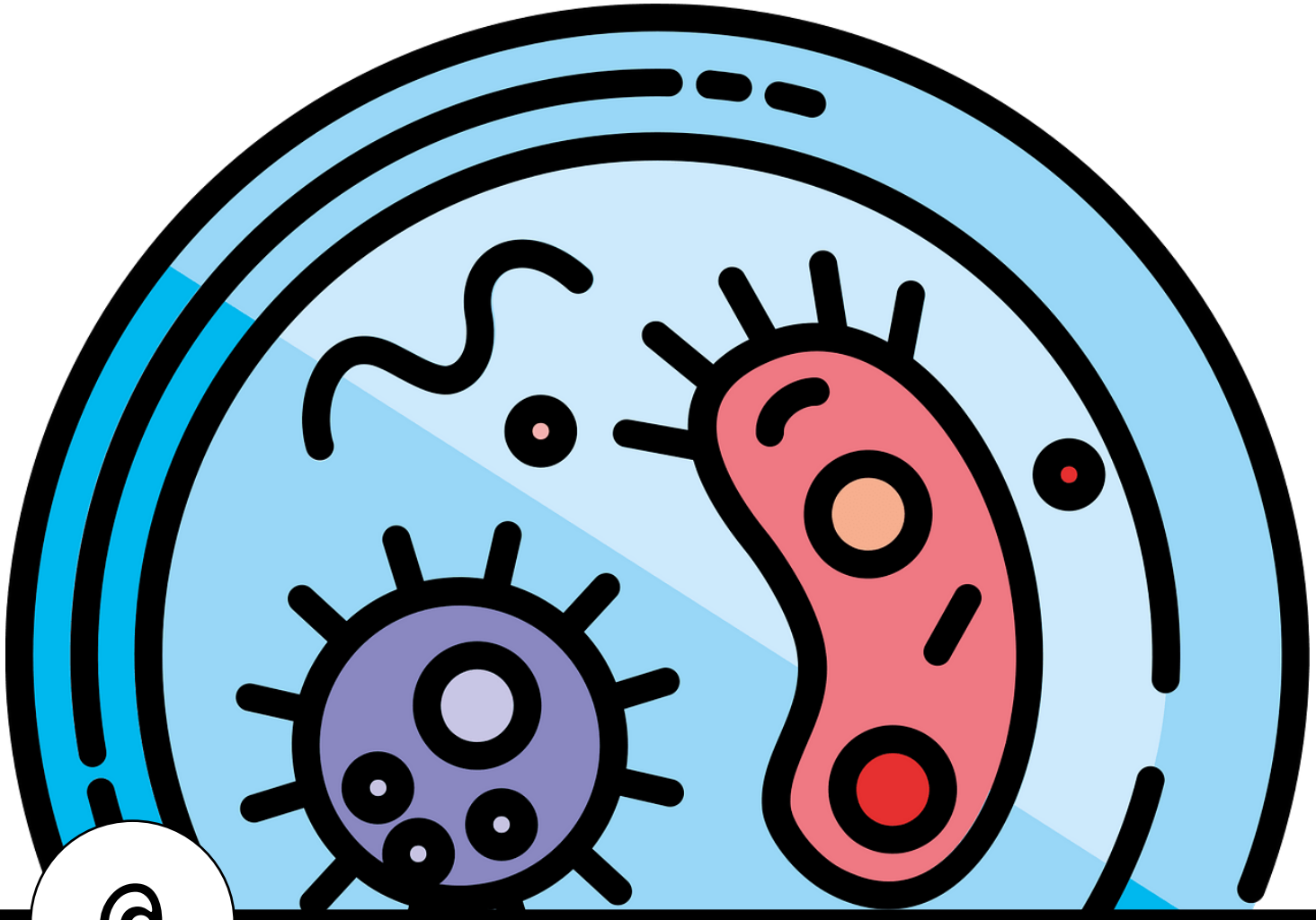
Biology

11

Chapter- 3. Plant Kingdom



1.What is the basis for the classification of algae?

Answer: Algae are classified primarily based on the pigments they contain, which determine their colour. There are three main groups:

- **Chlorophyceae (Green Algae):** Contains chlorophyll a and b, giving a green colour.
- **Phaeophyceae (Brown Algae):** Contains chlorophyll a, c, and fucoxanthin, which imparts a brown colour.
- **Rhodophyceae (Red Algae):** Contains chlorophyll a, d, and phycoerythrin, which gives them a red colour.

Other classification criteria include flagella, stored food type, and cell wall composition.

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?

Answer:

- **Liverworts:** Meiosis happens in the spore mother cells inside the capsule of the sporangium, leading to the formation of haploid spores.
- **Mosses:** Reduction division occurs in the spore sacs of the capsule within the sporangium.
- **Ferns:** Meiosis takes place in the spore mother cells located in sporangia on sporophylls (fertile leaves), resulting in haploid spores.
- **Gymnosperms:** Reduction division occurs in the microspore mother cells within the microsporangia on the microsporophylls, leading to the formation of pollen grains.
- **Angiosperms:** In the anther of the stamen, meiosis occurs in microspore mother cells, forming pollen grains (male gametophyte). In the ovule, the megaspore mother cell undergoes meiosis, producing a haploid megaspore (female gametophyte).

3. Name three groups of plants that bear archegonia. Briefly describe the life cycle of any one of them.

Answer: The three groups of plants that bear archegonia are **Bryophytes, Pteridophytes, and Gymnosperms**.

Life cycle of Bryophytes:

1. The main plant body is gametophytic (haploid), which can be either thallose (like *Riccia*) or foliose (like *Funaria*).
2. The dominant phase is the gametophyte, consisting of two stages: the protonema stage and the upright leafy stage.

3. The leafy gametophyte has a slender axis with spirally arranged leaves, anchored by multicellular, branched rhizoids.
4. Vegetative reproduction occurs through fragmentation and budding in the secondary protonema.
5. The male and female sex organs (antheridia and archegonia) form in clusters at the tips of the leafy shoots. Antheridia produce antherozoids (male gametes), while archegonia produce eggs (female gametes).
6. An antherozoid fuses with the egg to form a zygote, which develops into a sporophyte.
7. The sporophyte consists of a foot, seta, and capsule, where spores are produced.
8. Spores germinate on suitable substrates, forming a filamentous juvenile stage called the primary protonema, which eventually develops into the secondary protonema and produces 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 a monocot; ovum of a liverwort; and zygote of a fern.

Answer:

- Protonemal cell of a moss: Haploid
- Primary endosperm nucleus in dicot: Triploid
- Leaf cell of a moss: Haploid
- Prothallus cell of a fern: Haploid
- Gemma cell in Marchantia: Haploid
- Meristem cell of monocot: Diploid
- Ovum of a liverwort: Haploid
- Zygote of a fern: Diploid

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

Answer:

Economic Importance of Algae:

1. **Carbon Fixation:** Algae perform half of the total carbon dioxide fixation on Earth through photosynthesis, serving as primary producers in aquatic habitats.
2. **Food Source:** Many marine algae, such as *Porphyra*, *Sargassum*, and *Laminaria*, are edible. Algae like *Chlorella* and *Spirulina* are rich in proteins and are used as dietary supplements.
3. **Commercial Uses:**
   - **Agar:** Extracted from *Gelidium* and *Gracilaria*, agar is used in jellies and ice creams.
   - **Carrageenan:** Derived from red algae, carrageenan is used as an emulsifier in chocolates, paints, and toothpastes.

4. **Medicinal Uses:** Certain red algae, like *Corallina*, are utilized in treating worm infections.

Economic Importance of Gymnosperms:

1. **Construction Materials:** Many conifers, such as pine and cedar, provide softwood used in construction and packaging.
2. **Medicinal Uses:**
   - **Taxol:** An anticancer drug obtained from *Taxus*.
   - **Ephedrine:** Produced by species of *Ephedra*, used in the treatment of asthma and bronchitis.
3. **Food Source:** The seeds of *Pinus gerardiana* (chilgoza) are edible and nutritious.
4. **Source of Resins:** Resins are commercially significant for manufacturing sealing waxes and waterproof paints. Turpentine is a resin obtained from various species of pine.

6. Both gymnosperms and angiosperms bear seeds, then why are they classified separately?
Answer: Gymnosperms and angiosperms are classified separately due to the following reasons:

1. **Seed Enclosure:** In gymnosperms, seeds are naked and develop on the surface of open structures called megasporophylls, while in angiosperms, seeds are enclosed within a protective ovary that develops into a fruit.
2. **Endosperm Formation:** The endosperm in gymnosperms is haploid and forms before fertilization, whereas in angiosperms, it is triploid and formed after a process called double fertilization.
3. **Double Fertilization:** This unique process occurs in angiosperms but is absent in gymnosperms.
4. **Wood Structure:** Gymnosperm wood is typically nonporous, while angiosperm wood is porous, indicating structural differences.

These distinctions highlight the significant evolutionary adaptations that separate these two groups of seed-bearing plants.

7. What is heterospory? Briefly comment on its significance. Give two examples.

Answer:
Heterospory is the production of two distinct types of spores within the same plant, known as microspores and megaspores, which differ in size. The significance of heterospory includes:

(a) **Sexual Differentiation:** Heterospory is crucial for the sexual differentiation of gametophytes; microspores develop into male gametophytes, while megaspores develop into female gametophytes.

(b) **Survival Advantage:** In contrast to homosporous pteridophytes, where spores must germinate on soil and face environmental challenges, heterosporous pteridophytes allow spores to germinate within the sporangium. This provides a more favourable environment for gametophytes, enhancing their survival.

(c) **Foundation for Seed Development:** Heterospory is the basis for the development of the seed habit in higher plants, leading to the evolution of gymnosperms and angiosperms.

Examples: Salvinia and Selaginella are two plants that exhibit heterospory.

8. Explain briefly the following terms with suitable examples:

(a) Protonema: Protonema is the first stage in the life cycle of mosses, forming a green, branched, and filamentous structure from a germinating spore. In mosses, it produces buds that develop into the gametophyte plant, while in ferns, it develops into a prothallus.

(b) Antheridium: Antheridium is the male reproductive organ found in bryophytes, pteridophytes, and some algae and fungi. It produces male gametes (antherozoids) and is typically surrounded by a sterile jacket of cells. This organ may consist of a single cell or multiple layers.

(c) Archegonium: Archegonium is the multicellular, flask-shaped female reproductive organ present in bryophytes, pteridophytes, and many gymnosperms. The venter, its swollen base, contains the female gamete (egg). The cells in the neck of the archegonium dissolve to facilitate the movement of male gametes toward the egg.

(d) Diplontic: The term "diplontic" refers to a life cycle where the dominant phase is diploid. In this cycle, the diploid sporophyte is photosynthetic and independent, while the gametophyte is either highly reduced or represented only by gametes produced through meiosis. This is observed in all seed-bearing plants, including gymnosperms and angiosperms.

(e) Sporophyll: A sporophyll is a type of leaf that bears sporangia. In ferns, sporophylls are typically the foliage leaves, while in other plants, they may be modified and arise in specialized structures, such as strobili in club mosses or flowers in angiosperms. Sporophylls are usually classified into microsporophylls and megasporophylls.

(f) Isogamy: Isogamy is a form of sexual reproduction in which two identical gametes fuse during fertilization. These gametes are similar in size and structure and exhibit equal motility. An example of isogamy can be found in the algae Spirogyra.

9. Differentiate between the following:

1. Red algae and brown algae
2. Liverworts and mosses
3. Homosporous and heterosporous pteridophytes
4. Syngamy and triple fusion

Answer:

1. **Red Algae vs. Brown Algae**

Feature	**Red Algae**	**Brown Algae**
Classification	Rhodophyceae	Phaeophyceae
Food Storage	Floridean starch	Mannitol or laminarin
Pigments	Chlorophyll a, chlorophyll d, phycoerythrin	Chlorophyll a, chlorophyll c, fucoxanthin
Cell Structure	Cellulose, pectin, and phycocolloids	Cellulose and algin
Flagella	Absent	Two flagella

2. **Liverworts vs. Mosses**

Feature	**Liverworts**	**Mosses**
Rhizoids	Unicellular rhizoids	Multicellular rhizoids
Plant Structure	Thalloid with dichotomous branching	Foliage with lateral branching
Gemma Cups	Present	Absent
Sporophyte Structure	Very little photosynthetic tissue	Abundant photosynthetic tissue

3. **Homosporous vs. Heterosporous Pteridophytes**

Feature	**Homosporous Pteridophytes**	**Heterosporous Pteridophytes**
Spore Type	One type of spore	Two types of spores: microspores and megaspores
Gametophyte Type	Bisexual gametophytes	Unisexual gametophytes

4. **Syngamy vs. Triple Fusion**

Feature	Syngamy	Triple Fusion
Process	Fusion of male gamete with the egg	Fusion of male gamete with the diploid secondary nucleus
Outcome	Diploid zygote	Triploid primary endosperm

10. How would you distinguish monocots from dicots?

Answer:

Characteristic	Monocots	Dicots
Cotyledons in Seeds	Embryo with one cotyledon	Embryo with two cotyledons
Flower Parts	Flower parts in multiples of three	Flower parts in multiples of four or five
Leaf Venation	Major leaf veins are generally parallel	Major leaf veins are reticulated
Stem Vascular Bundles	Vascular bundles are scattered	Vascular bundles are arranged in a ring
Root System	Roots are adventitious type	Roots develop from radicle (tap roots)
Secondary Growth	Absent	Often present
Morphology of Leaves	Leaves are generally isobilateral	Leaves are dorsiventral
Number of Vascular Bundles	Numerous	Generally, 2 to 6
Cambium	Absent	Present

11. Match the following (Column I with Column II)

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

Answer:
The correct matches are:

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

12. Describe the important characteristics of gymnosperms.

Answer:
Gymnosperms have several important characteristics:

Characteristic	Details
(i) **Naked Seeds**	Gymnosperms have seeds that are not enclosed by an ovary; they remain exposed.
(ii) **Plant Size**	They range from medium-sized trees to tall trees and shrubs (e.g., Sequoia is a giant tree).
(iii) **Root System**	The root system consists of taproots, with some having coralloid roots that fix nitrogen.
(iv) **Stems**	Stems can be branched (e.g., Pinus, Cedrus) or unbranched (e.g., Cycas).
(v) **Leaves**	Leaves can be simple (e.g., Pinus) or compound (e.g., pinnate in Cycas), often needle-like.
(vi) **Sporophyte Body**	The plant body is a sporophyte, separated into roots, stems, and leaves.
(vii) **Heterospory**	They produce two types of spores: microspores and megaspores.
(viii) **Pollination**	Pollination usually occurs through wind; there are no flowers, just male and female cones.
(ix) **Gamete Dependency**	Male and female gametophytes are dependent on the sporophyte for nutrition.
(x) **Endosperm**	The seeds contain haploid endosperms and remain uncovered.