



2

THE KINGDOMS MONERA, PROTOCTISTA AND FUNGI

The kingdoms Monera which includes all the bacteria and the protocista which includes the protoza, the diatoms and some algae are in a way the lowest among the living world. All bacteria, majority of Protoctists and many fungi are microscopic and generally referred to as microorganisms. You will learn about the three kingdoms in this lesson.



OBJECTIVES

After completing this lesson, you will be able to :

- *state the basis for classifying certain organisms as members of kingdoms Monera, Protoctista and Fungi;*
- *emphasize the fact that kingdom Monera is the only prokaryotic kingdom and also it is the most primitive;*
- *describe the generalized structure of a bacterium and cyanobacterium;*
- *describe economic importance of bacteria with examples;*
- *recognize the status of cyanobacteria and justify its inclusion in kingdom Monera;*
- *describe the characteristics of kingdom Protoctista (protista);*
- *describe the structure of amoeba, paramecium, euglena and plasmodium;*
- *describe the structure of diatoms;*
- *list the uses of protists to humans and mention the diseases causing protozoa;*
- *list the general characteristics of fungi with examples;*
- *describe the structure and reproduction of yeast, Rhizopus, mushroom, penicillium and its utility by humans;*
- *explain what are mycorrhizae;*
- *describe the economic importance of fungi.*



2.1 KINGDOM MONERA

- Includes the bacteria and cyanobacteria (commonly called blue-green algae).
- Since only bacteria are prokaryotic (lacking a true nucleus), that is without nuclear membrane), monera is the only **prokaryotic** kingdom.
- Bacteria were the first organisms to evolve on planet earth after life originated around 3.5 billion years ago and were the **only** organisms on earth for almost the next two billion years.
- All bacteria and cyanobacteria are single celled or **unicellular** (monere : single)
- Monerans are also the most numerous of all living organisms.

2.1.1 Structure of a bacterial cell

The single celled bacterium has a cell wall made of compound peptido-glycan covering the cell membrane; a single chromosome. The cell has ribosomes but no membrane bound organelles. Let us get to know some details of these parts (Fig. 2.1).

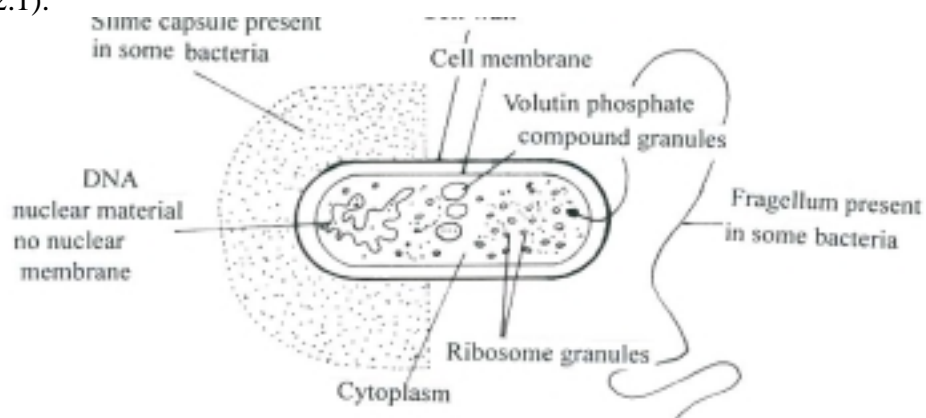


Fig. 2.1 Structure of a bacterium.

Note the following parts of a bacterium in the figure (Fig. 2.1). Outer most covering is the cell wall.

Cell wall

All prokaryotes have a rigid cell wall, which protects and gives shape to the cell. The cell wall is made up of a chemical, **peptidoglycan**, unique to bacteria.

Pili (Singular : pilus)

Pili are short and thin thread like structures projecting out from the cell wall in some bacteria.

Flagella

Some bacteria move with the help of one or two flagella. Flagella are longer and thicker than pili. Their structure is different from flagella of eukaryotes.

Plasma Membrane

Plasma membrane, present below the cell wall, encloses the cytoplasm and other cell contents. It is made up of lipids and proteins, as in eukaryotes.



Notes

Genetic Material

One circular chromosome made of a double helical molecule of DNA is located in a region of the cytoplasm called **nucleoid**. Since the chromosome is not lodged within a true nucleus, bacteria are termed prokaryotes. Hence Monera is the prokaryotic kingdom. Apart from the chromosome many species of bacteria possess rings of DNA called **plasmids**, which replicate along with bacterial chromosome and bear genes for antibiotic resistance, sex factor etc.

Cell Organelles

Membrane bound organelles like endoplasmic reticulum, mitochondria, chloroplast, golgi complex are **absent**. Only *ribosomes* are present, which are different from those of eukaryotes (see lesson 1 and 4).

Prokaryotes have no nuclear membrane around genetic material and no cell organelles. They have only the ribosomes.

2.1.2 Monera - General body functions

A. Nutrition

The four nutritional categories found in bacteria are :

- (i) Autotrophs - synthesize their own organic food.
- (ii) Saprotrophs - feed on dead and decaying matter.
- (iii) Symbionts - use food from other living organisms with which they are associated for mutual benefit.
- (iv) Parasites - absorb food from living organisms and cause harm to them

B. Respiration

Respiration in bacteria may be either

- (i) aerobic i.e. using oxygen for respiration or
- (ii) anaerobic i.e. respiration in the absence of oxygen.

Cellular respiration or breakdown of food to release energy occurs in **mesosomes** which are the inner extensions of the cell membrane.

C. Reproduction

(i) Asexual Reproduction

Bacteria reproduce asexually by **binary fission** (Fig. 2.2) under favourable conditions it takes about 20 minutes for one bacteria to divide into two by binary fission.

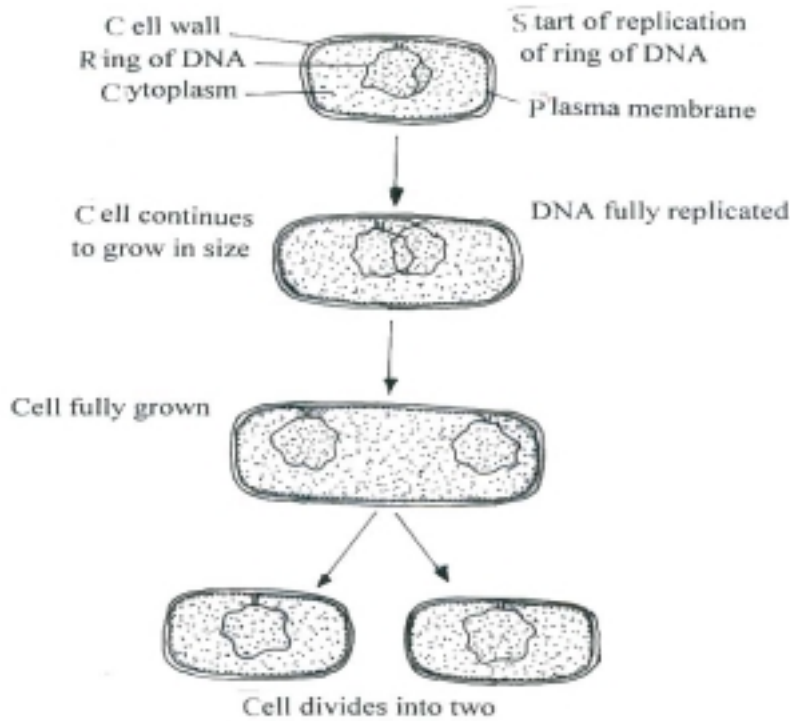


Fig. 2.2 Binary Fission in Bacteria

(ii) Sexual Reproduction

Some bacteria show a primitive mode of sexual reproduction. It is different from sexual reproduction in higher form. The steps are:

- Two conjugating (lie very close for exchange of genes) bacteria are held together by pili.
- A segment of DNA strand is transferred from one bacterium to another bacterium. (Fig 2.3)

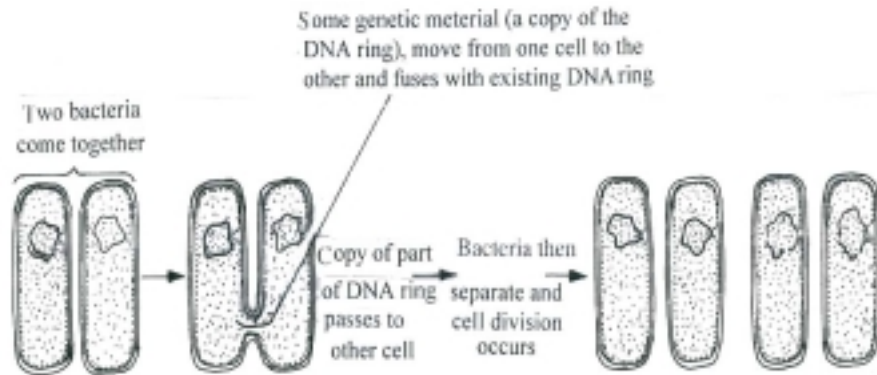


Fig. 2.3 Conjugation in Bacteria

**INTEXT QUESTIONS 2.1**

1. Of what the circular single chromosome of a bacterium made?
.....
2. Name the special region in the bacterial cell where genetic material lies.
.....
3. What is the cell wall made of in prokaryotes.
.....
4. State one point of difference between Flagella and pili.
.....
5. Give one difference between aerobic and anaerobic bacteria
.....
6. What is transferred during sexual reproduction in a bacteria?
.....

**Notes****2.1.3 Beneficial and harmful bacteria**

They harm us by causing many diseases. On the other hand some bacteria are very useful.

Diseases Caused By Bacteria

Name of Bacterium	Diseases Caused
1. <i>Vibrio cholerae</i>	Cholera
2. <i>Salmonella typhi</i>	Typhoid
3. <i>Clostridium tetani</i>	Tetanus
4. <i>Corynebacterium diphtheriae</i>	Diphtheria
5. <i>Mycobacterium tuberculosis</i>	Tuberculosis

Beneficial Activities of Bacteria

Name of bacterium	Activities
1. <i>Rhizobium</i>	Found in roots of legumes, (Peas, grams, Pulses etc) fixes atmospheric nitrogen as ammonia, which is then converted into useful amino acid.
2. <i>Azotobacter</i>	Makes the soil fertile. It fixes atmospheric nitrogen in the soil.
3. <i>Streptomycetes</i>	Produces Streptomycin antibiotic.
4. <i>Lactobacillus</i>	Ferments lactose (milk sugar) to lactic acid. This helps in setting of milk into curd.
5. Methanogenic bacteria	Sewage treatment



Notes

2.1.4 Cyanobacteria

These were earlier called the blue green algae. (Fig. 2.4a) A very successful group on primitive earth. They could carry out photosynthesis and the oxygen releases during the process changed the earth’s atmosphere and gradually the level of oxygen increased in the earth’s atmosphere.

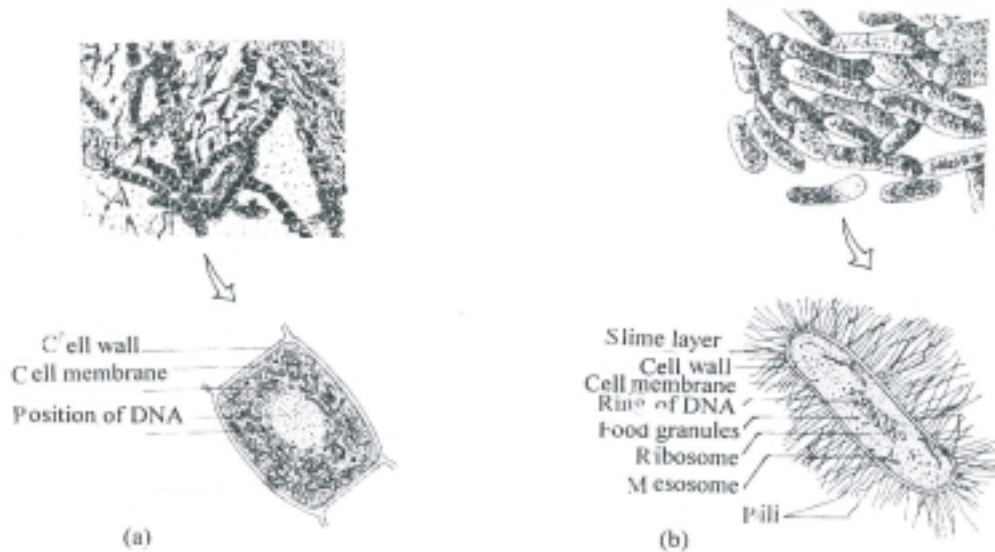
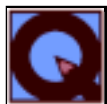


Fig. 2.4a-b Cyanobacteria (blue green algae)

Differences between Bacteria and Cyanobacteria

Bacteria	Cyanobacteria
1. Smaller cells 2. May have flagella 3. Some bacteria (green) carry out photosynthesis in a different way and do not release oxygen 4. Sexual reproduction by conjugation.	1. Comparatively larger cells 2. Do not have flagella. 3. They all carry out photosynthesis in the usual manner as in green plants and release oxygen 4. Conjugation has not been observed.



INTEXT QUESTIONS 2.2

1. Name the bacteria that :
 - (i) fix atmospheric nitrogen in the soil
 - (ii) set milk into curd



Notes

- (iii) cause tuberculosis
- (vi) cause tetanus
- 2. Approximately how many bacteria may be obtained from one bacterium in an hour?
.....
- 3. Give any three differences between bacteria and cyanobacteria.
.....

2.1.5 Archaeobacteria

Kingdom Monera includes two groups

1. Archaeobacteria and
2. Eubacteria

Archaeobacteria includes bacteria that live in unusual environments particularly at low levels of oxygen. Main types of Archaeobacteria are

- **Methanogenic** bacteria that live in sewage and intestinal tracts of animals
- **Thermoacidophilic** bacteria that live in hot springs.
- **Halophilic** bacteria live in salty conditions e.g. where hot sun concentrates sea water Eubacteria include cyanobacteria and all other bacteria.

2.2 KINGDOM PROTOCTISTA (UNICELLULAR EUKARYOTES)

- Protocista are **unicellular eukaryotes**. Protozoa and diatoms and algae are included in it.
- They have membrane bound organelles such as nucleus with chromosomes enclosed in nuclear membrane, mitochondria, chloroplast (in photosynthetic protocists only), golgi bodies and endoplasmic reticulum.
- Mitochondria are the respiratory organelles.
- Protocists are either photosynthetic, parasitic or saprotrophic.
- For locomotion, protocists may have cilia or flagella (Fig. 2.5) having 9 + 2 microtubules unlike those of bacteria, which have the 9 + 1 arrangement of microtubules.
- They reproduce both asexually and sexually.
- Some protocists are beneficial to humans while others are harmful.

2.2.1 Classification of Protocista

The kingdom protocista includes –

1. **Phylum Protozoa** which has the following four classes :
 - (i) Rhizopoda : Example *Amoeba*
 - (ii) Flagellata : Example *Euglena*



Notes

- (iii) Ciliata : Example *Paramecium*
- (iv) Sporozoa : Example *Plasmodium*
- 2. Phylum Bacillariophyta : Example diatoms
The algae belong to
- 3. Phylum Chlorophyta : Example *Chlorella*
- 4. Phylum Phaeophyta : Example Brown algae
- 5. Phylum Rhodophyta : Example Red algae
- 6. Phylum Oomycota : Example *Phytophthora*

2.2.2 Some examples of Protocists

1. Amoeba

Amoeba is commonly found in the mud in fresh water ponds and ditches containing decaying leaves.(Fig. 2.5a)

- It has blunt pseudopodia for locomotion.
- It captures food by pseudopodia to form a food vacuole.
- It has a contractile vacuole for osmoregulation

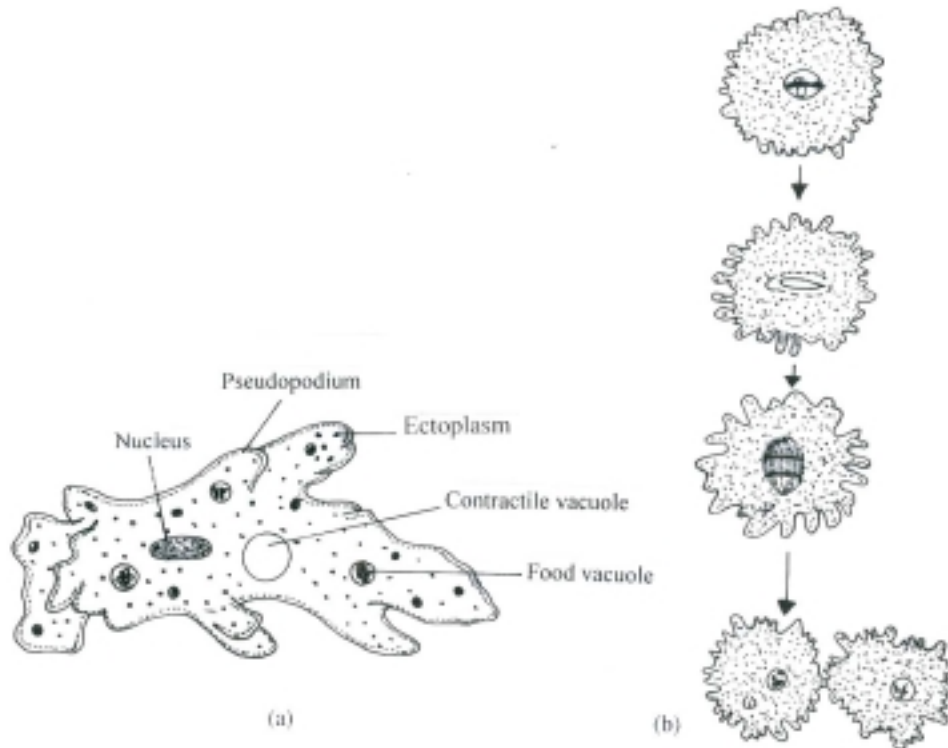


Fig. 2.5 Amoeba : (a) General Structure, (b) Amoeba showing binary fission.



Notes

Reproduction : Sexual reproduction is absent in *Amoeba*.

Asexual reproduction is by binary fission. (Fig. 2.5b)

2. *Entamoeba*

One common species is *Entamoeba histolytica* which causes amoebic dysentery in humans. It is amoeboid in form. New host gets infected when the cyst is swallowed along with contaminated food or water. The cyst bursts and releases *Entamoeba* in the intestines where it causes local abscesses (open injury). The symptoms of amoebic dysentery are abdominal pain, nausea, blood and mucus with stool.

3. *Plasmodium* (The malarial parasite)

The life cycle of *Plasmodium* has both asexual and sexual phases.

- The asexual phase is spent in the human blood.
- Sexual phase is spent in the female *Anopheles* mosquito Fig. 2.6.

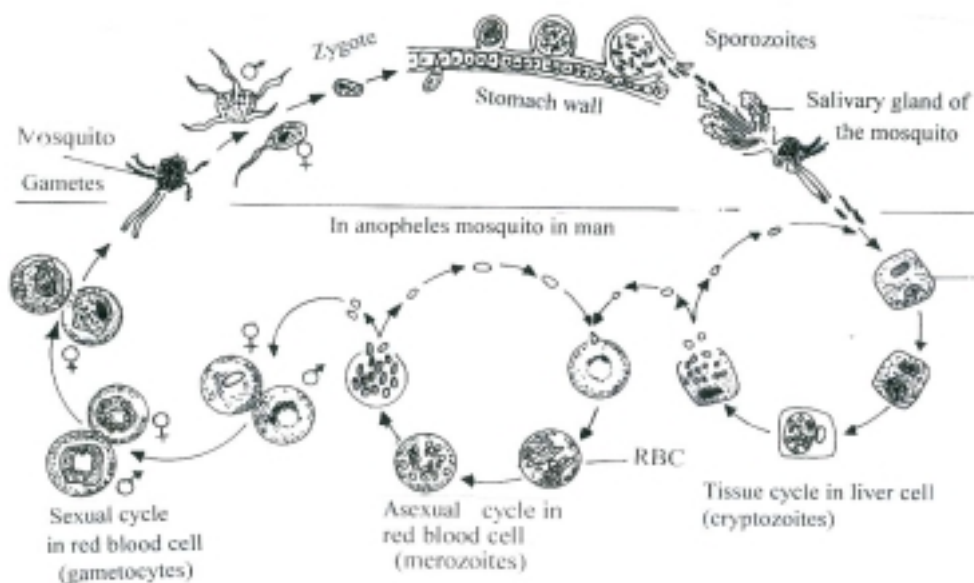


Fig. 2.6 The life cycle of *Plasmodium* in mosquito and man.

Male *Anopheles* cannot cause malaria as it feeds on plant juices and not human blood.

4. *Euglena* – A fresh water Flagellate

Euglena is abundantly found in stagnant waters such as pools, ponds, ditches etc. containing decaying organic matter. (Fig. 2.7)

As seen in the Fig. 2.7, the organism has the following parts.

Pellicle - elastic body covering made up of protein.

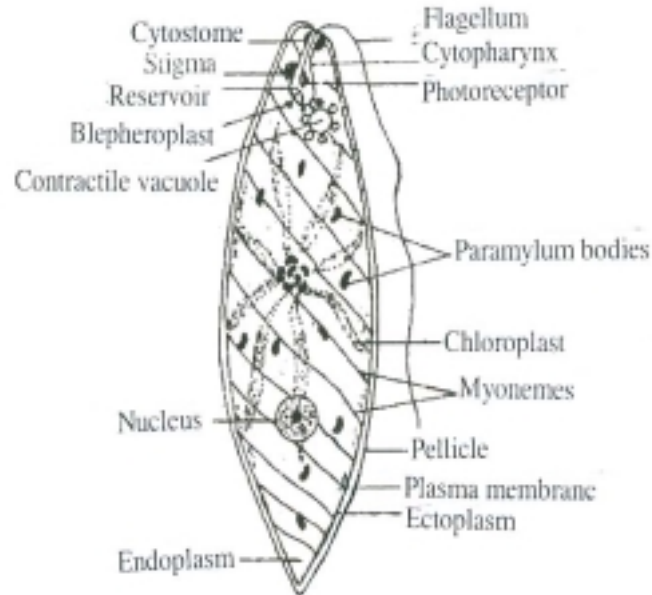


Fig 2.7 *Euglena* - General Structure

Cytostome and Reservoir - the cell mouth leading into a tubular cytopharynx which opens into a vesicle called reservoir.

Stigma - a prominent red pigment spot. It is sensitive to light.

Contractile Vacuole - for osmoregulation.

Flagellum - for propulsion in water.

Chloroplast - contain green coloured chlorophyll for photosynthesis.

Reproduction - is by binary fission.

5. The Diatoms

- The diatoms are found in both fresh and salt water and in moist soil.
- Thousands of species of diatoms form food for aquatic animals.
- Diatoms are either unicellular, colonial or filamentous and occur in a wide variety of shapes (Fig. 2.8).
- Each cell has a single prominent nucleus and plastids. They produce shells (cell walls) containing silica.

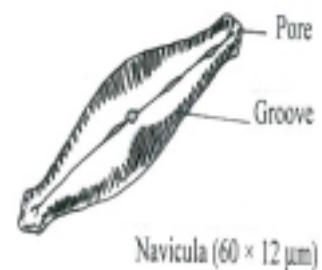


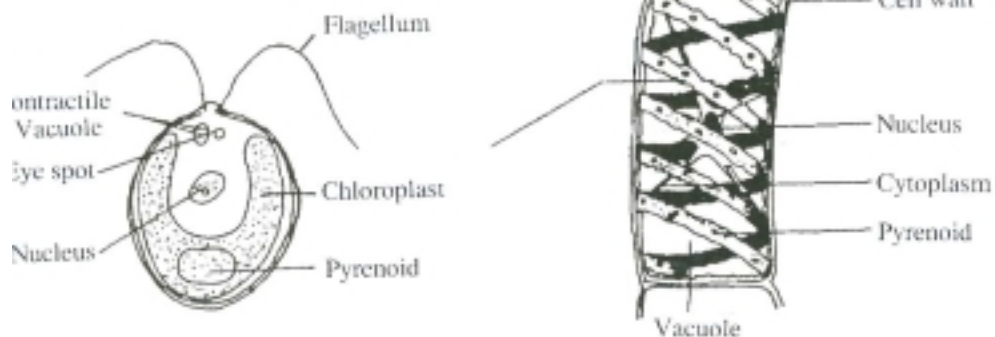
Fig. 2.8 Diatoms

6. Other Algae

- Algae can be unicellular e.g. *Chlamydomonas* (2.9a) or multi-cellular like *Spirogyra* (Fig. 2.9b)



Notes

Fig. 2.9 (a) *Chlamydomonas*(b) *Spirogyra*

- Algae can prepare their own food by photosynthesis as they contain chlorophyll. Some algae have other pigments also e.g. blue pigment (Phycocyanin), a brown pigment (Fucoxanthin) or a red pigment (Phycoerythrin). Depending on the pigment present, the algae are called blue, green, brown or red algae.

Colour of the Red Sea is due to the dominant occurrence of a red alga.

- Structurally the algae have a definite cell wall, cell membrane, a nucleus, cytoplasm and chloroplast. The chloroplast is cup-shaped in *Chlamydomonas* and ribbon-shaped in *Spirogyra*. Pyrenoid bodies are attached to chloroplasts.

2.2.3 Usefulness of Algae

- Provide food for fish as part of phytoplankton (organisms floating on the water surface)
- These are rich sources of vitamins A and E.
- Many marine forms are important sources of iodine, potassium and other minerals.
- Blue-green algae increase the soil fertility by fixing atmospheric nitrogen.
- Some algae can fix atmospheric nitrogen, so they are a source of natural fertilizer for the plants.
- A group of algae (diatoms) deposit silica in their walls. After their death these algae are preserved as fossils. Their deposits in large amounts are used as filters, and for lining of furnaces.



Notes



INTEXT QUESTIONS 2.3

1. Protocists are single celled like the Monera. Why have they been put in a separate kingdom? Answer in one short sentence.

2. Name the protozoan which causes
 - (i) Amoebic dysentery
 - (ii) Malaria
3. Which is the kind of asexual reproduction found in Protocista?

4. Through which part of the protocists does respiration occur?

5. Name the organelle responsible for regulating water content (osmoregulation) in amoeba.

6. Name two kinds of locomotion found in protocista.

2.3 KINGDOM FUNGI

2.3.1 Position of Fungi

During warm humid days slices of bread, chapati, leather belts or shoes, etc. develop powdery layer on them. In lawns and flower beds, mushrooms come out. These are all fungi.

Fungi were earlier classified as plants without chlorophyll and without differentiation of parts into root, stem and leaves. They are now included, in a separate Kingdom **Fungi**.

2.3.2 Characteristics of Fungi

- Fungi are **multicellular eukaryotes**
- Fungi exist as slender thread like filaments called hyphae. Hypha has many nuclei. Yeast, however, is single celled.
- The cell walls are made of chitin
- A hypha may be divided into cells by partitions called septa.



Notes

- Septa have pores through which cytoplasm streams freely.
- A group of hyphae forming a network is called mycelium, mycelos meaning fungus. (Fig. 2.10)
- Mycelia spread out on the substrate, or on the ground and even extend upto several kilometers.
- They do not possess chlorophyll as their nutrition is by absorption.
- No flagellum at any stage of life cycle.
- Reproduction in fungi is both asexual by means of spores and sexual through conjugation (refer to Fig. 2.13, 2.14).

Fungi are eukaryotic, multicellular saprotrophs having filaments which grow through soil, wood and other substrates.

2.3.3 Four main kinds of Fungi

The fungi are of four main kinds

1. **Yeasts**, which are unicellular.
2. **Slime moulds**, which have irregular shape.
3. **Mushrooms and toadstools**, which are large enough to be seen by naked eyes.
4. **Lichens and mycorrhizae** which exist in symbiotic associations.

1. Yeasts

Yeasts are fungi which do not produce any hyphae. These are generally in the form of single oval cells.

Fig. 2.10 shows the general structure of a yeast cell. Note the following features in it:

- ovoid cell.
- distinct cell wall and nucleus.
- one or more vacuoles in the cytoplasm.
- cytoplasm is granular and has glycogen and fat (oil) globules.



Fig. 2.10 A single cell of yeast

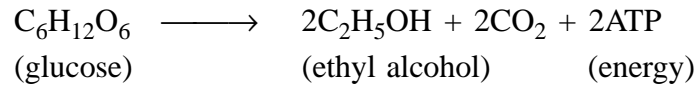
Nutrition

Yeast is saprotrophic. It can directly absorb simple sugar (glucose) but for obtaining sucrose (cane sugar) it gives out the enzyme *zymase* which breaks down sucrose into simple sugars. The simple sugars are then simply absorbed into the cell.



Notes

Yeast respire anaerobically to yield energy as follows



Reproduction

Yeast reproduces asexually by budding (Fig. 2.11).

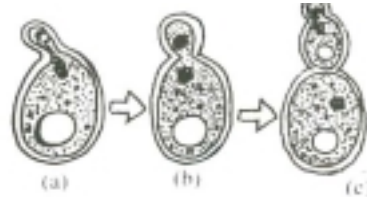


Fig. 2.11 Budding in yeast (a) A bud is forming and the nucleus is dividing; (b) Bud formed and the nucleus divided; (c) Further budding forms a chain

Sexual reproduction may also occur by its conjugation between two yeast cells. The fused contents divide twice to produce four individuals with a thick wall around each. These are the spores. The spores may be carried by wind and germinate under suitable conditions to produce new yeast cells.

2. Slime Moulds

These consist of a naked, creeping multinucleate mass of protoplasm sometimes covering up to several square metres.

3. Mushrooms and Toadstools

The vegetative part of the mycelium lies concealed in the substratum (in ground or in wood, etc.) When conditions are favourable the umbrella like mushroom grow out with a stalk and a cap. (Fig. 2.12)

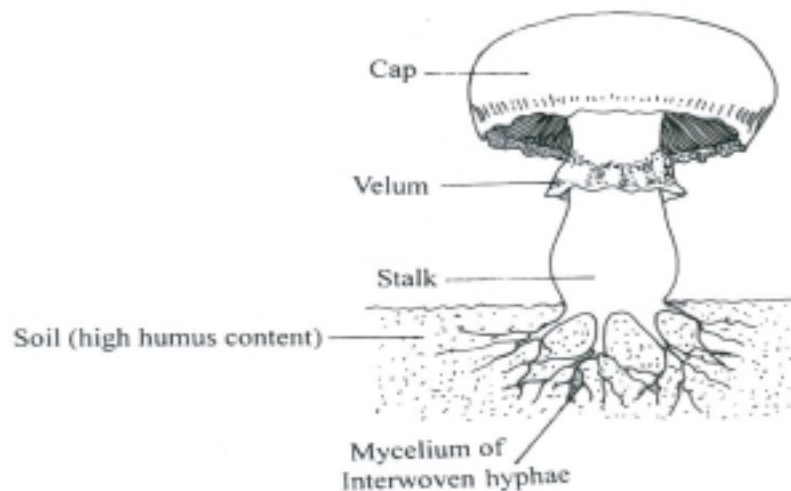


Fig. 2.12 A Mushroom

4. Lichens

These are a combination of certain fungi and a green algae which live in a symbiotic (mutually beneficial) association : the green algae prepares food while the fungi gives protection.



INTEXT QUESTIONS 2.4



Notes

1. Name the selender filaments that form the body of a fungus called
.....
2. Types of reproduciton found in fungi
.....
3. Draw two small figures to show asexual reproduction in yeast.
.....
4. Which are the four main kinds of fungi.
 1. 2.
 3. 4.

2.3.4 Economic importance of Fungi

A. Harmful Fungi

Several agricultural plants like sugar cane, maize, cereals, vegetables suffers from diseases caused by fungi.

1. *Puccinia graminis* (Wheat Rust)

It causes brown patches on leaf and stem of wheat. It decreases the yield of wheat and makes it unfit for human consumption.

2. *Rhizopus* or (Bread Mould) grows on bread (Fig. 2.13).

If the bread is exposed to warm and humid conditions a cottony mass develops in few days. This white cotton mass later develops a greyish black colour.

- The whitish network is called mycelium.
- The mycelium contains thread like structures called *hyphae*.
- The root-like sturctures growing out of the hyphae penetrate the bread, and secrete digestive enzymes (extracellular digestion) and absorb the digested food.
- Greyish black colour of the mould develops due to formation of sporangium which releases dark coloured spores. The spores scatter bywind and germinate after falling oil a suitable place. **This is asexual reproduction.**

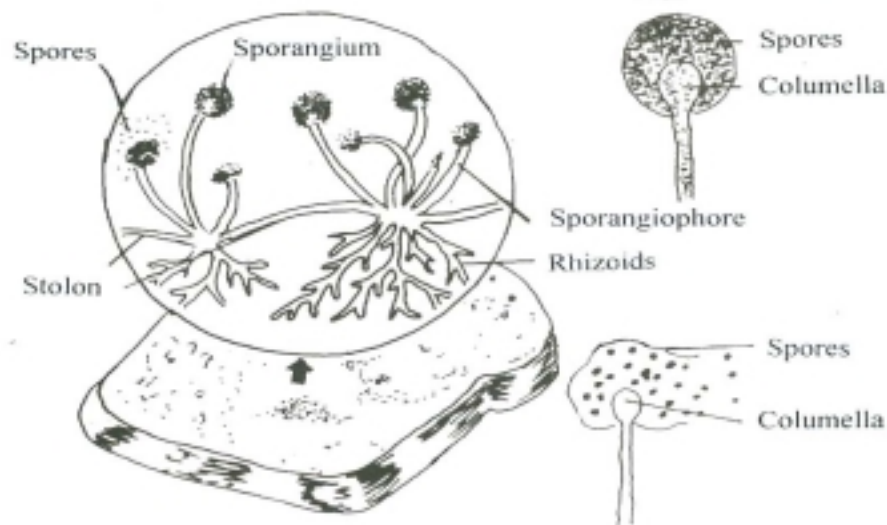


Fig. 2.13 Asexual reproduction in Rhizopus

Sexual reproduction (Fig. 2.14) takes place by conjugation between two neighbouring hyphae to produce a zygospore which after a period of rest produces a sporangium. When mature, the sporangium bursts to release spores which germinate on meeting favourable conditions and produce a new mycelium

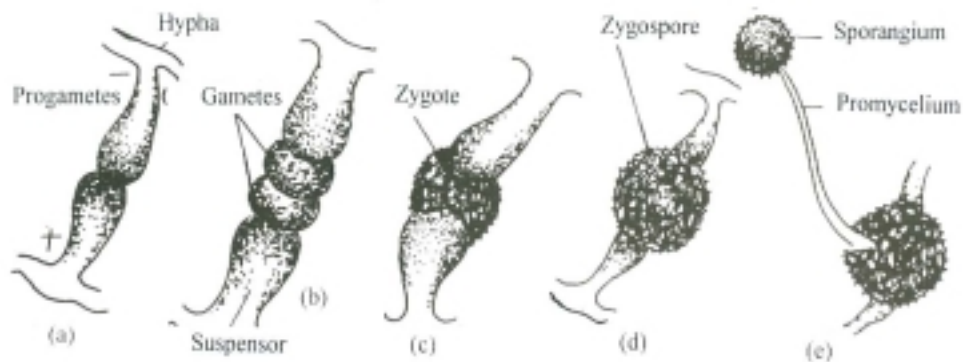


Fig. 2.14 Sexual reproduction in Rhizopus

3. In **human**, skin diseases like ringworm and athlete's foot are caused by fungi. Some ear infections are also caused by fungi.

B. Beneficial Fungi

- Certain Mushrooms (such as *Agaricus campestris*) are edible. Yeasts is used for fermentation during manufacture of bread, beer, soya sauce, cheese and wine.
- **Mycorrhizae** are fungi associated with roots of plants. Roots benefit in getting minerals from the environment while fungi gets food from the plant in return through such association.
- *Neurospora* has been a favourite experimental material in Genetics.
- Various antibiotics are derived from fungi. Penicillin is obtained from *Penicillium notatum* (Fig. 2.15). Its antibiotic effect was discovered by chance by Alexander Flemming in 1927.



Notes

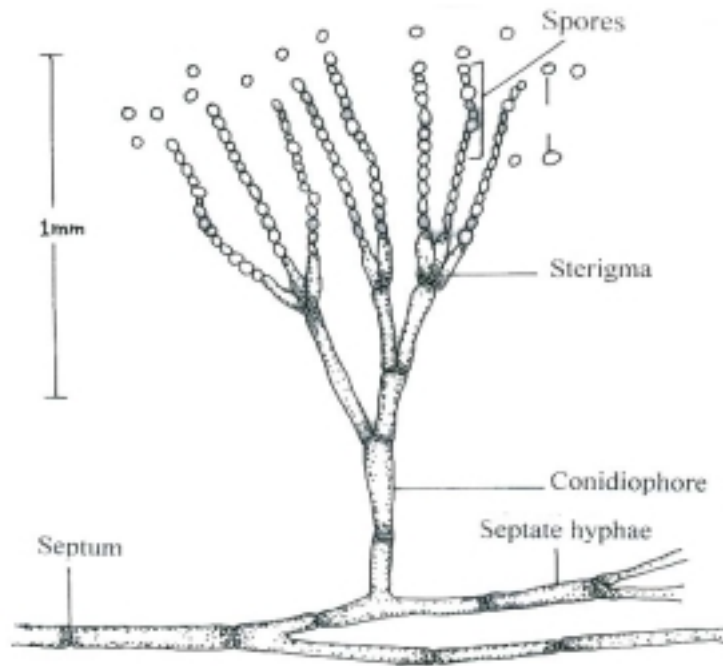


Fig. 2.15 Penicillium



INTEXT QUESTIONS 2.5

1. Name
 - (i) the fungus from which Penicillin is extracted
 - (ii) a unicellular fungus.
 - (iii) The fungus which cause wheat rust
 - (iv) The whitish cottony mass growing on stale bread.
 - (v) Two common human diseases caused by fungi

2. Who discovered antibiotic properties of Penicillium?

.....



WHAT YOU HAVE LEARNT

- Protocista includes protozoa, diatoms and other algae.
- They are unicellular eukaryotes and possess organelles like mitochondria, golgi, chloroplast, endoplasmic reticulum
- Protocists are autotrophic, saprotrophic or parasitic.
- Protozoans have cilia and flagella for movement.



Notes

- They reproduce asexually as well as sexually.
- Examples of protoctists are *Paramecium*, *Amoeba*, malarial parasite, *Chlorella*, *Euglena*, *Chlamydomonas*, *Spirogyra* etc.
- Some protozoa cause diseases. Algae provide food for fish, and are rich sources of some minerals and vitamins. Blue green algae fix atmospheric nitrogen. Walls of diatoms which have silica are used as filters and for lining furnaces.
- Diatoms form bulk of plankton and are food for many aquatic organisms.
- Prokaryotes lack true nucleus. Genetic material in Prokaryotes is in the form of single circular DNA.
- DNA is placed in special region in a bacterial cell called nucleoid. A small ring of extra DNA is present called plasmid.
- Bacteria exhibit four different kinds of nutrition - autotrophic, saprotrophic, symbiotic and parasitic.
- Cyanobacteria possess chlorophyll that helps in photosynthesis.
- Some bacteria fix atmospheric nitrogen to enrich soil, some help in sewage treatment.
- Certain bacteria cause diseases like cholera, typhoid, tetanus and tuberculosis, etc.
- There are bacteria that survive in extreme environments like these with high temperature, high salinity, and presence of methane.
- Fungi are eukaryotic, multicellular saprotrophs.
- Fungi are of several kinds such as yeasts, slime moulds, mushrooms, lichens and mycorrhizae.
- Yeasts are unicellular, which commonly reproduce asexually by budding. Sexual reproduction occurs by conjugation.
- Slime moulds are naked, creeping multinucleate mass of protoplasm.
- Lichens are symbiotic combinations of fungi and algae.
- *Rhizopus* is the common bread mould that produces whitish network (mycelium) on stale bread, in warm humid weather.
- *Rhizopus* reproduces asexually by spores, and sexually by producing zygospore which in turn produce spores.
- Wheat rust (*Puccinia graminis*) causes brown patches on leaf and stem of wheat.
- Ringworm and athlete's foot are two common fungal diseases of humans.
- Certain mushrooms are edible.
- Yeast is used in making bread, beer, etc.



TERMINAL QUESTIONS

1. Draw a labelled diagram of a typical bacterial cell.
2. List the different nutritional categories of bacteria and protocists.
3. Draw the labelled diagrams to show binary fission in bacteria.
4. How does amoeba normally reproduce ? Draw diagrams to represent the process.
5. Draw a labelled diagram of *Euglena*.
6. What are the common feature of diatoms which justify their inclusion in protocists?
7. Write a paragraph on economic importance of the protocists.
8. List any three characteristics of fungi.
9. What are mycorrhizae?
10. Name three harmful fungi mentioning their harmful effects.
11. Write a note on beneficial fungi.
12. Draw labelled diagrams of the following :
 - (i) A series of stages in the budding of yeast.
 - (ii) Magnified view of the bread mould growing on bread.



ANSWER TO INTEXT QUESTIONS

- 2.1**
1. DNA
 2. Nucleoid
 3. Peptidoglycan
 4. Flagella are thicker and longer than pili/used in movement, used in conjugation.
 5. Aerobic bacteria respire in presence of oxygen/the anaerobic bacteria respire in the absence of oxygen.
 6. A fragment of DNA strand.
- 2.2**
1. (i) *Azotobacter*
(ii) *Lactobacillus*



Notes

- (iii) *Mycobacterium tuberculosis*
- (iv) *Clostridium tetani*
- 2. Eight
- 3. Bacteria - smaller cells, flagella present, sexual reproduction by conjugation.
Cyanobacteria - large cells, no flagella, no, conjugation.
- 2.3**
 - 1. Protocista are Eukaryotes/ posses true nucleus.
 - 2. (i) *Entamoeba histolytica*
(ii) Malarial parasite or *Plasmodium*.
 - 3. Binary fission
 - 4. Mitochondria
 - 5. Contractile vacuole
 - 6. Flagellar, Pseudopodial or amoeboid (any two).
- 2.4**
 - 1. (i) mycelium
 - 2. asexually, sexually
 - 3. Refer diagram 2.12
 - 4. (i) Yeast
(ii) Slime moulds
(iii) Mushrooms and Toadstools
(iv) Lichens
- 2.5**
 - 1. (i) *Penicillium notatum*
(ii) Yeast
(iii) *Puccinia graminis*
(iv) mycelium, *Rhizopus*
(v) spores
(vi) Ringworm, Athlete's foot
 - 2. Alexander Flemming