CHAPTER

19

Reproduction

Living things reproduce.

This is the inherent property of the living organisms to continue their race by the mechanism of reproduction. The reproduction is a process by which the living beings propagate or duplicate their own kinds. The reproduction may be of following two types :

1. Asexual reproduction ; 2. Sexual reproduction.

The word 'reproduction' implies replication, and it is true that biologic reproduction almost always yields a reasonable facsimile of the parent unit. However, sexual reproduction, performed by the majority of living organisms, produces the **diversity** which is required for survival in a world of constant change. The process, whether sexual or asexual, comprises a basic pattern : (1) the conversion of raw materials from the environment into the offspring, or sex cells that develop into offspring of a similar constitution,and (2) the transmission of a hereditary pattern or code (DNA of the genes) from the parent.

ASEXUAL REPRODUCTION

The development of new individuals without the fusion of the male and female gametes is known as **asexual reproduction**. The asexual reproduction usually includes amitotic or mitotic division of the body (somatic) cells, therefore, it is also known as **somatogenic** or **blastogenic reproduction**. The asexual reproduction is common only in lower plants and amimals and it may be of following types:

1. Fission; 2. Budding; 3. Gemmule formation; 4. Regeneration.

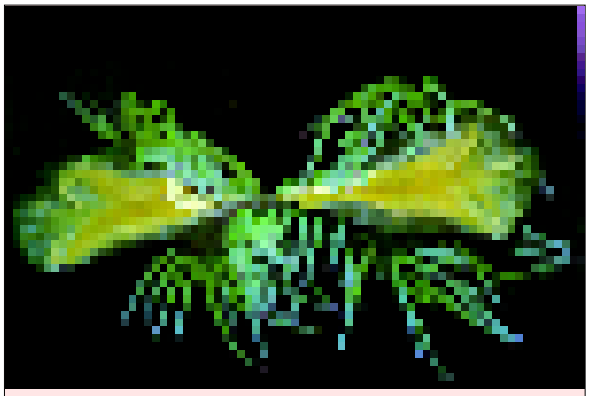
1. Asexual reproduction by the fission. The fission is the most widely occurring type of asexual reproduction of the

protozoans and various metazoans. In this method of reproduction the nuclear and cytoplasmic contents of the cell divide or split completely into smaller-sized daughter individuals. The fission itself may be of following types :

A. Binary fission. In the binary fission the animal body splits or divides in such a plane that two equal and identical halves are produced. It is most common in protozoans but it also occurs in certain lower metazoans. First of all the nucleus divides by amitotic or mitotic division and the division of the nucleus is followed by the division of the cytoplasm. According to the plane of fission following types of binary fission have been recognized in the organisms :

(i) Simple or orthodox type of binary fission. The simple or orthodox type of binary fission occurs in the irregular-shaped organims, *e.g.*, *Amoeba* in which the plane of division is difficult to observe.

(ii) Transverse binary fission. The transverse binary fission occurs in some protozoans, *e.g.*, *Paramecium* and some metazoans such as certain coelenterates, turbellarians and annelids. In transverse binary fission the plane of the division is always transverse to the longitudinal axis of the body of the organisms.



Binary fission in sea anemone.

(iii) Longitudinal binary fission. The longitudinal binary fission occurs in certain ciliates and flagellates, *e.g.*, *Vorticella* and *Euglena* (Protozoa) and some corals (Anthozoa). In longitudinal binary fission the nucleus and the cytoplasm divide in the longitudinal plane.

(iv) Oblique binary fission. The oblique binary fission occurs in most dinoflagellates. In this type of fission the cell or body of the organism divides by the oblique division.

(v) Strobilation. In certain metazoan animals a special type of transverse fission known as the strobilation occurs. In the process of the strobilation several transverse fissions occur simultaneously and giving rise to a number of individuals which often do not separate from each other immediately. The strobilation occurs in the scyphozoan (*Aurelia*), certain polychaets and ascidians. In *Aurelia*, for instance, the strobilation occurs during the formation of ephyra larva.

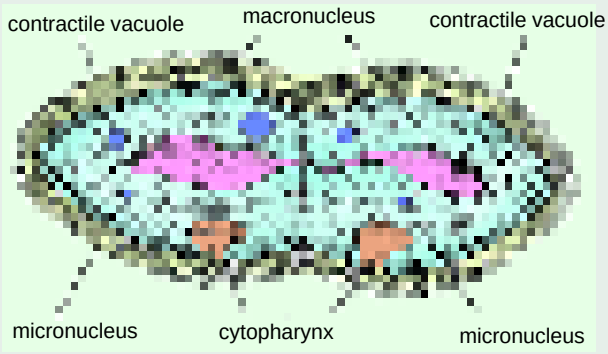


Fig. 19.1. Transverse binary fission in *Paramecium.*

B. Asexual reproduction by multiple fission. In the multiple fission, the nucleus of the cell divides very rapidly into many nuclei. Each daughter nucleus in later stage is surrounded by the little mass of the cytoplasm and forms the asexually reproducing body such as schizogont, gamont, spore, etc. The multiple fission occurs in most algae, fungi and some protozoans, *e.g.*, *Amoeba*, *Plasmodium* and *Monocystis*, etc.

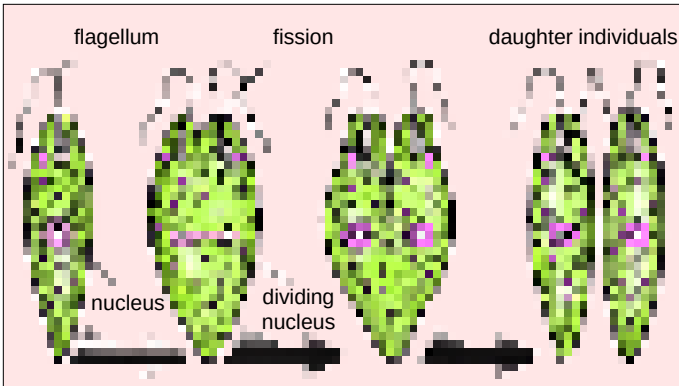
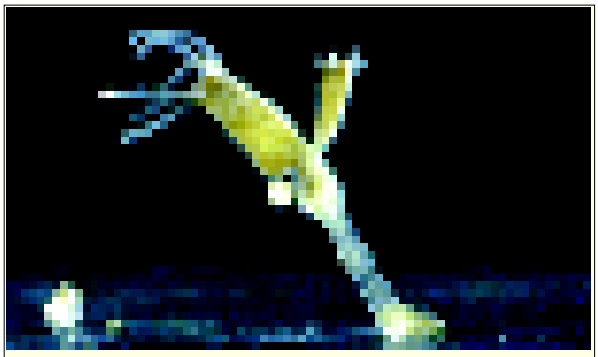


Fig. 19.2. Longitudinal binary fission in *Euglena*.

2. Asexual reproduction by budding or gemmation. In certain multicellular animals such as *Hydra* (coelenterates) and certain tunicates, the body gives out a small outgrowth known as the **bud**. The bud is supported by the parent body and it ultimately develops into a new individual. The process of development of a bud into an adult animal is called **blastogenesis**. The developing individual gets its food from the body of the parent and when it becomes fully mature it is detached from the body of the parent and leads an individual existence.



Budding in *Hydra*.

3. Asexual reproduction by gemmule formation. In certain metazoan animals the asexual reproduction is carried on by certain peculiar asexual bodies known as the **gemmules** and **statoblasts**. The gemmules occur in freshwater sponges (family Spongilidae) and the statoblasts occur in the bryozoans.

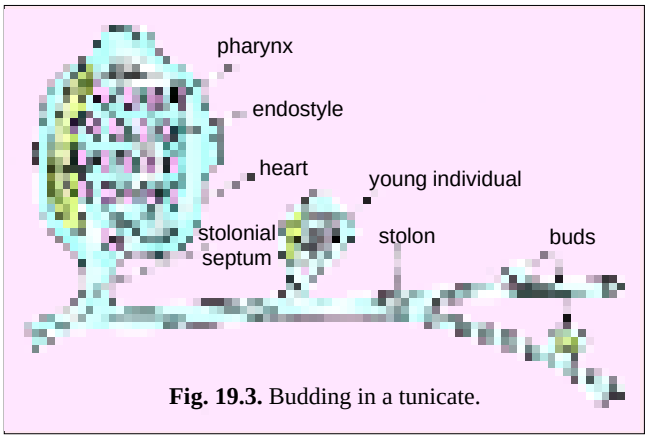


Fig. 19.3. Budding in a tunicate.

The gemmules and the statoblasts are composed of a group of undifferentiated cells which contain stored food material. These cells are enclosed and protected by the monaxon spicules in the gemmules and by the chitinous covering in the statoblasts. Both (gemmules and statoblasts) are set free by the destruction of the parental body and they develop into the new individuals in the favourable conditions.

4. Asexual reproduction by regeneration. The regeneration is a process by which the organisms develop or regenerate their lost or worn out parts. The regeneration is the best means of asexual reproduction in certain protozoans, sponges, coelenterates, planarians (Fig. 19.4) and echinoderms.

SEXUAL REPRODUCTION

In the sexual reproduction, the development of the new indivdual takes place by the fusion of the sex cells or male and female gametes (Fig. 19.5). The sexual reproduction is the most common type of reproduction among the plants and animals. It may be of following types :

A severed arm of starfish can regenerate into a whole new organism.

1. Syngamy. The syngamy is the most common type of sexual reproduction in the plants and animals. In syngamy (Gr., *syn*=together; *gam*=marriage) the fusion of two gametes takes palce completely and permanently. Following kinds of syngamy are prevalent among the living organisms :

(i) Autogamy. In autogamy (Gr., *auto*=self; *gam*=mariage) the male and female gametes are produced by the same cell or organisms and both gametes fuse together to form a zygote, *e.g.*, *Actinosphaerium* and *Paramecium.*

(ii) Exogamy. In exogamy (Gr. *exo*=external; *gam*=marriage) the male and female gametes are produced by different parents and both unite to form a zygote.

(iii) Hologamy. In the lower organisms, sometimes the entire mature organisms start to act as gametes and the fusion of such mature invividuals is known as the **hologamy**.

(iv) Paedogamy. Paedogamy is the sexual union of young individuals produced immediately after the division of the adult parent cell by mitosis.

(v) Merogamy. In the merogamy (Gr., *meros*=part; *gam*=marriage), the fusion of smaller-sized and morphologically different gametes (**merogametes**) takes place.

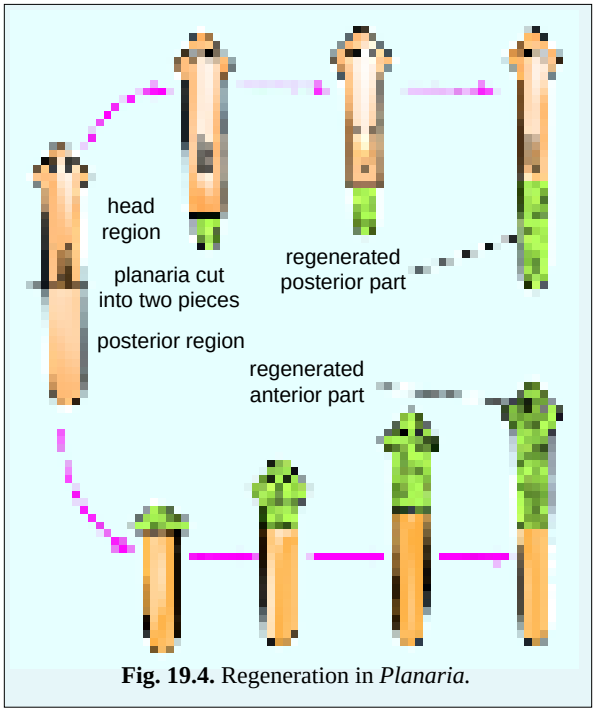


Fig. 19.4. Regeneration in *Planaria.*

(vi) Isogamy. In isogamy (Gr., *is*=equal; *gam*=marriage) the fusion of morphologically and physiologically identical gametes (**isogametes**) takes place.

(vii) Anisogamy. Some organisms produce two types of gametes. Both types of gametes differ from each other in their shape, size and behaviour and are collectively known as the **anisogametes** or **heterogametes**. The male gametes are motile and small in size and known as the **microgametes**. The female gametes are passive and have comparatively large size and known as the **macro**-or **megagametes**. The union of micro-and macrogametes is known as the **anisogamy** (Gr. *an*=without ; *is*=equal; *gam*= marriage). The anisogamy occurs in higher animals and plants but it is customary to use the term **fertilization** in them instead of the anisogamy or syngamy.

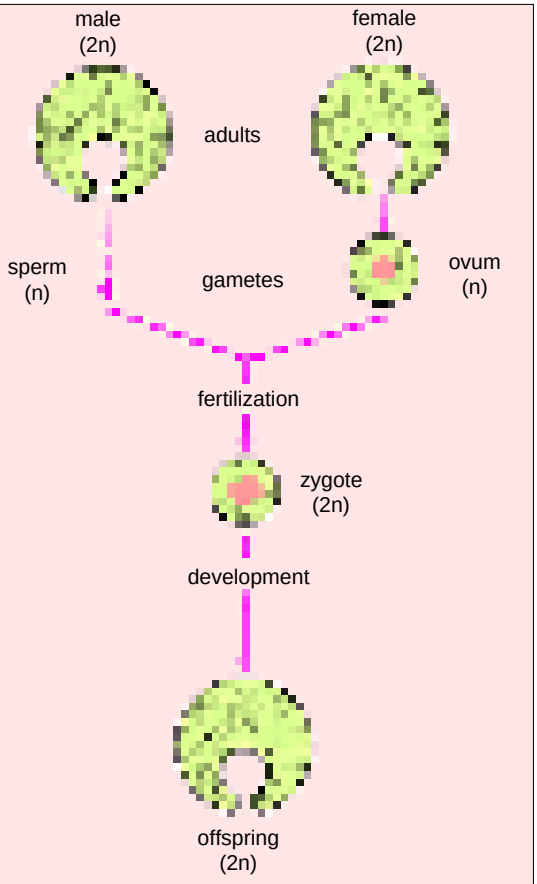


Fig. 19.5. A schematic representation of sexual reproduction.

(viii) Macrogamy. The syngamy or fusion of the macrogametes is known as **macrogamy** (Gr., *macro*=large; *gam*=marriage).

(ix) Microgamy. The microgamy (Gr., *micro*=small; *gam*=marriage) is common in certain protozoans, *e.g.*, foraminiferans and *Arcella*. In microgamy the fusion of microgametes takes place.

2. Conjugation. The conjugation is the temporary union of the two individuals of the same species. During the union both individuals known as **conjugants** exchange certain amount of nuclear (DNA) material and after which conjugants are separated. The conjugation is most common among the ciliates, *e.g.*, *Paramecium* and bacteria.

3. Automixis. When the gamete nuclei of the same cell unite together to form new individuals this phenomenon is known as the **automixis**.

4. Parthenogenesis. The parthenogenesis (Gr., *parthenos*=virgin, *genesis*= birth) is the special type of sexual reproduction. In parthenogenesis, the eggs of an organism develop into the young individual without the fertilization of the eggs by the sperms. The parthenogenesis occurs in certain insects (wasps and bees, etc.) and rotifers.

REVISION QUESTIONS

1. What is reproduction ? Write about its significance.
2. Describe various modes of asexual reproduction in living organisms.
3. Describe different types of sexual reproduction.
4. Write short notes on the following:
   (i) Binary fission;
   (ii) Strobilation;
   (iii) Anisogamy.

Aphids give birth to live young produced by the process of parthenogenesis.