UNIT: Life Under a Microscope

LIFE UNDER A MICROSCOPE

[THE MICRO-ORGANISMS]

9

SYLLABUS

1. What are microorganisms ?
2. Unicellular plants and animals — *Chlorella, Chlamydomonas, desmids, diatoms, yeasts.*
   Various types of bacteria.
   Amoeba, Paramoecium, Euglena.
3. Multicellular plants and animals :
   Filamentous algae — *Spirogyra;* Fungi — bread mould
   Colonial organisms — *Volvox*
4. Conditions for the growth of microorganisms
5. Useful microorganisms — e.g. fermentation, setting of curds, tanning of leather, retting of fibres, formation of compost and manure, biogas, *gobar gas etc.*
   Harmful microorganisms — disease causing viruses, bacteria, fungi, protozoa - only as examples — symptoms, vectors and spread need not be done.
   How to avoid infections and spoilage of food.

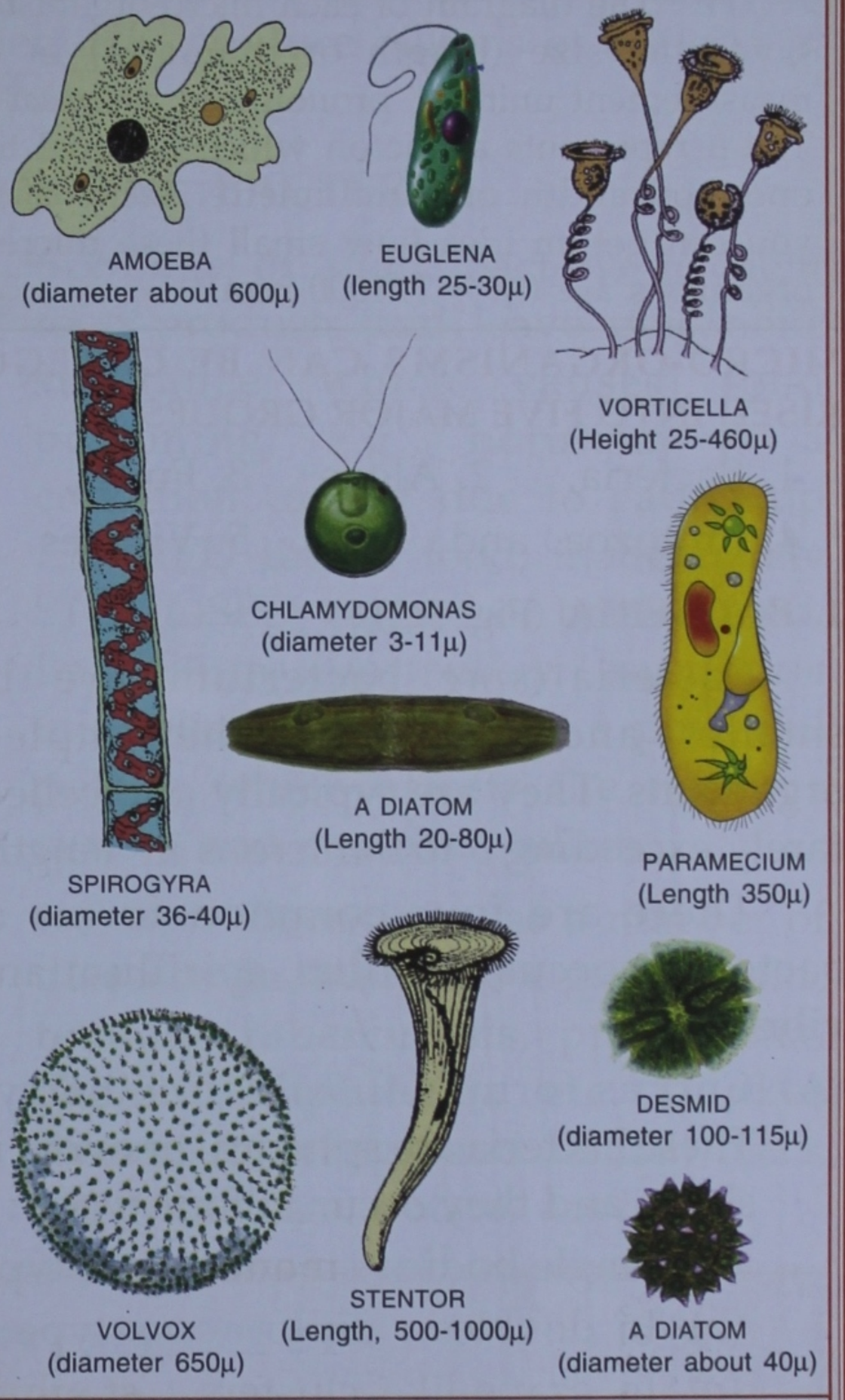
* Studying a drop of pond water under a microscope (D/E).
* Study of permanent slides of microorganisms — drawing the same (E).
* A simple experiment to determine conditions needed for the growth of mould on bread - need for a control to be discussed (E).
* Experiment to determine the conditions needed for the setting of curds (E).

Invention of the microscope opened up a vast world of tiny microscopic organisms that man was not able to see so far. The tiniest animals known to us up to that time were the insects like ants, lice or the fleas. One could at best distinguish their head and legs but, hardly anything inside their bodies. Similarly, the smallest plants, the humans knew in the earlier days were the green layer of mosses growing on the damp walls or on the stones, or the green thread-like algae floating on the pond, but they knew nothing of their internal structure. Today, we know about thousands and thousands of different kinds of living organisms visible only through a microscope (Fig. 9.1). For this reason, such organisms are categorised as **micro–organisms** (*micro :* small/minute, *organism :* living being). The branch of science which deals with the study of micro-organisms is called **microbiology**.

Fig. 9.1 A modern microscope

MICRO-ORGANISMS OCCUR EVERYWHERE

Micro-organisms occur everywhere in the world — from the Arctic to Antarctic and from the deep ocean bottoms to the high mountain tops. They are found in the air, in the soil, in water and even inside our own bodies. They may be found on all kinds of food stuffs, and more so in the decomposing food wastes. They are found on our body surface, inside our mouth and in the intestines, and far more numerous even in our faeces (stools). Certain micro–organisms are useful to us such as the ones used in making curd, vinegar, alcohol, bread, etc. Some micro–organisms are sources of medicines like the antibiotics. Some are natural inhabitants of our intestines and they are beneficial in producing some necessary vitamins. Many others are harmful, causing diseases like dysentery, malaria, tuberculosis, and so on. But there are as well quite many that are harmless living freely in waters or in soil contributing to the natural cycles of various elements.



Note : $\mu = \frac{1}{1000}$ th of a millimeter

ACTIVITY 1

Students can request the teacher to help them to prepare a fresh slide of a drop of pond water so that they can observe some microorganisms.

Materials required : Slide, coverslip and a microscope.

Procedure :

1. Collect some water in a small bottle from a near by pond.
2. Put one drop of this water on a slide and place a cover slip over it.
3. Wipe off excess water with a blotting paper, and examine the slide under the low and high powers of microscope.
4. You may find a variety of micro-organisms in it. It will show some actively swimming forms, some fixed to sand particles and some others just creeping slowly.
5. Try to identify them with the help of diagrams given above and draw these organisms in your record book.

NOTE : The diagram of each micro-organism gives the size (length or diameter) in a measurement unit "μ" pronounced as "*mew*". The μ represents a micron which is equal to one-thousandth of a millimetre. With this, you can get an idea how small these micro-organisms are (μ = 1/1000 mm).

MICRO-ORGANISMS CAN BE CATEGORISED INTO FIVE MAJOR GROUPS

1. Bacteria, 2. Algae 3. Fungi,
4. Protozoa, and 5. Viruses.

1. BACTERIA (Fig. 9.2)

Bacteria (*sing.* bacterium) are the smallest and structurally the simplest organisms. They are typically one-celled, rarely exceeding 3 to 5 microns in length.

There are four common forms of bacteria (coccus, bacillus, spirillum and vibrio).

(A) Coccus form (Gk. *kokkos* : a berry). These bacteria are spherical or ovoid in shape and they occur in four types :

(a) Single bodies : **monococcus** type
(b) In doubles : **diplococcus** type
(c) In grape-like clusters : **staphylococcus** type
(d) In strings : **streptococcus** type.

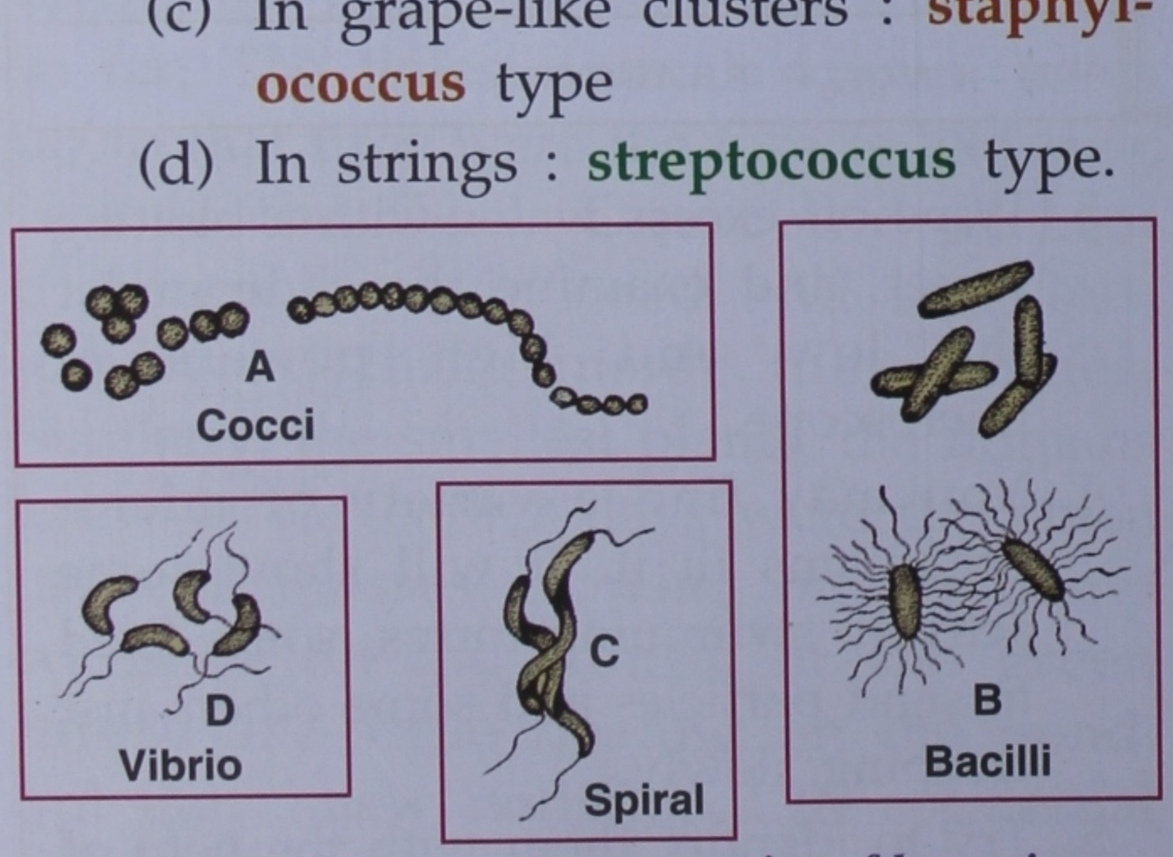


Fig. 9.2 Four major categaries of bacteria. A - Cocci (spherical) B - Bacilli (rod shaped), with or without flagella, C - Spiral, usually with flagella, D - Vibrio, slightly curved, with flagella

(B) Bacillus form (**bacillus** : rod). These are rod-shaped. These may also occur singly or in two's or three's, joined end to end in long chains.

(C) Spirillum form. These are spiral-shaped.

(D) Vibrio form. These are short, curved, appearing comma-shaped. Cholera bacteria (*Vibrio cholerae*) are of vibrio type.

Structure of a Bacterium Cell

A bacterium cell has most primitive nucleus not bound by nuclear membrane and has only chromatin material in the centre. Outermost cell wall is made up of largely protein-like material. The cell wall is surrounded by a gelatinous or proteinaceous **'capsule'**. Nucleolus, mitochondria and plastids are absent. Reserve food is 'glycogen' (Fig. 9.3).

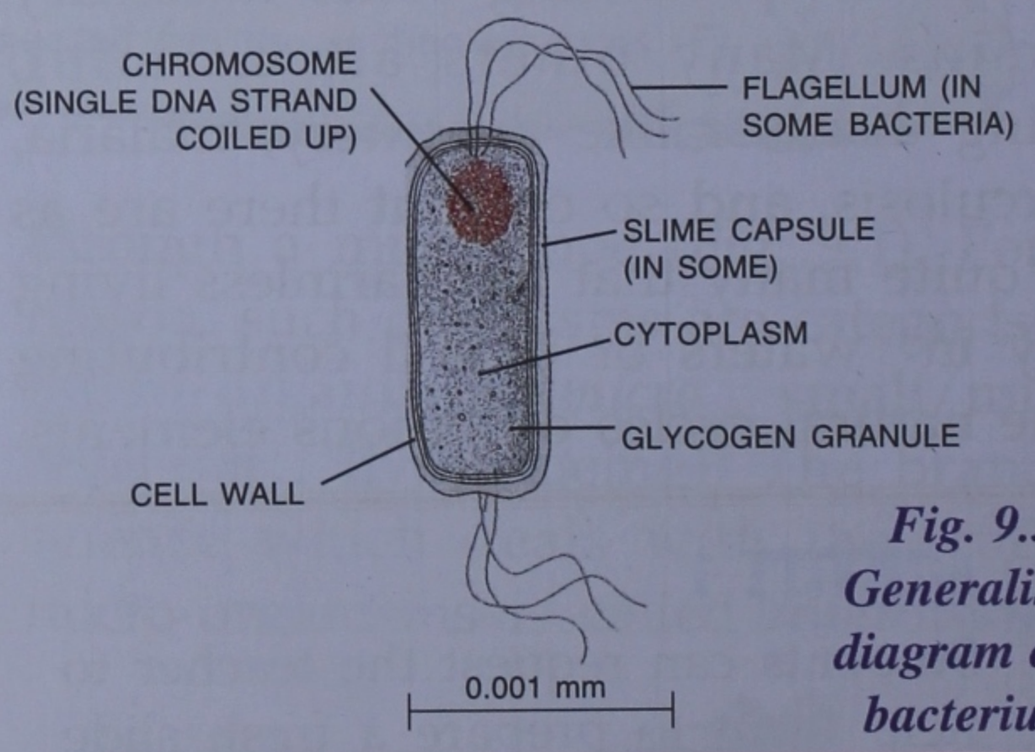
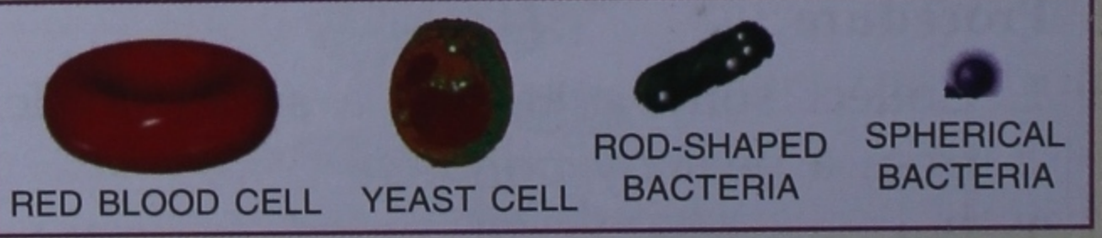


Fig. 9.3 Generalised diagram of a bacterium

How big are the bacteria ?

The sketches below compare the sizes of our red blood cell (extreme left), a yeast cell and two kinds of bacteria — a rod–shaped and a spherical (extreme right).



You know that red blood cells are microscopic, so compare its size with the bacteria given above.

Many bacteria possess one or more flagella that help them to move in liquid medium. Non-flagellated bacteria gets carried by wind, water and through contact.

Nutrition

Mostly, the bacteria lack chlorophyll and depend on other sources for their food.

Bacteria obtain their nutrition in three ways :

(i) Most bacteria draw nourishment from decaying dead animals and plants, these are categorized as **saprophytes** (*sapro* : rotten).

(ii) Many bacteria draw nourishment from the body of their hosts. These are called **parasites.**

(iii) Some bacteria live in association with other organisms obtaining nourishment from them without causing any harm, and may even provide some benefit. Such bacteria are termed **symbionts.**

Respiration

Some bacteria respire by absorbing **oxygen** (*aerobic* respiration), while others **without oxygen** (*anaerobic* respiration).

Reproduction

Bacteria reproduce very fast by asexual method or *binary fission* (dividing into two). A full grown bacterium, when conditions are favourable, divides into two daughter cells; on maturity after growth they divide and redivide further into a number of cells. The curd bacteria divide every 20 minutes or so, and can potentially produce billions of bacteria in 24 hours.

HARMFUL BACTERIA

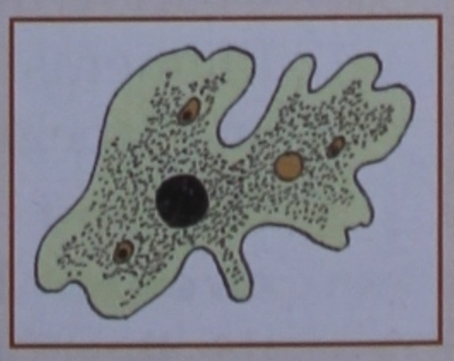
1. **Spoilage of food.** Bacteria ferment food products and leave poisonous substance which causes food poisoning, e.g., botulism is a condition caused due to eating up EXPIRED tinned food, inadequately STERILISED, canned or bottled food. Bacterium *Clostridium botulinum* multiplies and produces a powerful poison which affects the nervous system and causes botulism.
2. **Diseases.** Bacteria cause a number of diseases in humans, e.g., typhoid, tetanus, tuberculosis, pneumonia, cholera, diphtheria etc. Canker disease in orange and lemon, black rot in cabbage, potato, apple, etc.

ACTIVITY 2

Request your teacher to provide you with prepared slides of some micro-organisms. Fix the available slides one at a time, under the microscope. Focus under the microscope (your teacher will help in doing so). Make out the structures mentioned below under different examples.

1. Amoeba

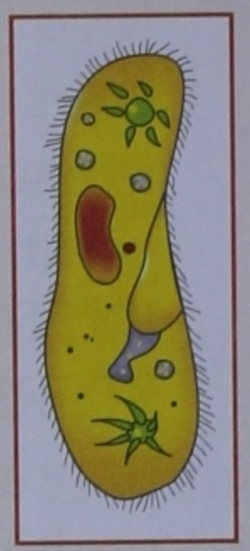
- Observe the irregularly shaped body, and locate the dark stained nucleus.



- Label the nucleus and pseudopodia.

2. **Paramecium**

- Observe the slipper-like shape of the organism.
- Locate one large-sized dark stained macro-nucleus, and another small, dot-like micro-nucleus
- Try to see the cilia all over the surface.
- Label macronucleus, micronucleus and cilia.



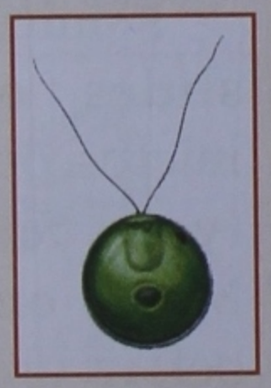
3. **Euglena**

- Note the somewhat elongated body.
- Locate the single dark nucleus. Label it.
- Do you see some darker oval structures (chloroplasts) distributed inside the body ? Label them.

- Do you see a single long flagellum. Yes/No. If yes, label it.

4. **Chlamydomonas**

- Note the somewhat globular body.
- Make out the somewhat U-shaped darker chloroplast and the nucleus and label these two structures.
- Try to see the two long flagella and label them.



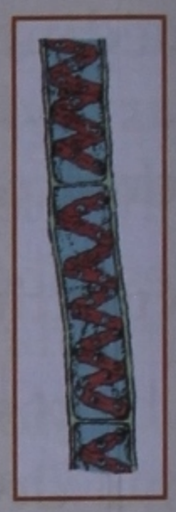
5. **Bread-mould**

- Observe the mass of filaments (hyphae) and label them.
- Do you see any swollen knobs at the tips ? Label them.

- Do you see any root-like processes? Label them.

6. **Spirogyra**

- Look at its filament. It consists of cells joined end to end.
- Draw the diagram, and label its chloroplast and nucleus.



2. ALGAE

You may have seen algae as a green layer on the surface of water in a pond. Algae (singular : alga) are aquatic plants found in ditches, ponds, streams, etc. They can prepare their own food (autotrophs) since they contain chlorphyll necessary for photosynthesis. Some types of algae may contain pigments of other colours. On the basis of the colour of their pigments, they can be classified as follows :

Green algae : They contain green pigment, the chlorophyll. They can be further grouped according to the nature of their body :

- Unicellular algae, for example *Chlorella, Chlamydomonas, Desmids, Diatoms,* etc.
- Multicellular algae, for example a filamentous algae — the *Spirogyra*.
- Colonial algae, for example *Volvox*.

Brown algae : They are mostly found in sea water and most of them are called sea-weeds. They contain a brown pigment alongwith chlorophyll. *Laminaria* and *Fucus* are good examples of brown algae.

Red algae : They are found in deep sea water. They contain a red pigment besides chlorophyll. *Chondrus* and *Kanten* are good examples of red algae. Few representative algae are briefly described below :

Chlorella

This is a small, spherical alga commonly found in stagnant fresh water. It contains a cup-shaped chloroplast and a central nucleus (Fig. 9.4). It is incapable of moving about. It usually keeps floating. It has been much used in scientific studies, specially on photosynthesis. It is a cheap source of high-grade protein and B-complex vitamins.

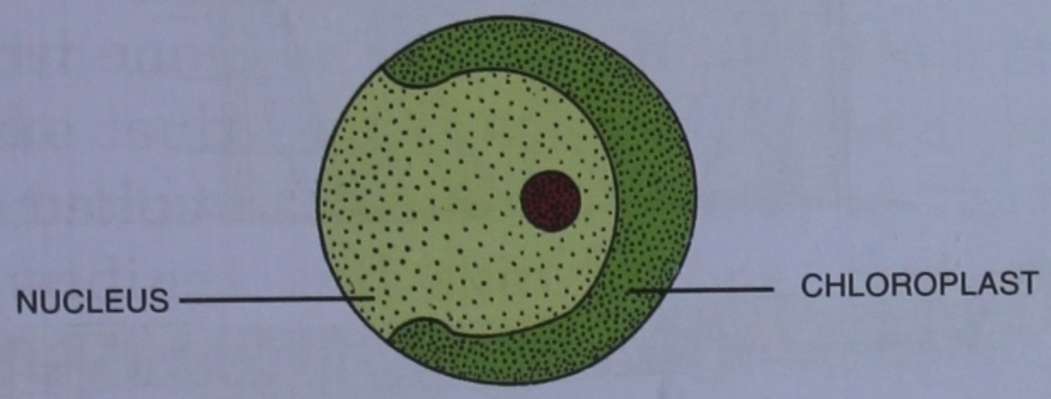


Fig. 9.4 Chlorella. A freshwater green alga

Chlamydomonas (Fig. 9.5)

Chlamydomonas (about 7-8 microns in diameter) is a very common alga found in standing water, soil, and even in swimming pools. Wherever the water appears green, it is sure, it contains *Chlamydomonas*.

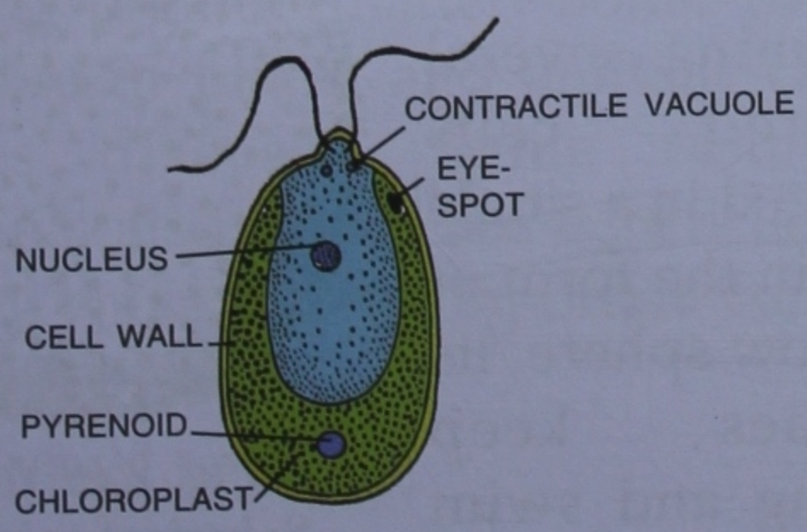


Fig. 9.5 Chlamydomonas. A freshwater alga

It consists of :

- A single cell which is spherical or somewhat egg shaped.
- There are two flagella (whip-like structures) at the front end, which help in swimming.
- Contains a single large cup-shaped chloroplast.
- A small roundish light coloured body (pyrenoid) lies embedded in the chloroplast. It stores starch.
- Nucleus is centrally placed.
- It has one eye-spot, sensitive to light.
- Two contractile vacuoles present near the front end to remove excretory wastes.

Desmids (Fig. 9.6)

These are tiny algae in a large variety of shapes. Many of these are very beautiful, one such form is shown here. Desmids are found floating in fresh water either singly or in groups. Most desmids possess :

- A deep median constriction dividing the cell into two halves — called semi-cells, joined by a middle part called **isthmus**.
- A single nucleus is contained in the middle constricted part.

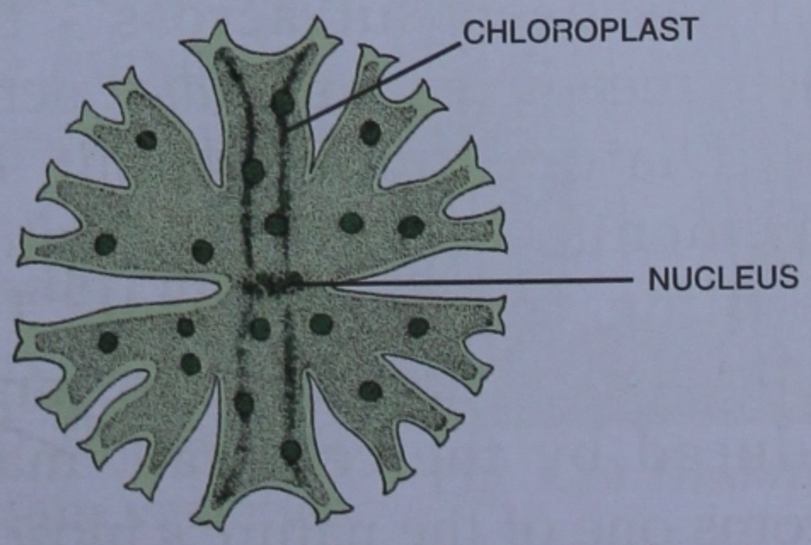


Fig. 9.6 A desmid Microsterias. Note the deep median constriction joining two halves of the cell, or semi-cells. Dark object in the centre is the nucleus

- Some rounded bodies may be the stored food.

Diatoms

Diatoms are a group of minute single-celled algae having a characteristic feature of a double shell of silica (glassy material). It is extensively used in making metal polish, toothpaste, porcelain, etc. The shell is compared with a soap-box or a pair of petri dish in which the cover fits the bottom portion. The figure (Fig. 9.7) given below shows a variety of shapes of diatoms. The figure (Fig. 9.8) gives the

Fig. 9.7 Various diatoms

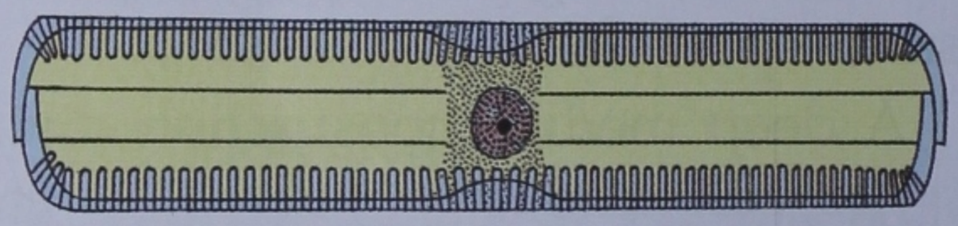


Fig. 9.8 One diatom cut in section to show two pieces fitting into each other

side view of one of the diatoms showing the overlapping halves, as if the complete shell has been cut across - the word diatom means the same (*dia* : across, *tome*: cut). Diatoms move about by jerky movements caused by cytoplasmic streaming inside the cell. The shell usually bears tiny dot-like impressions produced by the cell wall, making the diatoms one of the nature's most beautiful creations. Diatoms have been called "**Jewels of the plant world**".

Spirogyra (Fig. 9.9)

Spirogyra, is a common green algae forming the scum on the surface of stagnant water of ponds and streams. The cells are joined end to end forming a filament. The cells are all alike. Each cell is several times as long as it is thick. It contains one or more spiral chloroplasts (hence the name **Spirogyra**) which contain chlorophyll for photosynthesis. A single nucleus is suspended in the centre. It reproduces asexually by cell division, as well as sexually by, exchange of gametes between the two filaments that join in a bladder-like arrangement, by conjugating tubes.

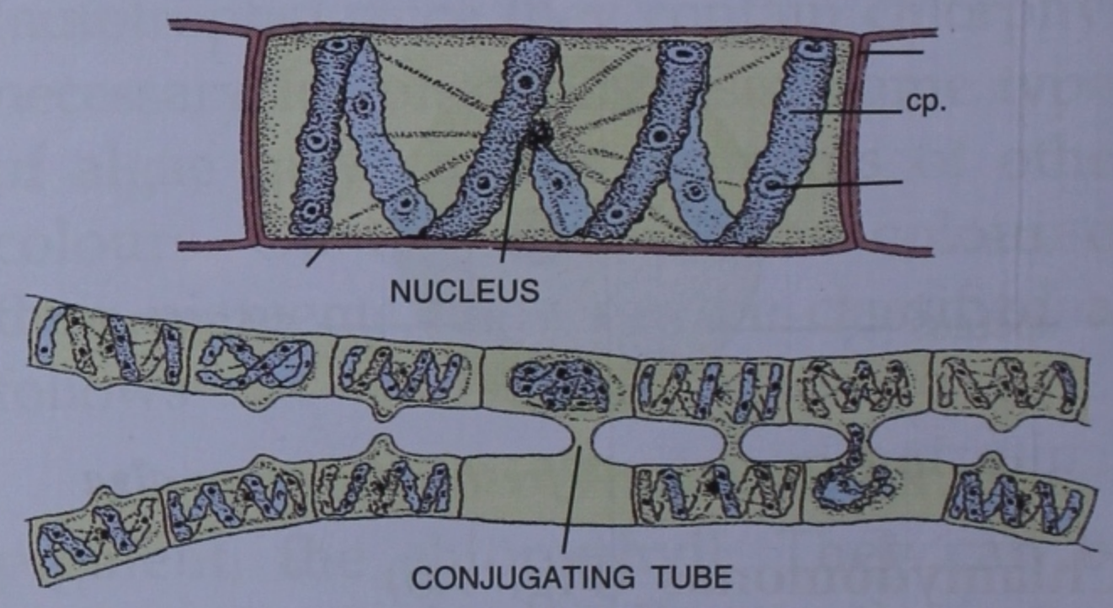


Fig. 9.9 Spirogyra. (Upper) A single cell of the filament; (Lower) Two filaments during conjugation (sexual reproduction)

Volvox (Fig. 9.10)

Volvox is a spherical colony containing several hundred cells arranged in a single layer in the form of a hollow sphere. Its colonies keep floating and swim in stagnant waters

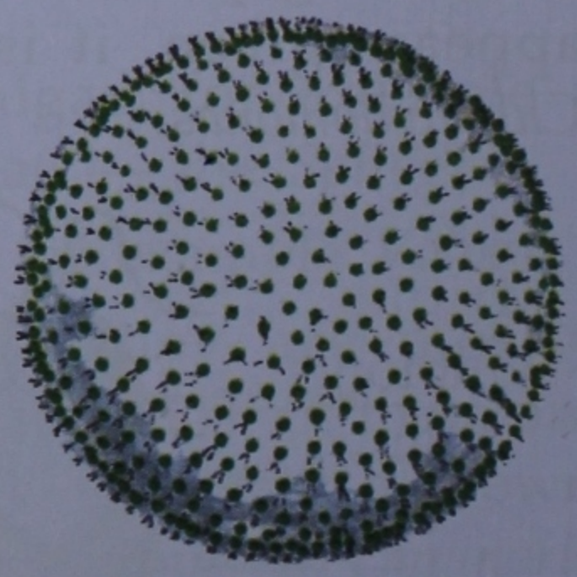


Fig. 9.10 Volvox. Spherical colony with hundred of cells

of ponds, ditches, etc. Most of its cells have flagella and they produce food by photosynthesis, they have chloroplasts, some cells are specialised to reproduce sexually or asexually.

Fucus : It is commonly known as rock weed growing in shallow sea water.

Laminaria : It is also known as *kelp*. Kelp is one of the largest marine plants growing upto the length of about 60 metres. It is a rich source of iodine and iron, and as it is used as a food for the livestock and also as an excellent fertilizer for the soil. Kelp also contain a substance called *algin* which is used in preparing icecream.

Chondrus : It is commonly called Irish moss or red alga. It contains a jelly-like substance which is used as a substitute for animal gelatin to thicken puddings and skin lotions. Red algae also provide *agar* which is used for culturing bacteria in labs.

3. FUNGI

Fungi (singular : fungus) are plant-like because their cells have a cell-wall. But since they do not have chlorophyll as such they can not prepare their own food. Fungi may be unicellular, multicellular or filamentous. Fungi mostly live on dead decaying organic matter. Some parasitic fungi live in plants and animals causing various diseases. Some fungi are symbionts also. Fungi are beneficial to us in many ways. A few important fungi are described below :

Bread Mould

Bread mould is multicellular and shows a mass of threads (hyphae) collectively called **'mycelium'**. The hyphae have outer cell wall made up of cellulose, an erect hypha called 'sporangiophore' which has spores inside it for reproduction. They have root-like structures, which are thinner hyphae called **'rhizoids'** (*rhizo*: root) (Fig. 9.11). Moulds respire in the presence of oxygen (aerobically), that is why they grow on top layer of the bread, and not in the lower layer.

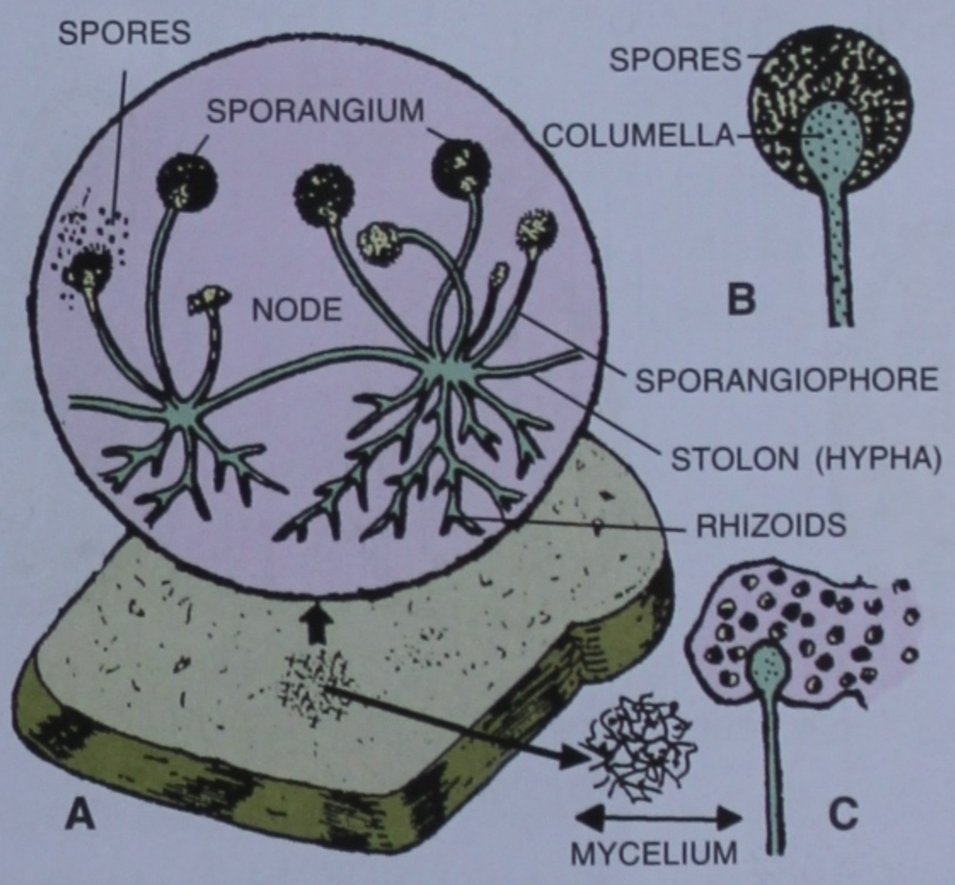


Fig. 9.11 A - Bread mould growing on bread, B - Structure of a mature sporangium, C - A sporangium bursting to release spores

Mushroom (Fig. 9.12)

Fig. 9.12 Mushroom

Mushrooms also belong to Fungi, but strictly speaking we cannot categorise them under micro-organisms. They are visible to the naked eyes. Certain varieties of mushrooms are edible, while some others like the toadstools are poisonous.

Yeast (Fig. 9.13)

Yeast is a unicellular fungus found in the air. It readily grows in sugar solutions, fruit juices, e.g., ripened palm fruit. When it is left out in warm weather for a few hours, fermentation takes place by the activity of yeast.

Structure

Yeast cell is ovoid in shape, has a distinct cell wall, a nucleus with a nucleolus and a few vacuoles in the cytoplasm. It has glycogen and oil globules (Fig. 9.13).

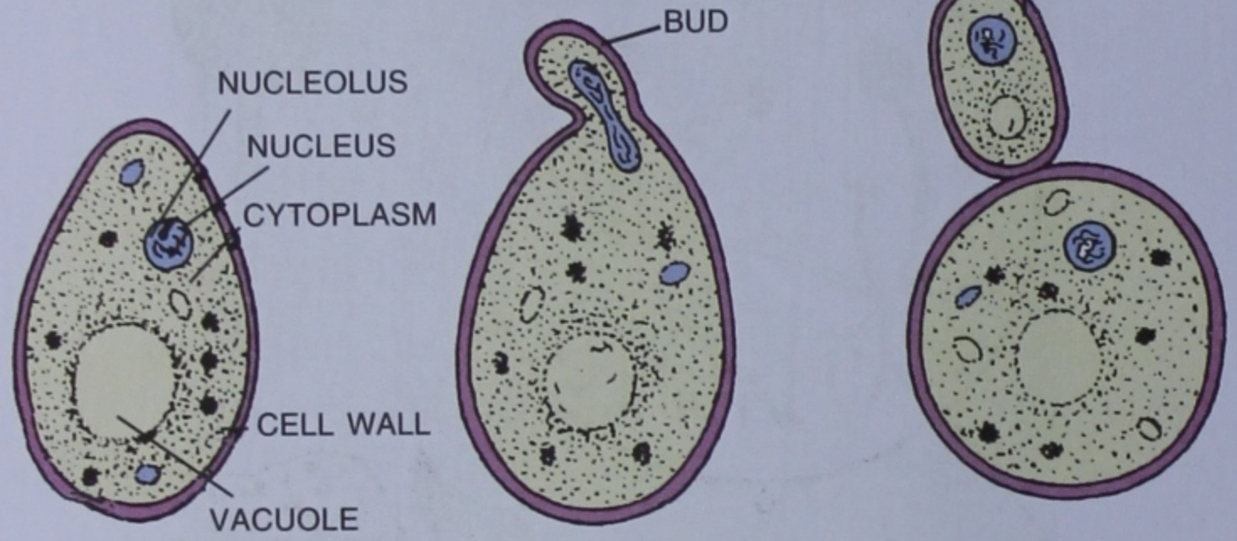


Fig. 9.13 Yeast cell and how it reproduces by budding

Yeast carries out its nutrition by giving out certain enzymes which digest sugary/starchy material to break it into glucose. Yeast absorbs this glucose and breaks it down during anaerobic respiration as follows :

$$C_6H_{12}O_6 \rightarrow 2\ C_2H_5OH + 2\ CO_2 + 2ATP$$

Glucose — Ethanol — Carbon dioxide — Energy

Ethanol and carbon dioxide are released in this process. The carbon dioxide gas gives the frothiness to the medium.

Economic Importance of Yeast

1. In breweries, yeast is used for alcoholic preparations from the fruit juices.
2. In bakeries, yeast is used to raise the bread. Carbon dioxide produced by yeast gets trapped on baking; gas leaves the dough and makes the bread spongy.
3. Yeast also produces vitamin B_2 (riboflavin).

4. PROTOZOA

Protozoans are unicellalar micro-organism. Most of the protozoans are free-living found in soil, fresh water or sea water but some live as saprophytes or parasites. Some free-living protozoans have been described here.

Amoeba

Amoeba is found in standing waters such as ponds, ditches, etc., sticking to the vegetation. It is irregular, constantly changing its shape. It moves by pseudopodia (false feet) extending them in one direction and withdrawing them from the other. Using, the same pseudopodia it engulfs its food. The nucleus is very prominent. A contractile vacuole throws out excretory wastes including excess water that enters the body. Amoeba reproduces by binary fission (splitting into two).

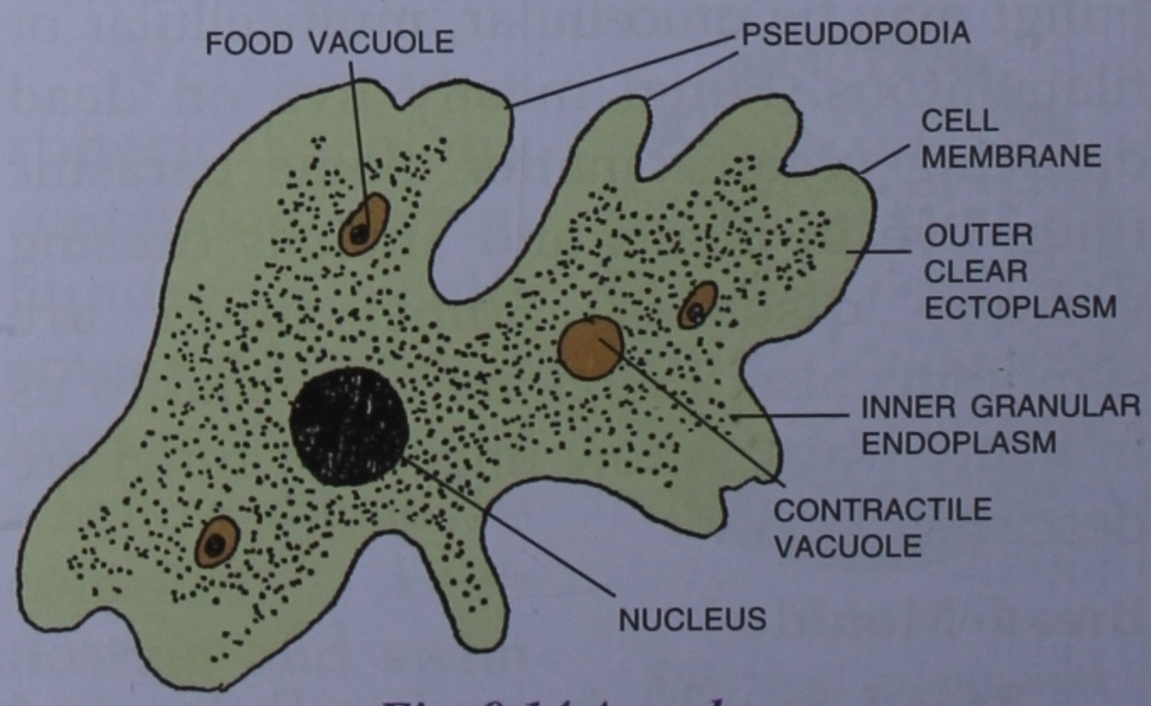


Fig. 9.14 Amoeba

Paramecium

Paramecium is commonly found in standing water in ponds and ditches. You have learnt about its movement in chapter 3. Paramecium has a fixed shape — slipper-like. It has cilia all over the body. It has two nuclei — one larger macronucleus and the other smaller micronucleus. It has two contractile vacuoles (Fig. 9.15). It reproduces by dividing into two (binary fission), as well as shows a very primitive type of sexual reproduction in which two parmamecia come together and exchange some of their nuclear material.

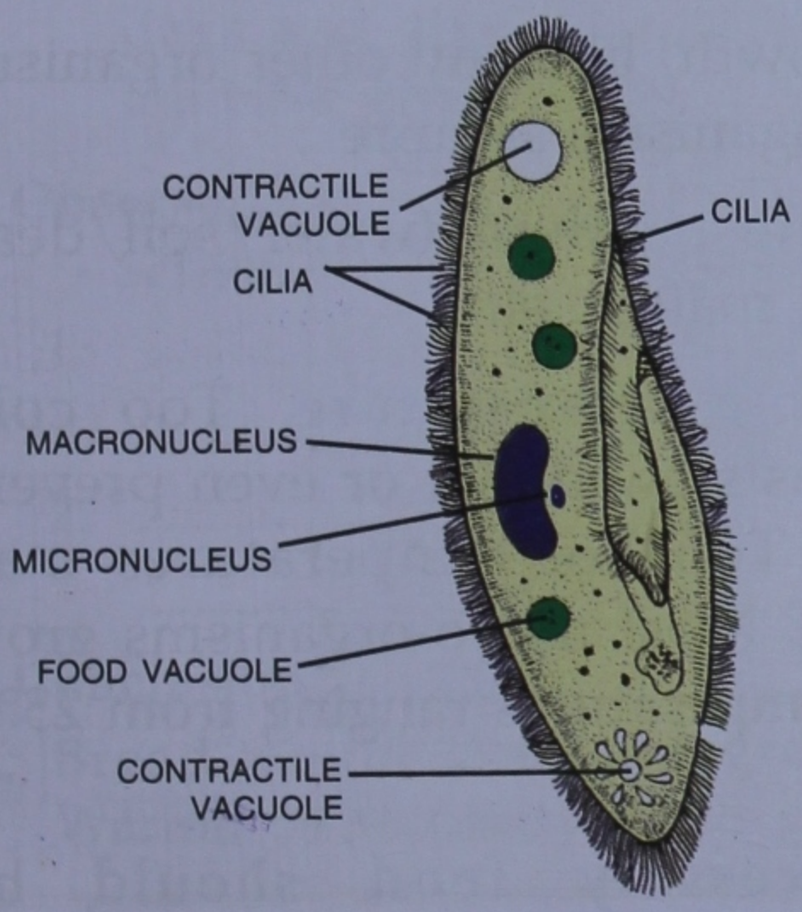


Fig. 9.15 Paramecium

Euglena

Euglena is found in ponds, ditches, etc., with a lot of vegetation. It has a spindle–shaped body (Fig. 9.16). A whip-like flagellum arising from the front blunt end provides sharp swimming. One most characteristic feature of Euglena is the presence of **chloroplasts** which carry out photosynthesis and for this reason it has been even grouped

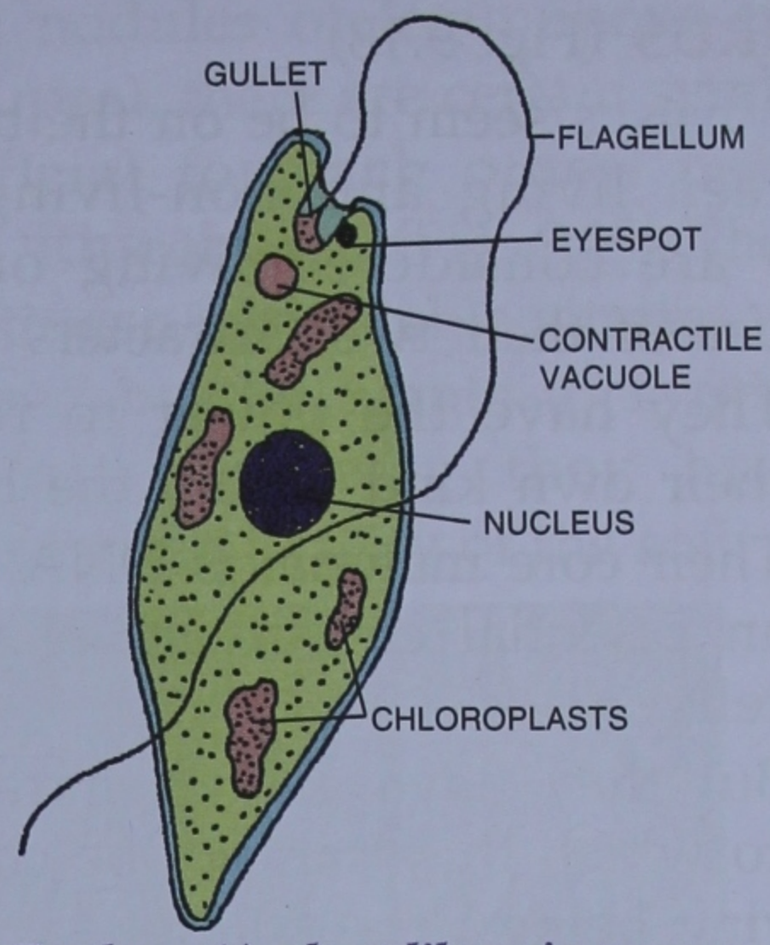


Fig. 9.16 Euglena (A plant like micro-organism)

under plants. It usually reproduces by longitudinal binary fission.

Euglena at times also shows saprophytic nutrition. While living in darkness for a long time, it loses its chlorophyll and starts feeding on decaying organic matter dissolved in the water in which it is living.

Saprophytic protozoans help in cleaning the environment by decomposing organic matter in the water. There are some disease causing protozoans (Fig. 9.17) also, like

1. Entamoeba causing amoebic dysentry.
2. Trypanosoma causing sleeping sickness.
3. Plasmodium causing malarial fever.
4. Giardia causing diarrhoea.

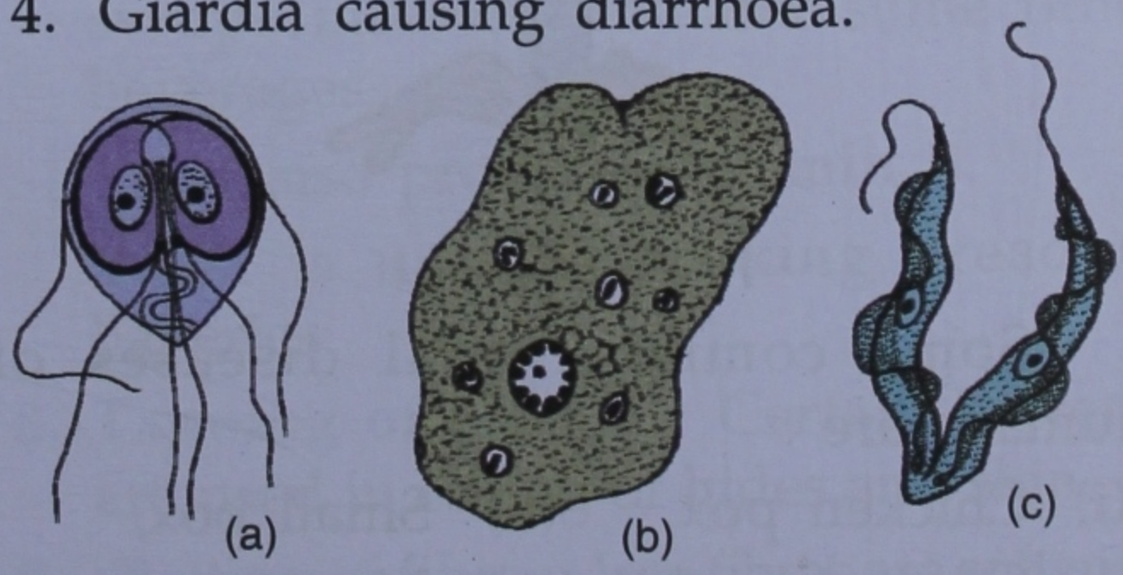


Fig. 9.17 Some harmful protozoans : (a) Giardia, (b) Entamoeba and (c) Trypanosoma

5. VIRUS (Fig. 9.18)

Viruses seem to be on the borderline between living and non-living things. They are considered living organisms because of their two characters :

1. They have the power to reproduce their own kind within the host cell.
2. Their core material is DNA, which is an essential constituent of all living cells.

But they have a few characteristics due to which they can not be considered as living beings, for example :

1. They lack a cellular structure.
2. They can be crystallised and stored in containers for a long period.

The term "virus" usually refers to those particles which infect both unicellular as well as multicellular organisms.

Viruses have a very simple structure. They have just a core of DNA surrounded by a sheath of protein. There is no cytoplasm, nucleus or cell membrane (Fig. 9.18). They multiply and grow only in living cells. The virsuses which infect bacteria are called "bacteriophage".

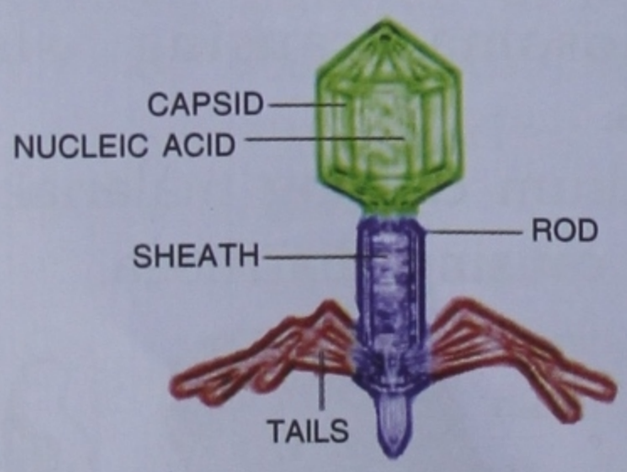


Fig. 9.18 A virus

Some common viral diseases of humans are :

(i) Chicken pox, (ii) Small pox,
(iii) Common cold, (iv) Mumps,
(v) Measles, (vi) AIDS.

CONDITIONS FOR GROWTH OF MICRO-ORGANISMS

There are so many different kinds of micro-organisms. Many of them live in fresh water, many in salt water, many of them are parasites living inside other organisms, many of them are saprophytes living in rotting and decomposing organic matter, etc. The free living micro-organisms that are plant-like having chlorophyll, produce their own food and, in turn, they are eaten up by other organisms, such micro-organisms form an important starting point in food chain, others feed on food available in the environment.

For growth, like any other organism, the micro-oganisms require :

- A **suitable medium** (water/soil/dead decaying matter, etc.).
- A **suitable temperature.** Too cold conditions slow down or even prevent growth. Too hot temperatures may kill them. Most micro-organisms grow best at temperatures ranging from 25°C to 35°C.
- The **necessary food** should be available, and for the photosynthetic micro-organisms, **ample sunlight** is required.
- **Moisture.** Non-aquatic micro-organisms also require moisture to grow. For example, moulds grow in warm and **humid weather**.
- **Suitable medium.** Too much acidic, alkaline or thick sugary or salty medium does not permit the growth of micro-organisms.

ACTIVITY 3

- Take a bread piece, moisten it with some water, keep it in a petridish, and put a glass cover over it so as to avoid evaporation of water. This is set up 'A'.
- Keep the set-up 'A' in the lab at room temperature.
- Take another bread piece, moisten this also with some water, put it on a petri dish and cover it with a glass plate. This is set-up 'B'.
- Keep the set up 'B' in a refrigerator. This set-up acts as a control.
- Examine the two set-ups after 3–4 days and give your observations in the table given below.

Observations :

Set-up A	*Set-up B*
1.	1. .....
.....	.....
2.	2. .....
.....	.....

Conclusion :

Bread-mould does not grow in cold. Warmth is necessary for its growth.

USEFUL MICRO-ORGANISMS

A large number of micro-organisms are useful to us in many ways :

1. Certain bacteria which are saprophytic, feed on dead organic remains, they act like scavengers, help in converting complex food material into agriculturally useful nutrients like nitrates, sulphates and phosphates. This way they increase the soil fertility, e.g., Nitrifying bacteria.
2. In the nodules of leguminous plants (gram, pea), there are certain symbiotic (beneficial for each other) bacteria called **'Rhizobium'** (Fig. 9.19) They fix soil nitrogen into soluble nitrates which are used by the plants to synthesise proteins. This way they help in increasing the fertility of the soil.

Fig. 9.19 Roots of leguminous plants show root nodules

3. **Escherichia coli** (*E. coli*) is the most normal bacterium found in human intestine. It helps in the production of vitamin **'B'**.
4. Bacteria found in the intestines of cows, horses, etc., help in the digestion of cellulose.
5. **Lactobacillus bacteria** is used in the formation of curd from milk. It converts the milk sugar (lactose) into lactic acid, giving the sour taste to the curd.
6. Certain bacteria ferment fruit juices into vinegar (acetic acid) and wine.
7. Yeast is used in fermenting sugary syrups into **alcohol** and some other beverages.

   Yeast also produces **vitamin B.**

   Yeast is used in making bread in bakeries.
8. **Tanning of leather :** Certain bacteria are used in curing of hides and skin.
9. **Retting of fibres :** Jute fibres are softened and separated by the use of bacteria.

ACTIVITY 4

- Take three bowls, label them 'A', 'B' and 'C'.
- Pour some luke warm milk in bowl 'A', *add a spoonful curd* (starter) in it and stir it well. Put a suitable cover over it, and keep it in the lab *at room temperature*.
- Similarly, take bowl 'B', pour luke warm milk in it, *add starter*, cover it, and put it in a *refrigerator*.
- In the same way, take bowl 'C', pour lukewarm milk in it, but **do not add any starter**. Keep this bowl in the lab *at room temperature*.
- Leave all the three bowls for 4–5 hours. Open each bowl and give your observations in the table given below.

Observations :

Samples	Observations	Inference
1. Bowl 'A' (milk, starter and warmth)	.....	.....
	.....	.....
2. Bowl 'B' (milk, starter but no warmth, since it was kept in a refrigerator)	.....	.....
	.....	.....
3. Bowl 'C' (milk, warmth but no starter)	.....	.....
	.....	.....

Conclusion :

The curdling of milk needs a starter (curd — which has a bacterium, *Lactobacillus*), in it and warmth. *Lactobacillus* multiplies rapidly at room temperature and makes the milk thicker.

10. Formation of compost and manure : Cow dung, horse dung and agricultural wastes are subjected to bacterial action which causes their decay and produce very useful manure.

11. Certain **antibiotic medicines** such as streptomycin, chloromycin etc., are produced by using bacteria.

12. Biogas and "gobar gas" : There are sewage plants in big cities (Delhi has one such unit) where the collected human excreta is decomposed by sewage bacteria. The inflammable gas produced in the process is collected for cooking, and the liquid and solid products are used as manure.

The "*gobar*" gas or better called **Biogas** plants are also designed on the same principle. Fermenting bacteria degrade cellulose of the cow dung and release inflammable gases mainly consisting of methane. The practice of installing biogas plants is serving a dual purpose (i) supply of fuel and (ii) supply of rich manure.

13. *Chlorella* (a green alga) is rich in proteins and Vitamin A, B and C is eaten as food in certain parts.

You have studied that extracts of *laminaria* are used commercially. **Algin** obtained from this brown algae is used in the preparation of ice cream. **Agar**, obtained from *Chondrus* and used in laboratory to grow plants (micro-propagation), is a gelatinous substance.

Diatoms are used in making glasses and porcelain because they are made up of silica and calcium.

PREVENTION OF INFECTIONS

Micro-organisms are found everywhere — in the air we breathe, in the food we eat, on the clothes we wear, and so on. So, we should be very careful in our daily life to protect ourselves from coming in contact with these micro-organisms and

avoid infections. For this, we must take care of the following :

- Keep our surroundings clean. Avoid throwing garbage in the open as these are the breeding grounds of micro-organisms.
- Water should not be allowed to stagnate in the neighbourhood as mosquitoes breed in stagnant water.
- Eatables should be keept properly covered.
- Keep your hands and fingers clean by washing them properly before eating and handling food.
- Keep your mouth and nose covered with handkerchief while sneezing and coughing.
- Always get yourself vaccinated against infectious diseases.
- Avoid direct or indirect contact with a patient suffering from an infectious disease.

PREVENTION OF SPOILAGE OF FOOD

We should take the following steps to protect our food from being spoiled by micro-organisms :

1. Food stuff should be protected from spoilage by bacteria by keeping it at low temperature (in the refrigerator) or at high temperature (sterilisation). Cooking food to 100°C kills bacteria cells and not its spores (resting stage). Spores can be killed at higher temperature under pressure (as in the pressure cookers).

2. **Pasteurisation.** It is done by heating the milk at 60°C for 30 minutes, followed by sudden chilling. Most disease producing bacteria in the milk get killed by this process.

3. **Dehydration.** Presence of moisture promotes bacterial growth in food grains, vegetables, meat, etc. Chemicals, salt, sugar etc., in their strong concentration dehydrates the bacteria and fungi by drawing out water from them. Eatable can be stored by dehydration.

4. **Ultraviolet radiations** found in sunlight, sterilise the air of the open area in the schools, hospitals, factories and homes. Radioactive radiations sterilise food stuff.

5. **Certain chemicals** like the food preservatives in jams and pickles kill the micro-organisms.

REVIEW QUESTIONS

MULTIPLE CHOICE QUESTIONS

1. Choose the correct option :

(i) Which of the following is **not** a unicellular organism ?
(a) Chlorella (b) Amoeba (c) Volvox (d) Euglena

(ii) Which one of the following contains chlorophyll ?
(a) Spirogyra (b) Yeast (c) Lactobacillus (d) Paramecium

(iii) Which one of the following is used in breweries for preparing alcohol ?
(a) Volvox (b) Desmids (c) Yeast (d) Chlorella

(iv) Some bacteria live in association with other organisms obtaining nourishment from them but do not cause any harm to them. What do you call such bacteria ?
(a) Parasites (b) Saprophytes (c) Scavengers (d) Symbionts

(v) Which of the following is found living in the root-nodules of leguminous plants ?
(a) Escherichia (b) Chlamydomonas (c) Rhizobium (d) Desmids

(vi) Which one of the following causes food-poisoning (botulism) in tinned food ?
(a) Clostridium (b) Escherichia (c) Diatom (d) Chlorella

(vii) Most micro-organisms grow best in a temperature range of :
(a) 0°-10°C (b) 10°-25°C (c) 25°-35°C (d) 35°-45°C

(viii) Retting of jute fibres is done by :
(a) Bacteria (b) Yeast (c) Protozoa (d) Fungi

(ix) Which of the following is used in the preparation of ice-creams ?
(a) Chlorella (b) Laminaria (c) Rhizopus (d) Clostridium

(x) Which one of the following are used in making porcelain ?
(a) Desmids (b) Diatoms (c) Yeast (d) Volvox

SHORT ANSWER QUESTIONS

1. Differentiate between the following :
(i) Saprophytes and parasites _____
(ii) Yeast and mushroom. _____

2. Name the following :
(i) A vitamin obtained from yeast. _____
(ii) An antibiotic obtained from mould. _____
(iii) A fungal disease. _____
(iv) A disease caused by yeast in plants. _____
(v) A bacterium in chain form. _____

3. Fill in the blanks :
(i) Toadstool is ..... mushroom.
(ii) ..... is an allergy disease caused by bacteria.
(iii) ..... bacteria converts free nitrogen into soluble nitrates.
(iv) ..... is a skin disease caused by bacteria.

4. Write *True* or *False* and write the false statements in correct form :
(i) Bacteria are found everywhere in the form of spores.
_____ _____
(ii) Yeasts have a slimy capsule.
_____ _____
(iii) Bacteria help in the digestion of cellulose in humans.
_____ _____
(iv) **E. coli** is a useful bacterium normally found in rivers.
_____ _____
(v) Certain bacteria are found in the nodules of leguminous plants.
_____ _____

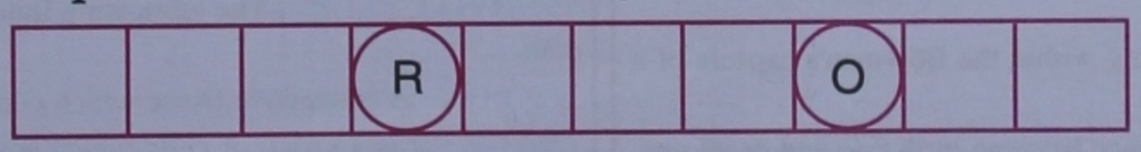
5. Match the items given under column I with those given under column II :

(i) Protozoa	(a) Typhoid
(ii) Bacteria	(b) Agar
(iii) Fungus	(c) Ringworm
(iv) Virus	(d) Diarrhoea
(v) Algae	(e) Polio

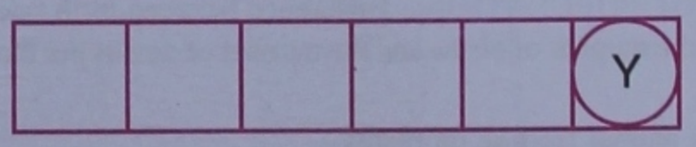
LONG ANSWER QUESTIONS (Write the answers in your note-book)

1. Bacteria are the simplest organisms. Give reasons.
2. How do fungi obtain their nourishment ?
3. On the basis of nutrition, how many types of bacteria are there ?
4. In what forms the fungi are present in the environment ?
5. Briefly describe the structure of bacteria and yeast cell.
6. Write down the usefulness of bacteria.
7. How are fungi harmful to us ?
8. Name the various ways to protect food from bacterial decay.
9. Give reasons :
   (i) It is difficult to set curd in winters.
   (ii) Your mother dries the cut pieces of unripe mango before preparing pickle.
   (iii) Food-stuff is kept in the refrigerator to prevent their spoilage.
   (iv) Surgical instruments are boiled in water before using them again for an operation.
   (v) 'Gobar gas' is of great utility for people living in villages.
   (vi) Leguminous plants are benefitted by having 'Rhizobium' bacteria in their roots.
10. Briefly answer these questions :
    (i) How do bacteria obtain their nourishment ?
    (ii) List the conditions which facilitate growth of bacteria.
    (iii) List any *five* ways in which algae are useful to us.
    (iv) How do bacteria help in maintaining fertility of the soil.
    (v) What are micro-organisms ?
11. Fill in the right alphabets in the blank spaces for the respective names asked in the following five statements [one or two encircled letters have already been given in each to help you].

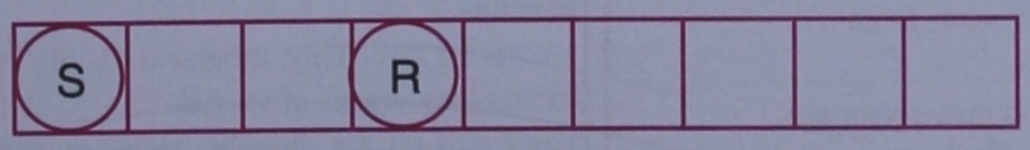
    (i) The instrument required to view microorganisms :

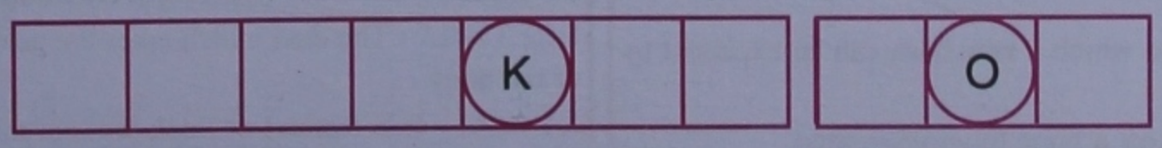
    (ii) Amoeba reproduces by .... fission.

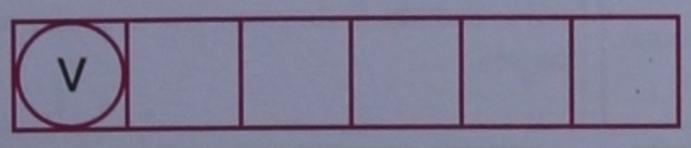
    (iii) Name the alga much used in scientific studies, specially on photosynthesis:

    (iv) Two word name of one of the human viral diseases.

    (v) A colonial alga.

GLOSSARY

AEROBIC : Complete breakdown of glucose with the help of oxygen.

AEROBIC RESPIRATION : Respiration in which oxygen is used for the complete oxidation of glucose with the formation of CO2, water and good amount of energy.

AFORESTATION : Planting more trees.

ANAEROBIC : Incomplete breakdown of glucose and release less energy in absence of oxygen.

ANAEROBIC RESPIRATION : Respiration in the absence of oxygen, is the incomplete break-down of glucose into ethanol and CO2, and releases only small quantities of energy.

ANTAGONISTIC : Opposite in the function.

ASSIMILATION : Utilisation of the digested and absorbed nutrients by the body.

AUTOTROPHS : All green plants which are capable of preparing their own food with the help of CO2 and H2O, in the presence of sunlight.

BALANCED DIET : A diet supplying all the nutrients in the right quantity according to the needs of the body.

BIRTH-RATE : The number of live births per 1000 people of population per year

CARNIVORE : An animal feeding on other animals.

CILIA : Tiny, delicate, hair-like outgrowths over the entire body of Paramecium for swimming.

COLLENCHYMA : It is made up of parenchymatous cells which are elongated and are thick at the corners.

COMMUNITY : It is the population of different species found in a particular place.

CONNECTIVE TISSUE : It connects various other tissues and organs, providing support to different organs to keep them in proper position.

CORTEX : The dark coloured outer area of the kidney.

CYTOPLASM : Semi-liquid, colourless and transluscent fluid filled in the entire cell.

DEATH-RATE : Number of deaths per 1000 of population per year.

DEFICIENCY DISEASE : A disease caused due to insufficient or more nutrients in the diet.

DEFORESTATION : Cutting down of forests.

DEMOGRAPHY : Statistical study of human population.

DIGESTION : Breaking down of complex food substances into simpler, absorbable substances with the help of enzymes.

ECOSYSTEM : It is the interaction between the biotic community with physical or non-living environment in an area.

EGESTION : Removal of the undigested food from the body.

EPITHELIAL TISSUE : It is a thin protective layer of cells, which covers the surface of the body and forms the lining of various body cavities and internal organs.

EXCRETION : Removal of harmful or unwanted substances (waste products) from the body.

EXPIRATION : Expelling air out of the lungs.

FERMENTATION : Process by which Yeast converts sugary solution into ethanol and carbon dioxide with the help of enzymes.

FLAGELLUM : Long, thread-like structure that, extends out through the anterior as in Euglena, for swimming.

GLOMERULUS : Mass of blood capillaries lying within the Bowman's capsule of a nephron.

GROWTH RATE OF POPULATION : Difference between birth rate and death rate. Difference between the number of births and the number of deaths per thousand of people per year.

HERBIVORE : An animal feeding on plants.

HETERODONT TEETH : Teeth different in size, shape and function.

HETEROTROPHS : All animals which depend on readymade food.

HOMODONT TEETH : Teeth similar in shape and size.

INFANT MORTALITY : The death-rate for children less than 1 year age.

INGESTION : Taking in of food into the alimentery canal.

INSPIRATION : Drawing air into the lungs.

LIFE EXPECTANCY : It is the average age to which a new born can be expected to live.

LIGAMENT : A connective tissue which connect a bone to another bone.

LOCOMOTION : Movement of the entire body of the animal from one place to another to gather food and to avoid enemies.

LYMPH : It is a fluid surrounding the body cells. It is essentially the plasma that has oozed out of the blood capillaries.

MEDULLA : The light coloured inner area of the kidney.

MERISTEMATIC TISSUE : It consists of actively dividing cells to produce more cells leading to growth.

MULTICELLULAR : Many - celled organism.

NASTIC MOVEMENT : Movement of plant parts in response to a diffused/non-directional stimulus.

NEPHRON : The structural and functional unit of kidney.

NUTRITION : A process by which living beings procure food or synthesise it, and utilise it for growth, body-building and its maintenance and to get energy to carry out various life processes.

OMNIVORE : An animal feeding on both animal as well as plant material.

ORGANELLE : Tiny structures of a cell concerned with specific function.

ORGANISATION : It is the manner in which small units of any structure or system are arranged into larger ones and the larger ones into still larger ones in hierarchy, where the units of each level coordinate with one another towards a particular goal.

PARASITE : An organism which lives in or on the body of another organism for its food and shelter.

PARENCHYMA : It is composed of large thin-walled cells, usually with a vacuole.

PASTEURISATION : Process by which milk is sterilized by heating at 60oC for 30 minutes and followed by sudden chilling.

PERMANENT TISSUE : It consists of differentiated or specialised cells which have lost their ability to divide, and perform a particular function.

PHLOEM : It is formed of living tubular cells which provide a passage for the downward movement of the food manufactured in the leaves to various parts of the plant.

PHOTOSYNTHESIS : A process by which plants prepare their food (starch) by using water and carbon dioxide in the presence of chlorophyll utilising sunlight as a source of energy.

POPULATION : It is a group of individuals of same species living in a particular locality.

PROTOPLASM : The living substance contained in the cell.

PSEUDOPODIUM : Finger-like projection of the body of amoeba for creeping movement.

RESOURCE : Any available means (substance, energy or organism) natural or artificial which is used by humans for their welfare.

SAPROPHYTE : Organism which draws nourishment from dead organic remains.

SCAVENGER : Carnivores which consume dead and rotting meat.

SCLERENCHYMA : It is composed of long, narrow and thick cells. These are dead cells, providing strength to plant parts.

SETAE : Tiny, curved bristles projecting out of the earthworm's skin, which help in providing grip while crawling.

SPHINCTER : A circular muscle which keeps the passage closed.

STOMATA : Minute pores in the leaf through which air enters into the leaf, and water gets evaporated from it.

SYNOVIAL FLUID : The lubricating fluid found between the two bones at a movable joint.

TENDON : A connective tissue which connect muscles to bones.

TISSUE : It is a group of cells which are similar in structure and perform the same particular function.

TRANSPIRATION : Evaporation of water in the form of water vapours from the aerial parts of the plants.

TROPIC MOVEMENT : Movement of the plant part in response to directional stimulus.

TUBE FEET : Tiny, tubular retractile structures, ending in a sucker. These are the locomotony organs of starfish.

UNICELLULAR : Single - celled organism.

URETER : The duct connecting the kidney with the urinary bladder.

URETHRA : The duct which takes the urine out from the urinary bladder to the outside of the body.

XYLEM : It is formed of thick-walled, tubular and often dead cells which are placed end to end like drain pipes, and transport water and minerals absorbed by the roots from the soil.