

Reproduction

- Reproduction is the biological process by which new individual organisms "offspring" are produced from their "parents".
- Reproduction is a fundamental feature of all known life; each individual organism exists as the result of reproduction.
- There are three forms of reproduction.

Types of Reproduction

□ There are three common methods of reproduction found in algae.

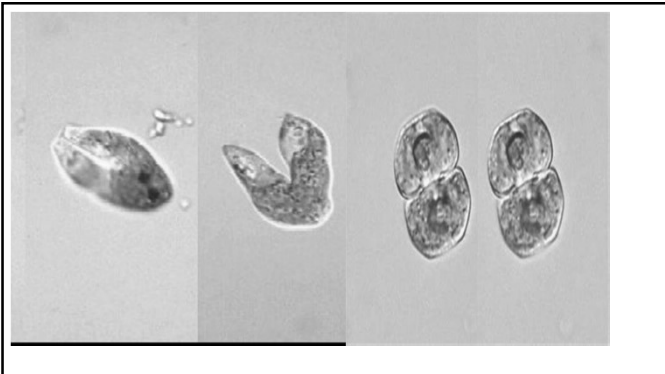
1. Vegetative reproduction.
2. Asexual reproduction.
3. Sexual reproduction.

1. Vegetative reproduction

- The vegetative reproduction in algae includes those methods of propagation in which portion of the plant body become separated off to give rise to individuals.
- Vegetative reproduction take place by different methods.

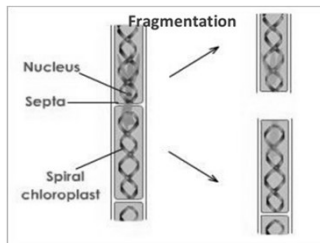
(i) By cell division:

- The mother cells divide and the daughter cells are produced, which become new plants.
- It is sometime known as Binary Fission.
- This type of reproduction is found in Diatoms , Euglena .



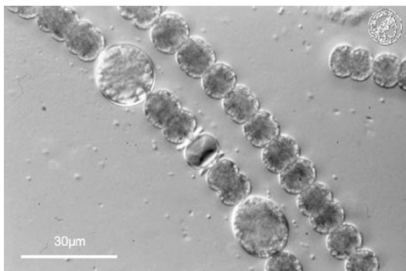
(ii) Fragmentation:

- The plant body breaks into several parts or fragments and each such fragment develops into an individual.
- This type of vegetative reproduction is commonly met within filamentous forms, e.g., Ulothrix, Spirogyra, etc.
- The fragmentation of colonies also takes place in several blue green algae, e.g. Aphanothece, Nostoc, etc.



(iii) Hormogone formation:

- When the trichome's break in small pieces of two or more cells, such pieces are called 'hormogones'
- In some Blue green algae the fragments undergoes a gliding movement which are called 'Hormogones'.
- Each hormogone develops into a new plant, e.g., Oscillatoria, Nostoc, etc



(iv) Hormospores or hormocysts:

- Such multicellular spore-like structure function as perennating bodies called " hormospores " or " hormocysts " .
- They are thick-walled hormogones, and produced in some drier conditions.

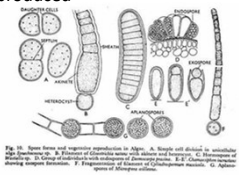


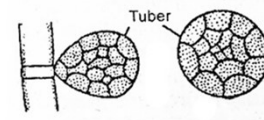
Fig. 10. Spore formation and vegetative reproduction in algae. A. Septa cell divided in vegetative reproduction. B. Formation of hormospore with thick walls and hatching. C. Hormocyst formation. D. Cell of filament of thick wall with thin wall of hormocyst. E. F. G. Hormospores of different shapes. H. I. J. Formation of hormocyst of different shapes. K. Spore of different shape.

(v) By adventitious thalli:

- Certain special structures of thalli are formed which help in vegetative reproduction.
- The well known propagula of Bryopsis, Sphacelaria are good examples

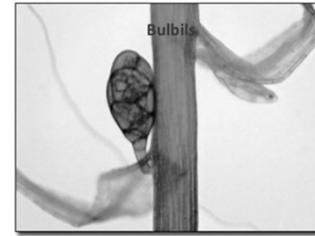
(vi) Tubers:

- Usually these bodies are rounded and filled up with abundance of starch.
- Each body may give rise to a new plant, e.g., Chara.

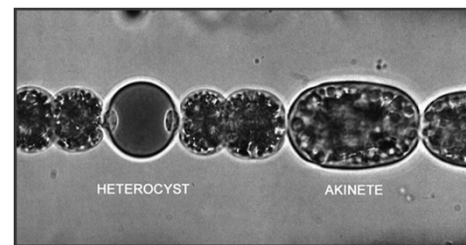


(vii) Bulbils:

- Small bud-like structures. Usually develop on the rhizoids of Chara are called bulbils.
- Each such bulbil may develop into a new plant.

**(viii) Akinetes:**

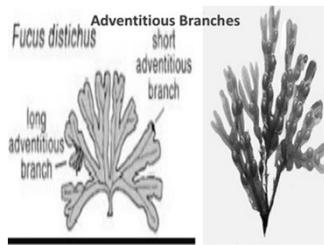
- It is the types of reproduction very common in the blue green as well as green algae.
- These akinetes are a type vegetative cell which is thick walled and will overcome the unfavourable condition.
- Sometimes they are formed in chain.



- Each akinete may develop into a new plant.
- This type of reproduction is found in Oedogonium, Ulothrix, etc.

(ix) Adventitious Branches:

- Adventitious Branches are formed in some large thalloid forms of algae.
- These branch when get detached from the parent thallus develops into new plant .
- Adventitious branch like protonema formed on the internodes of chara .
- E.g Dictyota , Fucus .



2.Asexual Reproduction

- Asexual reproduction is a mode of reproduction by which offspring arise from a single organism, and inherit the genes of that parent only.
- it is reproduction which almost never involves ploidy or reduction.
- The offspring will be exact genetic copies of the parent, except in the specific case of automixis .

- A more stringent definition is agamogenesis which is reproduction without the fusion of gametes.
- Usually the protoplast of a cell divides into several protoplasts and there after they escape from the mother and develop into new plants.
- Asexual reproduction is the primary form of reproduction for single-celled organisms such as the archaeobacteria , eubacteria, and protists .

- Many plants and fungi reproduce asexually as well.
- Asexual reproduction take place by a variety of spore formed in different Algae. they include.....

(i) By zoospores:

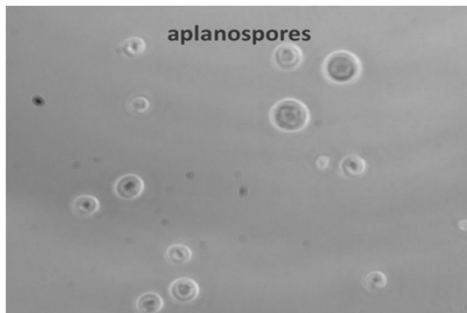
- The zoospores are formed from certain older cells of the filaments.
- The cytoplasm divides to form zoospores which are escaped from the mother cell.
- They are always formed in favourable conditions.
- The zoospores are always motile.



- The zoospore are naked protoplasmic bodies which move by mean flagella or cilia .
- They may be (i) biflagellate, (ii) tetraflagellate, and (iii) compound zoospores.
- E.g Oedogoniales , Vaucheriaceae

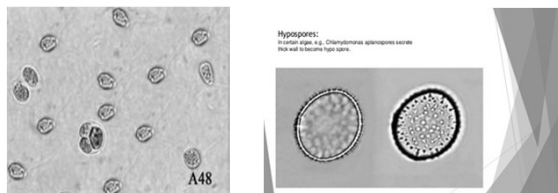
(ii) By aplanospores:

- When motile phase of zoospores is eliminated, the bodies are called aplanospores.
- The aplanospore are produce when there is a lack of sufficient water.
- These are covered by a thin wall but do not possess flagella like the zoospores.
- These are also germinate directly to give rise to new plant .



(iii) By hypnospores :

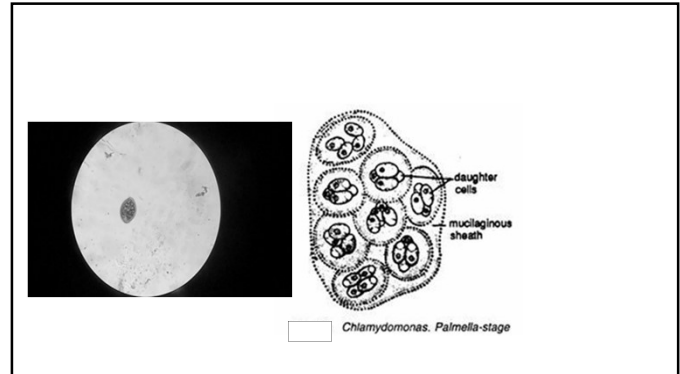
- Actually they are very thick-walled aplanospores and develop only in adverse conditions.
- In comparatively drier situation the content of mother cell round off and secrete a thick wall around them , to tide over the unfavourable condition.
- These thick walled structure called resting spore or hypnospores .



- Sometime the entire cell as such become thick-walled to form an akinete .
- They are usually produced at the approach of dry and hot weather .
- On the approach of favourable condition they germinate directly to produce a new plant or form zoospores.
- e.g., Pediastrum, Vaucheria.

(iv) Palmella stage:

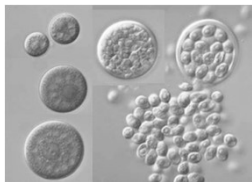
- The approach of dryness as when the plants are left on the moist bank by receding water of the ponds the cells of many algae continue to divide but their contents are not liberated.
- The mother wall becomes gelatinous thus forming a mass or colony of rounded cells which lie embedded in a jelly like substance formed from the cell walls.



- On the return of favourable condition the cell come out either as zoospore or as aplanospores.
- The germination to produce normal plant .
e.g Ulothrix etc

(v) Autospores:

- They are just like aplanospores except that they are smaller in size.
- They resemble in shape to mother cell except in size.
- Each autospore gives rise to a new plant.
- Such autospores are reported from many Chlorococcales.
- E.g ,Scenedemus etc.

**(vi) Endospores:**

- In many blue green algae and Bacillariophyceae, the endospores are formed within the cells.
- The endospore forming cell behaves as a Sporangium .
- On the approach of favourable conditions, each endospore develops in a new individual.

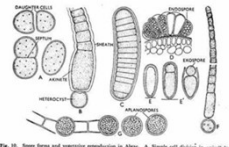
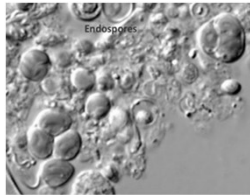
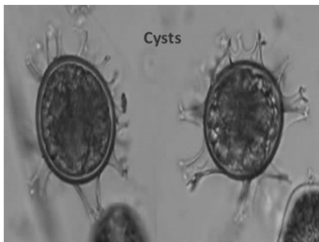


Fig. 10. Spore form and vegetative reproduction in *Bacillus*. A. Vegetative cell divided to spores. B. Spore. C. Germinating spore. D. Young vegetative cell. E. Vegetative cell. F. Spore. G. Germinating spore. H. Young vegetative cell. I. Vegetative cell. J. Spore. K. Germinating spore. L. Young vegetative cell. M. Vegetative cell. N. Spore. O. Germinating spore. P. Young vegetative cell. Q. Vegetative cell. R. Spore. S. Germinating spore. T. Young vegetative cell. U. Vegetative cell. V. Spore. W. Germinating spore. X. Young vegetative cell. Y. Vegetative cell. Z. Spore. AA. Germinating spore. AB. Young vegetative cell. AC. Vegetative cell. AD. Spore. AE. Germinating spore. AF. Young vegetative cell. AG. Vegetative cell. AH. Spore. AI. Germinating spore. AJ. Young vegetative cell. AK. Vegetative cell. AL. Spore. AM. Germinating spore. AN. Young vegetative cell. AO. Vegetative cell. AP. Spore. AQ. Germinating spore. AR. Young vegetative cell. AS. Vegetative cell. AT. Spore. AU. 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(vii) Cysts :

- These are thick walled spores formed during unfavourable conditions or even when food supply is abundant.
- During their formation as in vacheria the thallus becomes many septate and each chamber thus formed produce a thick walled cysts.



- sometime the cysts may be formed in rhizoides as in botrydium when they are called rhizocysts .
- Sometime a cyst may divide further to form a number of microcysts

3. Sexual reproduction

- The first fossilized evidence of sexual reproduction in eukaryotes is from the Stenian period, about 1 to 1.2 billion years ago.
- These reasons include fighting the accumulation of deleterious mutations, increasing rate of adaptation to changing environments, dealing with competition or as an adaptation for repairing DNA damage and masking deleterious mutations.

- While these ideas about why sexual reproduction has been maintained are generally supported, the ultimate size of the population determines if sexual reproduction is entirely beneficial.
- Larger populations appear to respond more quickly to benefits obtained through sexual reproduction than smaller population sizes.

- a basic advantage for sexual reproduction in slowly reproducing complex organisms, exhibiting characteristics that depend on the specific environment that the given species inhabit, and the particular survival strategies that they employ .
- It is greatly advanced method of reproduction

Conditions for sexual reproduction:

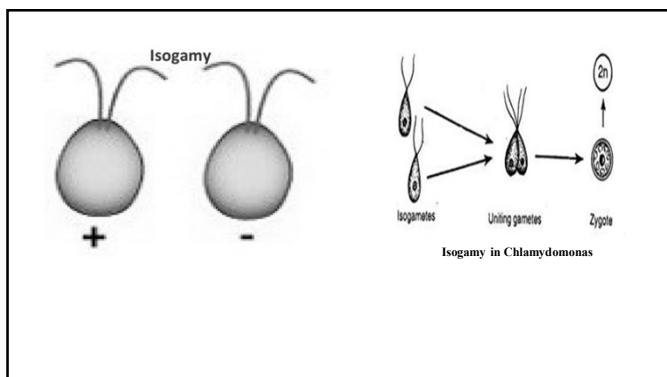
- (a) The sexual reproduction takes place after considerable accumulation of food material and the climax of vegetative activity is over.
- (b) The bright light is the major factor for the production of the gametes.
- (c) A suitable pH value is required.
- (d) The optimum temperature is necessary.

Sexual reproduction are three main types,

- (i) isogamy
- (ii) heterogamy
- (iii) Aplanogamy or conjugation

(i) Isogamy:

- The fusion of similar motile gametes is found in many species.
- Usually the gametes taking part in fusion come from two different individuals or filaments, sometimes these gametes come from two different cells of the same filament.
- they cannot be classified as "male" or "female." Instead, organisms undergoing isogamy are said to have different mating types, most commonly noted as "+" and "-" strains .



- although in some species there are more than two mating types .
- Fertilization occurs when gametes of two different mating types fuse to form a zygote.

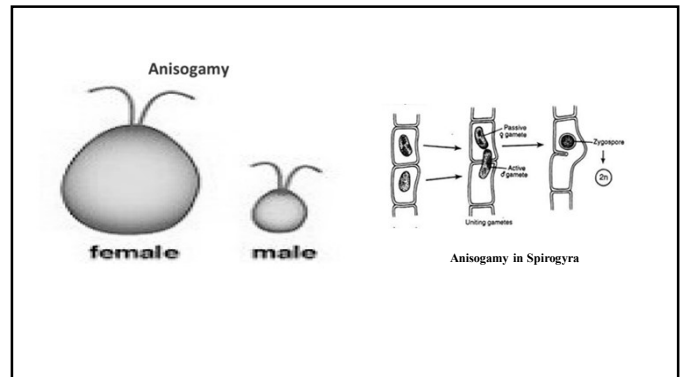
(ii) Heterogamy:

- The fusion of dissimilar gametes is called heterogamy.
- There are two main types ,

 - (a) Anisogamy:
 - (b) Oogamy:

(a) Anisogamy:

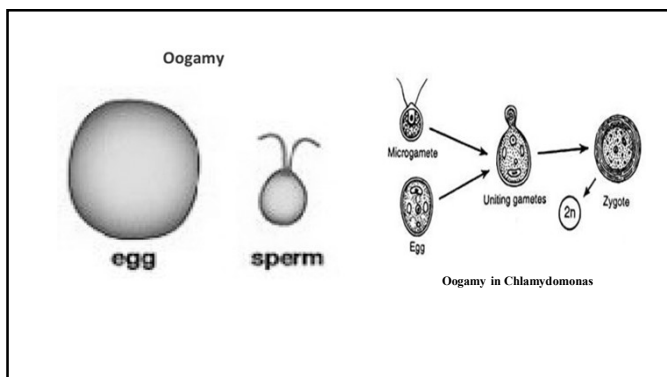
- The fusing gametes are similar in appearance and are motile but are different physiologically or in size.
- The smaller gamete is considered to be male (sperm cell), whereas the larger gamete is regarded as female (egg cell).
- Small or microgametes and large or macrogametes .



- There are several types of anisogamy. Both gametes may be flagellated and thus motile.
- Alternatively, neither of the gametes may be flagellated.
- This situation occurs for example in some algae and plants.
- In the red alga Polysiphonia, large non-motile egg cells are fertilized by small, non-motile spermatia.

(b) Oogamy :

- In this case, the male antherozoid (male gamete) fuses with the female egg.
- The fusing gametes are different in size and behaviour .
- One of the gamete is small and motile while the other is large and non-motile.



- This types of sexual reproduction is termed as fertilization or oogamyus reproduction and the product is called an oospore.
- This is usually found in higher types of green and brown algae.
E.g ,Vaucharia , Chara etc

(iii) Aplanogamy or conjugation:

- It implies the fusion of two non-flagellate amoeboid gametes (aplanogametes).
- They are morphologically similar but physiologically dissimilar, e.g., order Conjugales.
- In fresh water algae, the sexual reproduction is best means of perennation because it is followed by the formation of thick-walled zygote or oospore.

