

NCERT Solutions for Class-XI Biology

Chapter-3

1. What is the basis of classification of algae?
1. Fritsch (1935), has classified algae considering phylogeny, affinities and inter-relationships of various forms. He classified algae mainly on the basis of the characters like structure of plant body, nature of the pigments, reserve food material, number and position of flagella, chemistry of cell wall and methods of reproduction etc. Algae is divided into 11 classes but among them 3 main classes are Chlorophyceae, Phaeophyceae and Rhodophyceae.
2. When and where does reduction division take place in the life cycle of a liverwort, a moss, a fern, a gymnosperm and an angiosperm?
2. Liverwort – In liverworts, the main plant-body is haploid (gametophytic). It bears the male and female sex organs which produce gametes. These gametes fuse to form a zygote. The zygote develops on the gametophytic plant-body to form a sporophyte. The sporophyte is differentiated into the foot, seta, and capsule. Many haploid spores are produced as a result of the reduction division taking place inside the capsule.
Moss – In mosses, the primary protonema (developed in the first stage) develops into the secondary protonema. Both these stages are haploid or gametophytic. The secondary protonema bears the sex organs which produce gametes. These gametes fuse to form a zygote. The zygote develops into a sporophyte. Many spores are formed as a result of the reduction division taking place in the capsule of this sporophyte.
Fern – In ferns, the main plant-body is sporophytic. Its leaves are known as sporophylls and these bear the sporangia. Reduction division takes place in these sporangia, thereby producing many spores.
Gymnosperm – In gymnosperms, the main plant-body is sporophytic. They bear two types of leaves – microsporophylls and megasporophylls. Reduction division takes place in the microsporangia present on the microsporophylls (producing pollen grains) and on the megasporangia present on the megasporophylls (producing megaspores).
Angiosperm – In angiosperms, the main plant-body is sporophytic and bears flowers. The male sex organ in the flower is the stamen, while the female sex organ is the pistil. Reduction division takes place in the anthers of the stamen (producing haploid pollen grains) and in the ovary of the pistil (producing eggs).
3. Name three groups of plants that bear archegonia. Briefly describe the life cycle of any one of them.
3. The three groups of plants that bear archegonia are bryophytes, pteridophytes and gymnosperms.
Life cycle of a bryophyte is as follows : The main plant body of bryophyte is gametophytic (n), which is independent and may be thallose (no differentiation in root,

stem, leaves) e.g., *Riccia*, or may be foliose (having leafy axis) e.g., *Funaria*. The dominant phase in the life cycle of *Funaria* is the gametophyte, which occurs in two stages, the protonema stage and the erect, leafy gametophytic plant.

The leafy gametophyte consists of an upright, slender axis (stem-like) that bears spirally arranged leaves and is attached to the substratum by multicellular, branched rhizoids. Vegetative reproduction takes place by fragmentation; by the buds formed in secondary protonema etc. The sex organs, antheridia and archegonia are produced in dusters at the apices of the leafy shoots. Antheridia produces antherozoids and archegonia produces egg. Antherozoid (male gamete) and egg (female gamete) fuses and form zygote. Zygote develops into a sporophyte; which is differentiated into foot, seta and capsule and spores are produced in the capsule.

Spores on reaching a suitable substratum germinate to produce a filamentous juvenile stage, called the primary protonema, which later produces secondary protonema that forms erect leafy plants.

4. Mention the ploidy of the following: protonemal cell of a moss; primary endosperm nucleus in dicot, leaf cell of a moss; prothallus cell of a fern; gemma cell in *Marchantia*; meristem cell of monocot, ovum of a liverwort, and zygote of a fern.

4. (a) Protonemal cell of a moss – Haploid
(b) Primary endosperm nucleus in a dicot – Triploid
(c) Leaf cell of a moss – Haploid
(d) Prothallus of a fern – Haploid
(e) Gemma cell in *Marchantia* – Haploid
(f) Meristem cell of a monocot – Diploid
(g) Ovum of a liverwort – Haploid
(h) Zygote of a fern – Diploid

5. Write a note on economic importance of algae and gymnosperms.

5. Economic importance of algae is as follows:

The group Algae plays both economically beneficial as well as harmful roles.

Beneficial importance :

(i) People of coastal countries have been using sea weeds & certain other algae as source of food, e.g., *Porphyra*, *Ulva*, *Laminaria*, etc.

(ii) Some algae are used as food for marine as well as domestic animals, e.g., *Sargassum*, *Macrocystis*.

(iii) Algae are useful source of many commercial products like agar, a jelly like substance (complex polysaccharide) is extracted from species of red algae belonging to the genera *Gelidium*, *Gracilaria* etc. Agar is also used as base in culture media. Carrageenin occurs as a cell wall polysaccharide, esterified with sulphate. It is extracted from red alga like *Chondrus Crispin*, etc. is used in pharmaceutical emulsifier and textile, leather, cosmetic industries. Alginates are salts of alginic acid found in the cell wall of phaeophyceae (brown algae) like *Fucus*, *Laminaria* etc.

(iv) Algae are also useful in medicine industry. Antibiotic chlorellin is obtained from *Chlorella*. Extracts of *Cladophora*, *Lyngbya* kill strains of *Pseudomonas* and

Mycobacterium like bacteria. Nitella is used to destroy mosquitoes growth in ponds and hence used in control of malaria.

(v) Some algae are used in agriculture like Nostoc, Anabaena etc. are used to convert atmospheric N₂ into nitrogenous compounds which are absorbed by higher plants. Some sea weeds like Fucus, Litlwhphyllum, Lycophyllum etc. are rich in K, P, trace elements and growth substances and are used as fertilisers by coastal people.

(vi) Some algae like Chlorella, Chlamydomonas, etc. are used in sewage disposal in ponds. These algae help in bacterial decomposition by providing O₂.

(vii) Some algae like Chlorella, Synecoccus, etc are used in space travels. A person inside a spaceship will need a device to get rid of CO₂ and other body wastes and will require sources of O₂ and food. These algae are very useful for this purpose.

(viii) A large amount of iodine (mineral element present in thyroxine hormone of thyroid gland) is extracted from kelps (brown sea weeds or members of phaeophyceae) like Laminaria, Fucus, Ascophyllum etc. Similarly red algae like Rhodomela, Polysiphonia, Rhodymenia are sources of bromine.

Harmful importance:

(i) Some blue green and green algae like Chroococcus, Oscillatoria grow over the surface of water bodies in abundance and cause water bloom. On death and decay these algae give off bad smell. Some algae secrete poisonous or toxic substances.

(ii) Parasitic algae like Cephaleuros virescens causes red rust of tea, coffee etc.

Economic importance of gymnosperms is as follows:

(i) Some species of Cycas like C. revoluta, C. rumphii look like palm tree and are used for decoration purposes as they remain fresh for long period.

(ii) Stem portion of Cycas revoluta is a good source of 'sago', a kind of starch used in making bread by poor people. Seeds of some species of Cycas are roasted and taken as food. Young succulent leaves of some species of Cycas are cooked as vegetable.

(iii) Many gymnosperms have medicinal value. The fresh juice extracted from the Cycas circinalis leaves is used as medicine for stomach disorders, blood vomiting and other skin diseases. Pollen grains of some Cycas plants are reported to have some narcotic effect.

(iv) Some gymnosperms like Pinus, Abies, Cedrus are the chief source of various types of woods. The wood of Juniperus is used in making pencils, scales, holders etc.

(v) Some species of Pinus is a good source of turpentine, wood gas, wood alcohol.

6. Both gymnosperms and angiosperms bear seeds, then why are they classified separately?

6. Gymnosperms and angiosperms are seed-producing plants with diplontic life cycles. In gymnosperms, the sporophylls are aggregated to form compact cones. The microsporophylls are broad and are not distinguished into filaments and anthers. The megasporophylls are woody and lack the ovary, style, and stigma, because of which the ovules lie exposed. The female gametophyte consists of archegonia. The fertilisation process involves the fusion of a male gamete with the female gamete. Their endosperm is haploid. The produced seeds are naked as there is no fruit formation.

Angiosperms are also known as flowering plants. They have sporophylls that aggregate to form flowers with the perianth. The microsporophylls consist of stamens containing pollen sacs. These sacs bear the male gametes called pollen grains. The megasporophylls are delicate and rolled, forming carpels that contain the ovary, style, and stigma. The ovules are present inside the ovary. The archegonium is replaced by an egg apparatus. Two male gametes enter the egg apparatus at the time of fertilisation. One male gamete fertilises the egg and the other fuses with the diploid secondary nucleus to form an endosperm. The resulting endosperm is thus triploid. In addition, in angiosperms, the development of seeds takes place inside the fruits.

7. What is heterospory? Briefly comment on its significance. Give two examples.
7. Heterospory is a phenomenon in which two kinds of spores are borne by the same plant. These spores differ in size. The smaller one is known as microspore and the larger one is known as megaspore. The microspore germinates to form the male gametophyte and the megaspore germinates to form the female gametophyte. The male gametophyte releases the male gametes and these reach the female gametophyte to fuse with the egg. The development of the zygote takes place inside the female gametophyte. This retention and germination of the megaspore within the megasporangium ensures proper development of the zygote. The zygote develops into the future sporophyte. The evolution of the seed habit is related to the retention of the megaspore. Heterospory is thus considered an important step in evolution as it is a precursor to the seed habit. Heterospory evolved first in pteridophytes such as *Selaginella* and *Salvinia*.
8. Explain briefly the following terms with suitable examples:-
 - (i) protonema
 - (ii) antheridium
 - (iii) archegonium
 - (iv) diplontic
 - (v) sporophyll
 - (vi) isogamy
8. (i) Protonema : It is the first, usually branched, green and filamentous structure produced by a germinating moss or fern spore. The protonema of mosses bears buds that develop into the gametophyte plant. In fern the protonema becomes the prothallus.
(ii) Antheridium : The male sex organ of cryptogams (algae, fungi, bryophytes and pteridophytes) is known as antheridium. It produces the male gametes or antherozoids. It may consist of a single cell or it may have a wall that is made up of one or several layers forming a sterile jacket around the developing gametes.
(iii) Archegonium : The multicellular flask shaped female sex organ of bryophytes, pteridophytes and many gymnosperms is known as archegonium. Its dilated base called the venter contains the female gamete or egg or oosphere. The cells of the narrow neck of archegonium liquify to allow the male gametes to swim towards the oosphere.
(iv) Diplontic : It is the kind of life cycle in which the diploid sporophyte is dominant and this diploid phase is photosynthetic. The gametophytic phase is represented either

by gametes only, that are formed through meiosis or by a highly reduced few celled gametophyte. E.g., all seed-bearing plants (gymnosperms and angiosperms).

(v) Sporophyll : It is a type of leaf bearing sporangia. In ferns, the sporophylls are the normal foliage leaves, but in other plants the sporophylls are modified and arise in specialised structure such as the strobili of club-moss, gymnosperms and the flower of angiosperms. In most plants sporophylls are of two types – microsporophylls and megasporophylls.

(vi) Isogamy: It is a type of sexual reproduction where fusion takes place between two identical gametes. The gametes are similar in size and structure and they show equal motility during sexual reproduction, e.g., Spirogyra (algae).

9. Differentiate between the following:-

- (i) red algae and brown algae
- (ii) liverworts and moss
- (iii) homosporous and heterosporous pteridophyte
- (iv) syngamy and triple fusion

9. (i) Red algae and brown algae

Red algae		Brown algae	
1.	Red algae are grouped under the class Rhodophyceae.	1.	Brown algae are grouped under the class Phaeophyceae.
2.	They contain floridean starch as stored food.	2.	They contain mannitol or laminarin as stored food.
3.	They contain the photosynthetic pigments chlorophylls a and d, and phycoerythrin.	3.	They contain the photosynthetic pigments chlorophylls a and c, and fucoxanthin.
4.	Their cell walls are composed of cellulose, pectin, and phycocolloids.	4.	Their cell walls are composed of cellulose and algin.
5.	Flagella are absent	5.	Two flagella are present

(ii) Liverworts and moss

Liverworts		Moss	
1.	They have unicellular rhizoids.	1.	They have multicellular rhizoids.
2.	Scales are present very often	2.	Scales are absent
3.	They are generally thalloid, with dichotomous branching.	3.	They are foliage, with lateral branching.
4.	Gemma cups are present	4.	Gemma cups are absent
5.	Sporophyte has very photosynthetic tissue little	5.	Sporophyte has abundant photosynthetic tissue

(iii) Homosporous and heterosporous pteridophyte

Homosporous pteridophytes		Heterosporous pteridophytes	
1.	They bear spores that are of the same type.	1.	They bear two kinds of spores – microspores and megaspores.
2.	They produce bisexual gametophytes.	2.	They produce unisexual gametophytes.

(iv) Syngamy and triple fusion

Syngamy		Triple fusion	
1.	It is the process of fusion of the male gamete with the egg in an angiosperm.	1.	It is the process of fusion of the male gamete with the diploid secondary nucleus in an angiosperm.

2.	A diploid zygote is formed as a result of syngamy.	2.	A triploid primary endosperm is formed as a result of triple fusion.
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10. How would you distinguish monocots from dicots?

10. Differences between monocots and dicots are as follows :

	Column I	Column II
(a)	The seeds contain one cotyledon.	The seeds contain two cotyledons.
(b)	Flowers are generally trimerous.	Flowers are generally pentamerous or tetramerous.
(c)	Pollen grains generally possess a single germ pore.	Pollen grains commonly have three germ pores.
(d)	Leaves generally possess parallel venation.	Leaves possess reticulate venation.
(e)	Primary root is short lived. Tap root is absent. Adventitious roots present.	Primary root is long lived and it forms tap root. Adventitious roots are found in some cases.
(f)	In stems, ground tissue is not differentiated into cortex and pith.	In stems. Ground tissue is differentiated into cortex, pith, endodermis etc.
(g)	Vascular bundles are scattered and closed. Cambium absent.	Vascular bundles are arranged in a ring and open. Cambium present.
(h)	In root, a pith is always present. Vascular bundles are many (more than 8).	In root, pith is absent. Vascular bundles are few.
(i)	Vessels are rounded in outline.	Vessels are polygonal in outline.

11. Match the followings (column I with column II)

	Column I		Column II
(a)	<i>Chlamydomonas</i>	(i)	Moss
(b)	<i>Cycas</i>	(ii)	Pteridophyte
(c)	<i>Selaginella</i>	(iii)	Algae
(d)	<i>Sphagnum</i>	(iv)	Gymnosperm

11.

	Column I		Column II
(a)	<i>Chlamydomonas</i>	(i)	
(b)	<i>Cycas</i>	(ii)	
(c)	<i>Selaginella</i>	(iii)	
(d)	<i>Sphagnum</i>	(iv)	

12. Describe the important characteristics of gymnosperms.

12. The term gymnosperm is derived from two Greek words: Gymnos = naked + Sperma = seed, i.e., naked seeded plants. So gymnosperms are a group of plants in which the ovules are freely exposed on open megasporophylls. The important characteristics of gymnosperms are :

- Living gymnosperms are perennial and vary from predominantly medium – sized trees (*Cycas*) to tall trees (*Pinus*) and shrubs (*Ephedra*).
- Plants possess tap root system. Some genera possess symbiotic relationship of N₂ fixing algae in coralloid roots (*Cycas*) and fungi in mycorrhizal roots (*Pinus*).

The stems are aerial, erect, branched (unbranched in *Cycas*) and woody.

The leaves may be simple or compound. They are scaly and foliage also. Leaves are well

adapted to withstand extremes of temperature, humidity and wind.

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Exarn.



- Stems are provided with collateral, endarch and open vascular bundles which are arranged in a ring. Secondary growth is present and annual rings are formed.
- Xylem contains xylem parenchyma and tracheids with bordered pits and vessels are absent (except in Gnetum; Ephedra and Weluhtschia).
- Phloem contains sieve cells and phloem parenchyma and companion cells are absent (except in Gnetum; Ephedra and Weluhtschia).
- Leaves are protected by thick layers of cuticle. Sunken stomata are present. Mesarch xylem and transfusion tissues are found in the leaves. Palisade tissue and spongy parenchyma may be present in mesophyll or it may be undifferentiated.
- The reproductive organs form cones or strobilus except female organs of Cycas.
- The male cone is made of overlapping microsporophylls, that bear microsporangia on the abaxial side which produce microspores.
- Female cone is formed by overlapping megasporophylls which bear ovules (megasporangia).
- Ovule is orthotropous, unitegmic with 3 layers i.e. outer fleshy, middle stony and inner fleshy.
- The nucellus of ovule contains single megaspore mother cell which undergoes reduction division to form 4 megaspores, out of which 3 degenerate and only one survives.
- So gymnosperm is heterosporous i.e. producing microspores and megaspores.
- Single megaspore forms haploid female gametophyte or endosperm before fertilisation. .
- At micropylar end of female gametophyte 2 or more archegonia are produced. Archegonium is with reduced neck (with no neck canal cell).
- Microspores are released from microsporangium and are carried in air currents and come in contact with the micropyle of the ovules.
- Pollen tube carrying the male gametes grows towards archegonia and discharges its contents near the mouth of the archegonia.
- After fertilisation zygote or oospore gives rise to embryo proper and the ovules develop into seeds.
- Polyembryony i.e., development of more than one embryo is an usual feature of gymnosperms but only one of them survives at later stage.
- In embryo 2 or many cotyledons are present.
- The seeds of gymnosperms are uncovered.