Reproduction?

Answer-Reproduction is a biological process by which an organism produces another organism (offspring) similar to itself.

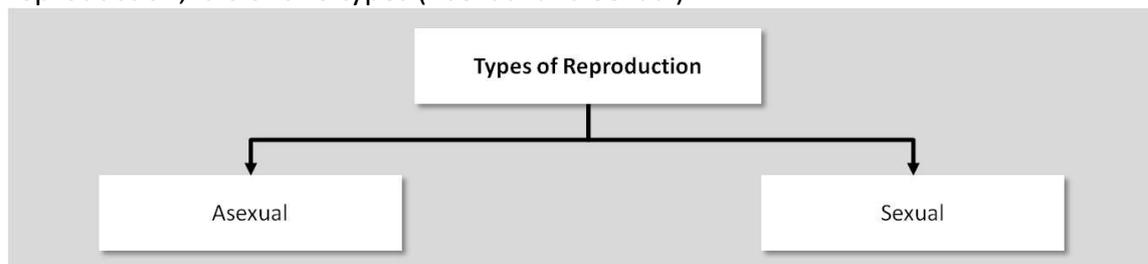
Question in mind- What are functions or importance of Reproduction?

Answer-Importance of Reproduction are-

- Reproduction is necessary for the continuity of the species.
- Sexual reproduction is responsible for variation in a population and its inheritance to future generations.

Question in Mind- Is only one parent is required for reproduction or more than one?

Answer-Based on whether there is participation of one organism or two in the process of reproduction, it is of two types (Asexual and Sexual).



Asexual Reproduction -When offspring is produced by a single parent with or without the involvement of gamete formation.

Sexual Reproduction - When two parents (opposite sex – male and female) participate in the reproductive process and also involve fusion of male and female gametes.

Asexual Reproduction	Sexual Reproduction
1) Does not involve formation or fusion of gametes.	1) Involves formation and fusion of gametes.
2) The offspring is clone	2) The offspring is not clone, it lead to variation in a population.
3) It is a simple and fast process.	3) It is an elaborate, complex and slow process.
4) It only involves only mitosis.	4) it involves meiosis
5) It is always uniparental.	5) It is usually Biparental.
6) It does not play any role in Evolution process.	6) It plays a vital role in evolution process.
7) It is common among Single-celled organism , in plants and animals with relatively simple organization.	7) It is common in higher animals with complex organization.

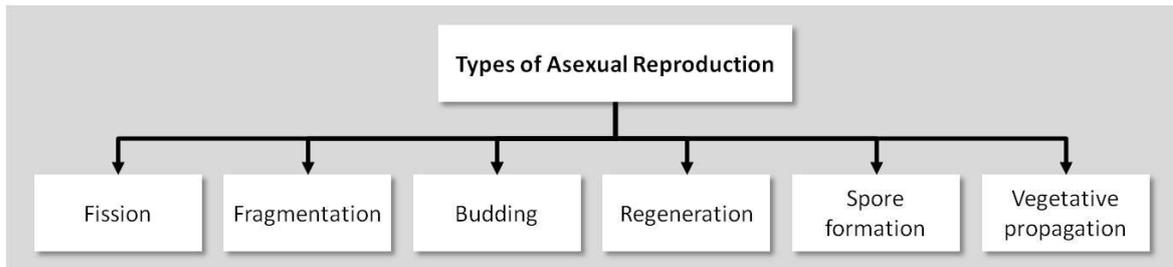
Question in mind-What are characteristics of Asexual Reproduction?

Answer-It includes:

- Uniparental with or without gametes formation.
- Offsprings are exact copies or clones of each other and the parent.
- Mitosis is the essential mode of asexual reproduction.

Question in mind- What are types of Asexual Reproduction?

Answer-There are many type of asexual reproduction which is followed by organism are Fission, Sporulation, Fragmentation , Budding, Regeneration, Spores formation and Vegetative Propagation.



Let's discuss them in detail.

FISSION: The splitting of parental cell into two or more daughter cells.

(a)Binary fission: The splitting of a parental cell into two equal daughter cells, each of which rapidly grows into an adult is called binary fission. It occurs in single celled animals like bacteria and protozoan's (e.g., Amoeba, paramecium). It can be simple or irregular, longitudinal, oblique or transverse, depending on the plane of division.

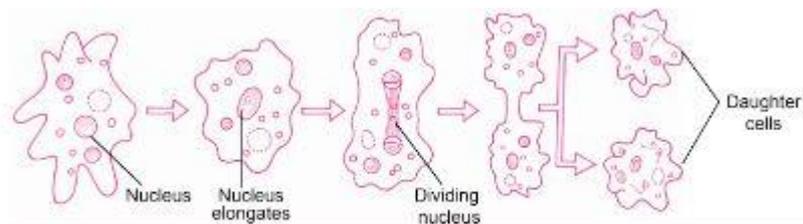


Fig. 1.1 Binary fission in Amoeba

(b)Multiple division: The splitting of parent cells into numerous daughter cells, each of which grows into an adult is called multiple fission, e.g., in Plasmodium.

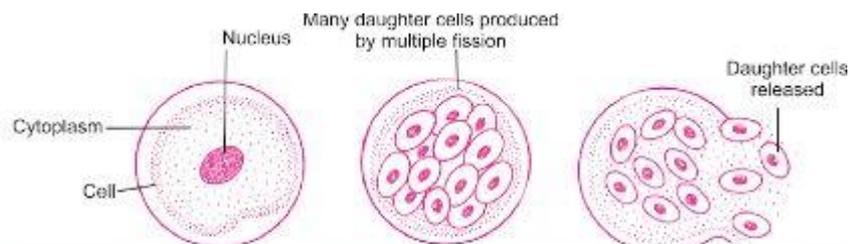


Fig. 1.2 Multiple fission in Plasmodium

Sporulation: - During unfavourable conditions, organisms like Amoeba cover themselves with a three-layered hard covering or cyst. This is called encystation. On the return of favourable conditions, it divides by multiple fission within the cyst and produces many Amoebas. The cyst bursts and spores are released to develop into adults. This is called sporulation.

Fragmentation: It is a mode of asexual reproduction in which the parental body breaks into two or more fragments and each fragment grows into a new individual, e.g, Spirogyra.

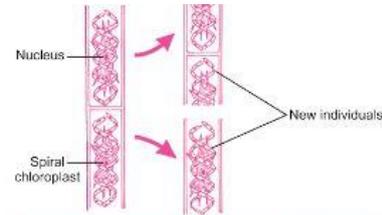


Fig. 1.3 Fragmentation in Spirogyra

Budding: It is a mode of asexual reproduction in which one or more outgrowths (buds) are produced which initially remain attached to the parent cell and eventually get separated from it to grow into a new individual, e.g, yeast.

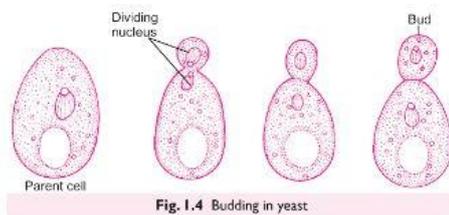


Fig. 1.4 Budding in yeast

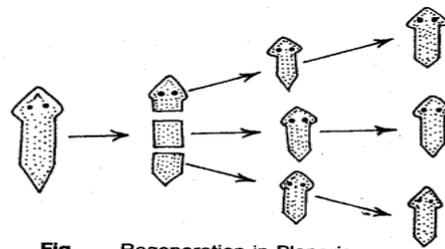


Fig. Regeneration in Planaria.

Regeneration: It is a mode of asexual reproduction in which the missing parts of an organism is repaired by proliferation (rapid increase in the number) of cells, e.g, in Planaria.

Spore Formation:

- **Zoospores:**-These are endogenously (growth from deep tissue) produced unicellular, naked and motile spores with one or two flagella. Zoospores are produced in a sac like structure called zoosporangium. E.g Chlamydomonas.
- **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.
- **Gemmules:**-Internal asexual reproductive units or buds are called gemmules, e.g, sponges. These develop within the parental body and are released during germination

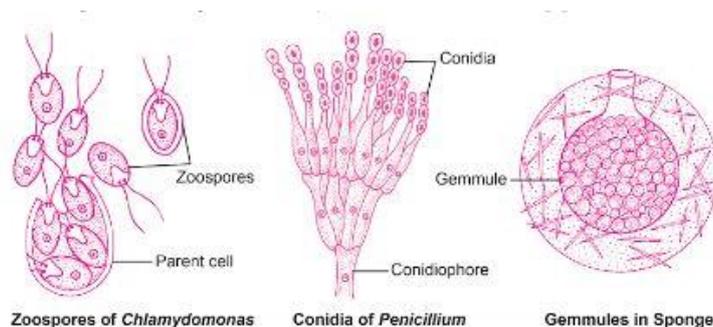


Fig. 1.5 Spore formation

Vegetative Propagation:-It is a mode of reproduction in which new plants are formed from vegetative parts (vegetative propagules) of the plant like root, stem, etc.

Following are some units of vegetative propagation:

- Bulbil -- Agave
- Bulbs--Onion, Garlic
- Eyes -- Potato
- Leaf buds – Bryophyllum
- Offset – Hycauth and Pistia
- Rhizome – Ginger
- Sucker –Minot

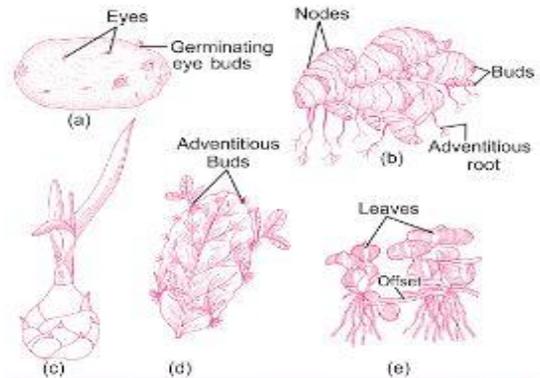


Fig. 1.6 Vegetative propagules in angiosperms: (a) Potato tuber; (b) Rhizome of ginger; (c) Bulbil of Agave; (d) Leaf buds of *Bryophyllum*; (e) Offset of water hyacinth

Our next topic is **SEXUAL REPRODUCTION-**

Question in mind-What is Sexual Reproduction?

Answer-Sexual reproduction involves the fusion of male and female gametes to form a zygote.

Question in mind- When the organisms are able to reproduce sexually?

Answer-All organisms go through a phase to attain the stage of growth and maturity in their life, before they can reproduce sexually. This phase is called **juvenile phase**. (Juvenile phase in plants is called vegetative phase.)

- In non-primates (cows, sheep and dogs) the female reproductive cycle is called **oestrus cycle**. And in primates (monkeys, apes and humans), the female reproductive cycle is called **menstrual cycle**.

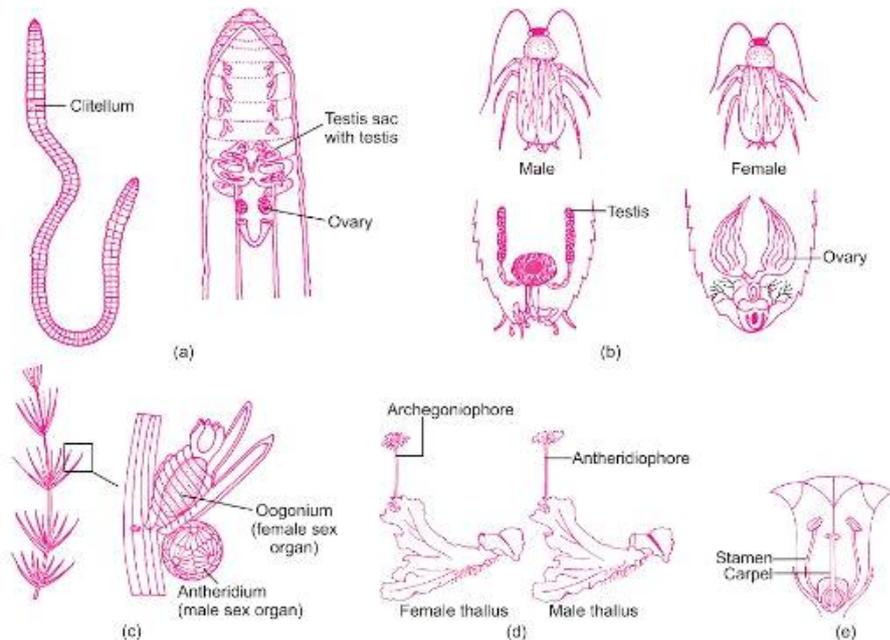


Fig. 1.7 Diversity of sexuality in organisms: (a) Bisexual animal (Earthworm); (b) Unisexual animal (Cockroach); (c) Monoecious plant (*Chara*); (d) Dioecious plant (*Marchantia*); (e) Bisexual flower (sweet potato)

Now let's talk about EVENTS IN SEXUAL REPRODUCTION

Question in mind- What are events occur in sexual reproduction?

Answer- Events in sexual reproduction may be grouped into three distinct stages as follows:

- i. Pre-fertilisation (before fertilisation)
- ii. Fertilisation (also known as syngamy)
- iii. Post- fertilisation (after fertilisation)

Before discussing them in detail, we should know that we are not talking about any particular organism, we are discussing these three events, which are same for every organism but we have few terms which are specific for a particular type of organisms like (Plants, fungi, algae and animals).

(i) Pre - fertilisation:-This includes the formation of gametes (gametogenesis) and their transfer.

(a) Gametogenesis- It involves formation of two haploid (having half no. of chromosomes) reproductive units called gametes.

Common terms-

- The formation of male gametes or male reproductive unit is called **spermatogenesis**.
- The formation of female gametes or female reproductive unit is called **oogenesis**.
- **Male gamete-** antherozoids or sperm.
- **Female gamete-** egg or ovum.
- When male and female gametes are similar in appearance and it is not possible to differentiate between them, they are called **homogametes or isogametes**.
- When the male and female gametes are morphologically (appearance) distinct, they are called **heterogametes**.

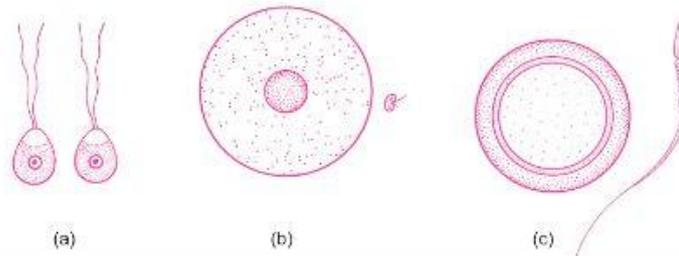


Fig. 1.8 Types of gametes: (a) Isogametes of *Cladophora* (an alga); (b) Heterogametes of *Fucus* (an alga); (c) Heterogametes of *Homo sapiens* (human beings)

Terms used for plants-

- Several fungi and plants having both male and female sex gametes is called **homothallic or monoecious**. e.g, **coconut**.
- Fungi and Plants which carry male and female gametes separately are called **heterothallic or dioecious**, e.g, **papaya**.
 - Unisexual male flowers bearing stamens are called **staminate flowers**.
 - Unisexual female flowers bearing pistils are called **pistillate flower**.

Terms used for Animals-

The animals bearing both the sexes are called **hermaphrodites**, e.g, **earthworm, sponge, tapeworm and leech**.

Question in mind- How gametes are formed?

Answer-Gametes are always haploid. Haploid organisms produce gametes by mitotic division. Diploid organisms undergo meiosis of specialised cells called meocytes (gametes mother cell) to form gametes. At the end of both divisions, only one set of chromosomes is present in each gamete.

(b) Gamete transfer-After gametes formation, male and female gametes must be physically brought together to do fusion (fertilisation).

- Male gametes are usually motile, whereas female gametes are static (non-motile).

Question in mind-How gametes are transferred in plants?

Answer- In lower plants like some algae and fungi, both male and female gametes are motile. In simple plants like algae, bryophytes and peridophytes, water acts as the medium of gametes transfer. In angiosperms, the pollen grains are transferred from anther of one flower to the stigma of another flower. This is called **pollination**.

(ii) Fertilisation or Syngamy: - It is the fusion of male and female gametes to form a diploid cell called zygote. Fertilisation is of two types, i.e **external fertilisation and internal fertilisation**.

Question in mind-What is the difference between internal and external fertilization?

Answer-

BASIS FOR COMPARISON	INTERNAL FERTILIZATION	EXTERNAL FERTILIZATION
Meaning	The process of fusion of male and female gamete (sperm and egg) taking place inside the body of the female, is called as internal fertilization.	The process of fusion of male and female gamete (sperm and egg) taking place in the external environment (in water bodies) and so-called as external fertilization.
Gametes released	Less number of gametes (sperms) are released, which gets deposited inside the female body.	Numerous gametes (sperms and egg) are released into the environment. These gametes are of male as well as of female.
Process involves	Only male gametes are released or discharged into the female genital tract.	Both male and female release or discharge their gametes in their external surrounding.
	Further process of development (syngamy) occurs inside the body only.	Further process of development (syngamy) occurs outside the body.
	There are three types by which internal fertilization occurs: 1. Oviparity. 2. Viviparity. 3. Ovoviviparity.	It occurs only in an external environment.

Examples	Mammals (including humans), Reptiles, Birds, Bryophytes and Tracheophytes.	Amphibians, Algae, Fish, etc.
Advantages	<ol style="list-style-type: none"> 1. There are more chances of survival of offspring, as they get parental care. 2. Even the rates of successful fertilization are much higher. 3. There are chances of success of survival of the offspring even in harsh condition. 	<ol style="list-style-type: none"> 1. The offspring produced are higher in number. 2. Less amount of energy is required to find a mate. 3. Less competition between offspring and their parents.
Disadvantages	<ol style="list-style-type: none"> 1. Requires high energy to find a mate. 2. The offspring produced are few. 3. Larger contribution of the female parent only. 	<ol style="list-style-type: none"> 1. Fewer chances of survival of the offspring, as there is no parental care and they (offspring) get preyed upon. 2. Due to unprotection, many offspring do not get fertilized or survive till their maturity. 3. Can survive in moistened or in the wet environment only.

Special term-

Parthenogenesis – is the phenomenon by which female gametes directly develop into an individual without fertilisation. e.g, rotifers honeybees, lizards and birds.

(iii) Post-Fertilisation Events:- These include development of zygote and embryo after fertilisation.

(a) Zygote development:-**Question in mind – Where Zygote development take place?**

Answer- In external fertilisation, zygote is formed in the external medium; whereas in internal fertilisation, zygote is formed inside the body of the organism. Further development of zygote depends upon the life cycle and environment.

Based on whether the zygote develops inside or outside the female body, animals can be classified into **oviparous and viviparous**, respectively.

Question in mind-What is the difference between oviparous and viviparous?

Answer-

BASIS FOR COMPARISON	OVIPAROUS ANIMALS	VIVIPAROUS ANIMALS
Meaning	Oviparous are the animals which lay fertilized or an unfertilized egg.	Viviparous are the animals which give birth to the young ones, and their development occurs inside the female body (mother's womb).

Lay/Give birth	Oviparous are known to lay eggs, which can be fertilized or unfertilized.	Viviparous animals directly give birth to the young ones.
Type of fertilization	It can be internal or external fertilization.	It is internal fertilization.
Development of zygote	The development of the embryo takes place outside the embryo.	The development of the embryo takes place inside the embryo.
Nutrients to the developing embryo	The embryo receives the nutrients from the egg yolk.	The embryo receives the nutrients from the mother.
Survival chances	Less chances of survival, as the eggs are laid in an open environment.	More chances of survival, as proper protection and nutrition, is provided to the embryo inside the mother's womb.
Examples	Insects, amphibians, fish, reptiles, birds.	Mammals like cats, dogs, humans, elephants, lions, tigers, etc.

Question in mind-Why Zygote is important?

Answer-Because zygote ensures the continuity of species between organisms of one generation to next generation. That's why in algae and fungi, the zygote develops a thick wall to resist desiccation and damage.

Point to learn-

- In haplontic life cycle, the zygote undergoes reductional division (meiosis) to form a haploid organism.
- In diplontic life cycle, the zygote undergoes mitotic division

(b)Embryogenesis:-The process of development of embryo from the zygote is called embryogenesis.

- During embryogenesis, zygote undergoes -
 - (i) Cell division (mitosis) to increase cell number, and
 - (ii) Cell differentiation to form specialised tissues and organs.

Question in mind-What happens in plants after zygote formation?

Answer-In flowering plants, the zygote is formed inside the ovule, where the zygote develops into an embryo. The fertilised ovule develops into seed and ovary develops into fruit. The outermost protective covering of fruit is called pericarp or fruit wall.

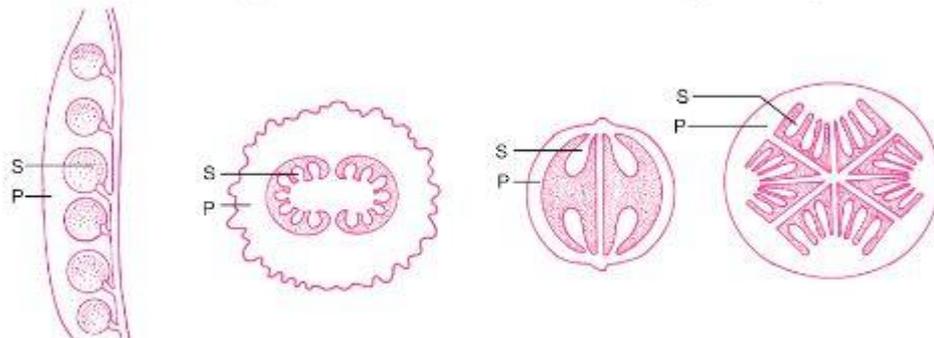


Fig. 1.9 A few kinds of fruit showing seeds (S) and protective pericarp (P)

Frequently Asked CBSE Boards Questions

Question from Asexual Reproduction

Q. 1. Name the vegetative propagules in the following:

- (a) Agave (b) Bryophyllum

Ans. (a) Agave—Bulbil
(b) Bryophyllum—leaf buds/adventitious buds.

Q. 2. Name an organism where cell division is itself a mode of reproduction.

Ans, Protists/Monerans/Amoeba/Paramecium.

Q. 3. How does Penicillium reproduce asexually?

Ans, Penicillium reproduces asexually by spore formation.

Q. 4. Name the units of vegetative propagation in water hyacinth. Explain giving reasons why it has become the most invasive aquatic weed.

Ans. Offset, since the formation of hyacinth offsets does not involve two parents, the process involved is asexual, therefore they spread quickly.

Q. 5. Mention a characteristic feature and a function of zoospores in some algae.

Ans. Zoospores are microscopic motile structures. These are special structures by which algae reproduce asexually.

Q.6. Name an alga that reproduces asexually through zoospores. Why are these reproductive units so called?

Ans Chlamydomonas. The reproductive units are called zoospores because they are motile.

Q.7. In yeast and Amoeba, the parent cell divides to give rise to two new individual cells. How does the cell division differ in these two organisms?

Ans. In Amoeba, binary fission takes place whereas in yeast cell division occurs by budding.

Q. 8. Aruna's mother was making idli. Aruna was curiously watching her. She noticed that her mother added a small amount of yeast to the batter, mixed it and left it for some time. When they saw the batter again, it had risen in the bowl. Aruna was surprised and asked her mother about it.

i. Why was only a small amount of yeast added?

ii. How does yeast multiply?

iii. What is this process called?

iv. What values are exhibited by Aruna's mother?

Ans. (i) Yeast divides rapidly so only a small amount was added to get the desired effect in the quantity available.

(ii) Yeast multiplies by the method of budding.

(iii) The process occurring in batter is called fermentation.

(iv) Aruna's mother exhibits scientific temperament and awareness.

Question from Parthenogenesis

Q. 1. Name the phenomenon and the cell responsible for the development of a new individual without fertilisation as seen in honey bees.

Ans. The phenomenon is called parthenogenesis and the cell responsible for it is female gamete, ovum.

Q.2. Why banana is considered a good example of parthenocarpy?

Ans. Because formation of fruit occurs without fertilisation, i.e., there is no formation of seeds.

Q. 3. Give reasons for the following: Some organisms like honey-bees are called parthenogenetic animals.

Ans. They (drones/males) develop from unfertilised eggs.

Q. 4. Name the phenomenon and one bird where the female gamete directly develops into a new organism.

Ans. The phenomenon is called parthenogenesis. Turkey.

Q. 5. Name any two organisms and the phenomenon involved where the female gamete undergoes development to form new organisms without fertilisation.

Ans. The phenomenon of development of female gamete directly into an individual without fertilisation is called parthenogenesis, e.g., rotifers, honeybees, lizards and birds.

Q. 6. (a) State the difference between meiocyte and gamete with respect to chromosome number.

(b) Why is a whiptail lizard referred to as parthenogenetic?

Ans. (a) Meiocytes contain diploid sets of chromosomes whereas gametes contain haploid sets of chromosomes.

(b) Whiptail lizard reproduces without fertilisation, i.e., an unfertilised egg develops into a new individual. Therefore, they are referred to as parthenogenetic.

Question from Sexual Reproduction

Q. 1. Mention the unique feature with respect to flowering and fruiting in bamboo species.

Ans. Bamboo flowers once in its life time generally after 50—100 yrs of vegetative growth. It produces large number of fruits and dies.

Q. 2. Mention the unique flowering phenomenon exhibited by *Strobilanthus kunthiana* (neelakuranji).

Ans. *Strobilanthus kunthiana* flowers once in 12 years.

Q. 3. Name the phase that all organisms have to pass through before they can reproduce sexually.

Ans. Juvenile/growth phase.

Q. 4. Why are large numbers of male gametes produced as compared to female gametes?

Ans. Several male gametes fail to reach the female gamete. So, in order to compensate this loss of male gametes during transport, the number of male gametes produced is several thousand times more than the number of female gametes produced.

Q.5. Why coconut plant is referred to as monoecious?

Ans. A coconut plant has both male and female flowers present on same individual thus it is known as monoecious.

Q. 6. Which of the following are monoecious and dioecious organisms:

(a) Earthworm

(b) Chara

(c) Marchantia

(d) Cockroach.

Ans. (a) Monoecious

(b) Monoecious

(c) Dioecious

(d) Dioecious

Q. 7. Rearrange the following events of sexual reproduction in the sequence in which they occur a flowering plant: embryogenesis, fertilization, gametogenesis, pollination.

Ans. Gametogenesis, pollination, fertilization, embryogenesis.

Q. 8. From which part do fruit, seed and embryo develop?

Ans. Fruit	--	ripened ovary
Seed	--	ripened ovule
Embryo	--	mature zygote.

Q. 9. Why do algae and fungi shift to sexual mode of reproduction just before the onset of adverse conditions?

Ans. Algae and fungi shift to sexual mode of reproduction for survival during unfavourable conditions. Fusion of gametes helps to pool their resources for survival. The zygote develops a thick wall that is resistant to desiccation and damage which undergoes a period of rest before germination.

Q. 10. Mention the site where syngamy occurs in amphibians and reptiles, respectively.

Ans. In amphibians, external fertilisation occurs hence, syngamy occurs in the medium of water. In reptiles, internal fertilisation occurs hence, syngamy occurs within the body of female parent.

Q. 11. Name the type of cell division that takes place in the zygote of an organism exhibiting haplontic life cycle.

Ans. Meiosis.

Q. 12. Name the group of organisms that produce non-motile gametes. How do they reach the female gamete for fertilisation?

Ans. Angiosperms produce non-motile gametes. They reach the female gamete with the help of air or water.

Q. 13. Cucurbits and papaya plants bear staminate and pistillate flowers. Mention the categories they are put under separately on the basis of the type of flowers they bear.

Ans. Cucurbit is a monoecious plant having staminate and pistillate flowers on the same plant.
Papaya has staminate and pistillate flowers on separate plants and hence it is dioecious.

Q. 14. Why are mosses and liverworts unable to complete their sexual mode of reproduction in dry conditions? Give reasons.

Ans. Mosses and liverwort is a bryophyte which is unable to complete its life cycle in a dry environment because-

- i. The fertilisation of male and female gametes takes place in water.
- ii. Male gametes, antherozoids, swim in water to reach the eggs for sexual reproduction to take place.

Q. 15. A moss plant produces a large number of antherozoids but relatively only a few egg cells. Why?

Ans. Antherozoids are motile male gametophytes which have to swim on the water surface to fertilise the immotile female gametophytes, i.e., egg. Since, during its transfer many antherozoids get destroyed, a large number of them are produced.

Q.16. How many chromosomes do drones of honeybee possess? Name the type of cell division involved in the production of sperms by them.

Ans. Drones of honey bee possess 16 chromosomes. The sperms in honey bee are produced by mitosis.

Q.17. A male honeybee has 16 chromosomes whereas its female has 32 chromosomes. Give one reason.

Ans. Male honey bees (are born from unfertilised eggs, whereas female honey bees are born from fertilised eggs. Because the unfertilised egg carries half the number of chromosomes as compared to the fertilised egg, male honey bees have half the number of chromosomes as compared to female honey bees.

Q. 18. A list of three flowering plants is given below. Which ones out of them are (i) Monoecious and (ii) bearing pistillate flowers?

List: Date palm, Cucurbits and Pea.

Ans. (i) Monoecious plant—Cucurbits
(ii) Bearing pistillate flowers—Date palm.

Q. 19. Why papaya and date are palm plants said to be dioecious whereas cucurbits and coconut palms monoecious, in spite of all of them bearing unisexual flowers?

OR

Coconut palm is monoecious, while date palm is dioecious. Why are they so called?

Ans. Papaya and date palm plants are dioecious because male and female flowers are present on different plants, i.e., each plant is either male or female (bisexual). Cucurbits and coconut palms are monoecious because male and female flowers are present on the same plant (unisexual).