

Reproduction in Organisms

1 INTRODUCTION

- The period from birth to natural death of an organism is called its life span. Life spans of organisms are not necessarily correlated with their sizes, the sizes of crows and parrots are not very different yet their life spans show a wide difference. Similarly, a mango tree has a much shorter life span as compared to a peepal tree. No organism is immortal except single celled organisms.
- Reproduction is defined as a biological process in which organism gives rise to young ones (offspring) similar to itself. Based on whether there is participation of one organism or two in the process of reproduction, it is of two types. When offspring is produced by a single parent with or without involvement of gamete formation, the reproduction is asexual. When two parents (opposite sex) participate in the reproductive process and also involve fusion of male and female gametes, it is called sexual reproduction.
- The organism's habitat, its internal physiology and several other factors are collectively responsible for how it reproduces.

2 ASEQUAL REPRODUCTION

- In this method, a single individual (parent) is capable of producing offspring (clones)
- The term clone is used to describe such morphologically and genetically similar individuals.
- Asexual reproduction is common among single celled organisms and in plants and animals with relatively simple organisations.
- In protists and monerans, cell division is itself a mode of reproduction.

- Organisms reproduce asexually by

- a. Binary fission : *Amoeba*,
Paramecium
- b. Budding : Yeast
- c. Fragmentation : *Hydra*

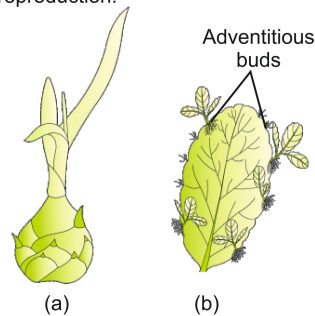
Asexual reproductive structures

- a. Zoospores : Fungi and Algae
- b. Conidia : *Penicillium*
- c. Buds : *Hydra*
- d. Gemmules : Sponge
- e. Bulbils : *Agave*

- In plants, the term vegetative reproduction is frequently used for asexual reproduction. In plants, the units of vegetative propagation such as runner, rhizome, sucker, tuber, offset, bulb are all capable of giving rise to new offspring. These structures are called vegetative propagules.



- Water hyacinth also called terror of Bengal is one of the most invasive weeds found growing in standing water, propagating through offset.
 - It drains oxygen from the water, which leads to death of fishes.
 - This plant was introduced in India because of its beautiful flowers and shape of leaves. Since it can propagate vegetatively at a phenomenal rate and spread all over the water body in a short period of time, it is very difficult to get rid of them.



Vegetative propagules in angiosperms:
(a) Bulbil of *Agave*; (b) Leaf buds of *Bryophyllum*

3 SEXUAL REPRODUCTION

- Sexual reproduction involves formation of 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.
- It is an elaborate, complex and slow process as compared to asexual reproduction.
- Because of the fusion of male and female gametes, sexual reproduction results in offspring that are not identical to the parents or amongst themselves. When it comes to sexual mode of reproduction, organisms share a similar pattern, though they differ greatly in external morphology, internal structure and physiology.
- All organisms have to reach a certain stage of growth and maturity in their life, before they can reproduce sexually. That period of growth is called the juvenile phase. It is known as vegetative phase in plants. This phase is of variable duration in different organisms.
- Plants-the annual and biennial types, show clear cut vegetative, reproductive and senescent phases, but in the perennial species it is very difficult to clearly define these phases.
- A few plants exhibit unusual flowering phenomenon, such as bamboo species flower only once in their life time, generally after 50-100 years, produce large number of fruits and die.
- *Strobilanthes kunthiana* flowers once in 12 years, this plant flowered last during September-October 2006.
- In both plants and animals, hormones are responsible for the transitions between the three phases. Interaction between hormones and certain environmental factors regulate the reproductive processes and the associated behavioural expressions of organisms.



- Buds (eyes) of potato tuber, rhizome of banana and ginger give rise to new plants. The site of origin of the new plantlets in the plants are invariably the nodes present in the modified stems of these plants.
- Adventitious buds arise from the notches present at margins of leaves of *Bryophyllum*.

4 EVENTS IN SEXUAL REPRODUCTION

- The events in sexual reproduction follow a regular sequence. These sequential events may be grouped into three distinct stages namely the pre-fertilisation, fertilisation and the post-fertilisation events.

5 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. In some algae the gametes are homogametes (isogametes). However, in a majority of sexually reproducing organism the gametes are heterogametes. In such organisms the male gamete is called antherozoid or sperm and the female gametes is called the egg or ovum.

Name of organism	Meiocyte (2n)	Gamete (n)
Human beings	46	23
Fruit fly	8	4
<i>Ophioglossum</i> (a fern)	1260	630
Apple	34	17
Rice	24	12
Maize	20	10
Potato	48	24
Butterfly	380	190
Onion	16	8

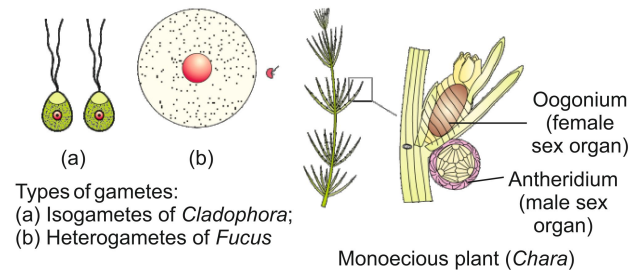
Chromosome numbers in meiocytes and gametes of some organisms.

Cell division during gamete formation :

- Gametes are haploid though the parent body may be haploid or diploid.
- A haploid parent produces gametes by mitotic division whereas a diploid parent produces gametes by meiosis in meiocytes (gamete mother cell). At the end of meiosis, only one set of chromosomes gets incorporated into each gamete.
- Monerans, fungi, algae and bryophytes possess haploid body.
- Pteridophytes, gymnosperms and angiosperms possess diploid body.

Sexuality in organisms

- 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.
- In flowering plants, the unisexual male flower is staminate, while the female is pistillate.
- Some examples of monoecious plants are cucurbits and coconut and of dioecious plants are papaya and date palm.



Types of gametes:
(a) Isogametes of *Cladophora*;
(b) Heterogametes of *Fucus*

Monoecious plant (*Chara*)

Gamete transfer

- In several simple plants like algae, bryophytes and pteridophytes, water is the medium through which gamete transfer takes place.
- A large number of the male gametes, however fail to reach the female gametes. To compensate this loss of male gametes during transport, the number of male gametes produced is several thousand times the number of female gametes produced.
- In seed plants, pollen grains are the carriers of the male gametes. A specialised event called pollination facilitates transfer of pollen grains to the stigma.
- Successful transfer and coming together of gametes is essential for the most critical event in sexual reproduction, the fertilisation.

6 FERTILISATION

- Fusion of gametes is called syngamy or fertilisation, which results in formation of a diploid zygote.
- It is the most vital event of sexual reproduction.

Where does syngamy occur?

External fertilisation :

(Requires great synchrony between sexes and release of large number of gametes)

Fertilisation outside the body of the organism. Eg. Majority of algae and fishes as well as amphibians.

Internal fertilisation :

(Number of sperms produced is very large though there is significant reduction in number of eggs)

Syngamy occurs inside the body of the organism. Eg. Higher animals and majority of plants.

7 POST FERTILISATION EVENTS

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

The zygote

- Formed in all sexually reproducing organisms.
- Development of the zygote depends on the type of life cycle the organism has and the environment it is exposed to.
- Zygote is the vital link that ensures continuity of species between organisms of one generation and the next.

Embryogenesis

- Embryogenesis refers to the process of development of embryo from the zygote. During embryogenesis, zygote undergoes cell division and cell differentiation.
- In flowering plants, the zygote develops in the embryo, ovule into seed, ovary into fruit which has a thick wall called pericarp that is protective in function. After dispersal, seeds germinate to produce new plants.



- A major disadvantage of external fertilisation is that the offsprings are extremely vulnerable to predators threatening their survival upto adult hood.