

MICROORGANISMS

2 CHAPTER

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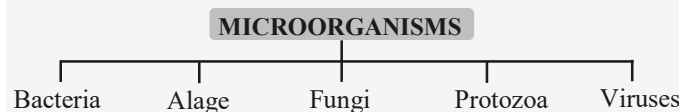
The organisms which are too small to be seen by the naked eyes & can be seen only through a microscope are called microorganisms.

➤ OCCURRENCE OF MICROBES

Microorganisms are present everywhere in air, soil, water, food stuffs, sewage, waste as well as inside of any living bodies. The maximum number of microbes are found in natural substrate which are rich in organic food, and have a suitable temperature and moisture for their growth and multiplication. An important fact about these microorganisms is that they are strong. They can survive extreme conditions of temperature and dryness by forming a **cyst**, which is a hard outer coat around their bodies.

➤ MAJOR GROUPS OF MICROORGANISMS

Microorganisms are present in the air, water, food and even inside our bodies. While a majority of the microbes are harmless, some of them have the capability of causing dangerous diseases.



➤ CLASSIFICATION OF MICROORGANISMS

Microbes are mainly classified into five major groups :

◆ Bacteria :

- Bacteria (singular: bacterium) are single-celled organisms that vary in shape and size. Some bacteria are round or oval (coccus), others are rod-shaped (bacillus) or spiral. Some bacteria are autotrophic as they contain chlorophyll, but most of them are heterotrophic, showing saprophytic or parasitic mode of nutrition.

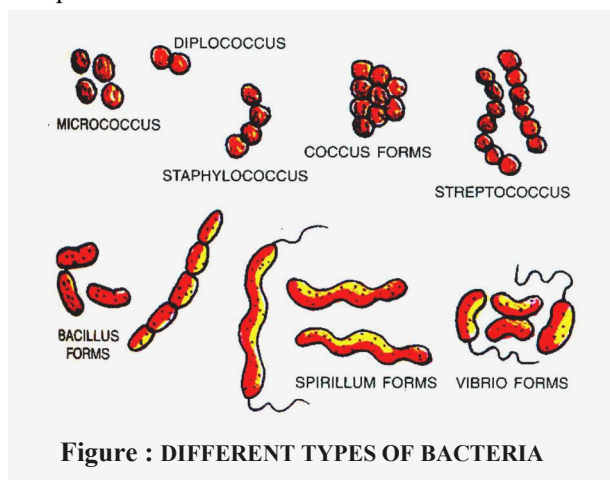


Figure : DIFFERENT TYPES OF BACTERIA

◆ Algae :

- Autotrophic organisms having undifferentiated plant bodies are called algae (singular: alga). Algae occur abundantly, like grass in aquatic habitats and are also called '**grass of water**'.

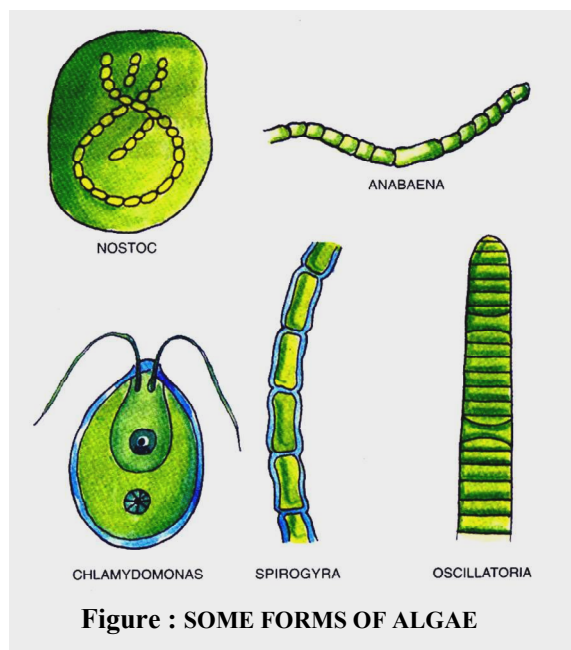


Figure : SOME FORMS OF ALGAE

◆ Fungi :

- Fungi (singular: fungus) are a group of plant-like organisms exhibiting heterophic (saprophytic or parasitic) nutrition. They are commonly found on bread, leather, cotton, paper, etc. Fungi grow vigorously in damp, warm, dark places. Yeast, moulds and mushrooms are forms of fungi. Yeast is commonly used for baking bread, cakes, etc. The yeast ferments sugar present in the wheat and converts it to carbon dioxide and alcohol.

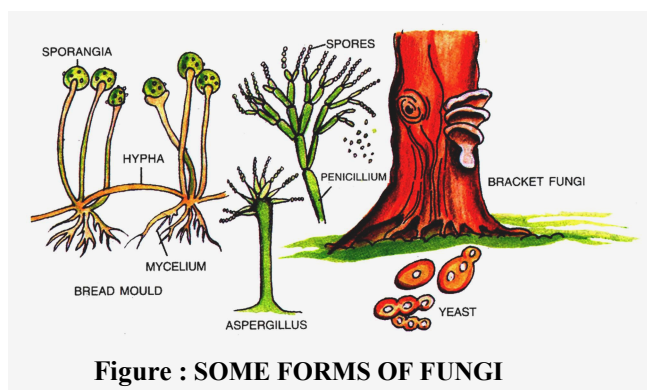


Figure : SOME FORMS OF FUNGI

◆ Protozoa :

- Unicellular organisms that exhibit animal-like characteristics are called protozoa (singular: protozoan). The word protozoan literally means 'the first animal'. Most protozoa are heterotrophic.

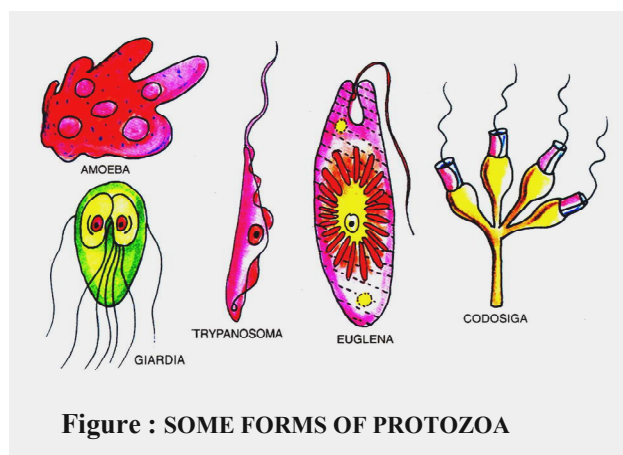


Figure : SOME FORMS OF PROTOZOA

◆ Viruses :

- A virus is a microorganism which exhibits characteristics of living as well as non-living thing. Viruses exhibit a variety of shapes, having simple structure. Reproducing only inside a living organism, viruses can cause many diseases.

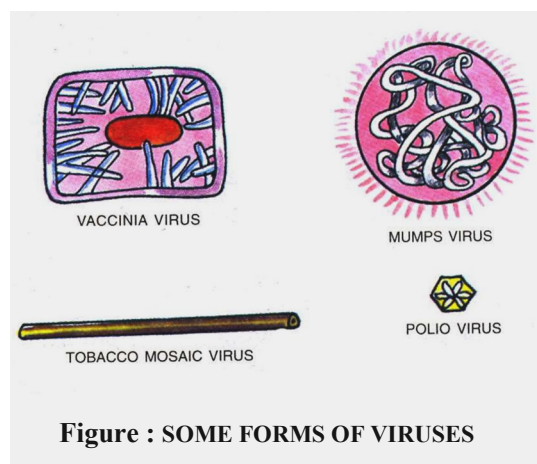


Figure : SOME FORMS OF VIRUSES

➤ USES OF BACTERIA

◆ In Medicine :

- Antibiotics :** Many well known antibiotics such as streptomycin, aureomycin and chloromycin are obtained from bacteria.

◆ In Agriculture :

- Decay of Organic Substances :** Bacteria act on dead bodies of animals and plants and convert various complex organic compounds into simple inorganic substances. Thus, bacteria help in **recycling** of matter.

(ii) **Nitrification** : The protein confined in dead bodies of animals and plants is converted into ammonia by ammonifying bacteria. This process is known as **ammonification**. This ammonia is converted into nitrites by bacteria of the **nitrosomonas** group.

(iii) **Nitrogen Fixation** : Some of the soil bacteria like *Azotobacter*, *Clostridium* and **symbiotic** bacteria (*Rhizobium* found in root nodules of leguminous plants) are capable of fixing free atmospheric nitrogen into nitrates. This nitrates are used by green plants to produce proteins.

◆ **In Industry :**

- (i) *Lactobacillus* bacteria help in the formation of milk products such as curd and cheese.
- (ii) Some bacteria are also used in the preparation of industrial products such as lactic acid, acetone, alcohol etc.

➤ **USES OF FUNGI**

◆ **In Medicine :**

- Many well-known **antibiotics** are obtained from fungi. **Penicillin** is obtained from the fungus *Penicillium notatum*. **Griseofulvin** is extracted from the fungus *Griseofulvum*.

◆ **In Industry :**

- (i) **Brewery and Bakery** : The wine (brewery) and **bread (bakery)** industries are the two most important industries which make use of the fungus **yeast**. Both these industries are based on **fermentation** activity of yeast.



- (ii) **Vitamins** : Yeast is an important source of vitamin B-complex.

(iii) **Preparation of Organic Acids :**

Fermentation properties of several fungi are utilized for the manufacture of oxalic acid, citric acid, etc.

◆ **In Agriculture :**

- Fungi decompose the dead bodies of plants, animals and their waste products.

◆ **As Food :**

- (i) Some species of fungi are edible. They are cooked like vegetables or used in *pulao* or prepared as soups. Some common edible fungi are *Morchella*, *Agaricus*, *Ramaria*, *Clavaria* and *Plurotus*.
- (ii) Yeast is also used in the preparation of *idli* and *dosa* from a mixture of powdered rice and dal.

➤ **USES OF ALGAE**

Algae play an important role in medicine, agriculture, industry and as food.

◆ **In Medicine :**

- The green algae *chlorella* yield an important antibiotic called **chlorellin**.

◆ **In Industry :**

- (i) **Algal Products** : Agar and algin are obtained from red and brown algae respectively. These are used in the preparation of medicines, food and cosmetics.

(ii) **Source of Iodine (I), Sodium (Na) and Potassium (K) :**

The brown algae are the most important sources of sodium, potassium and iodine. Iodine is obtained from an alga called **kelp**.

◆ **In Agriculture :**

- (i) **As Manure** : Many of the sea weeds are directly added to agricultural fields as manure because they are rich in nitrogen and potassium.
- (ii) **Nitrogen Fixation** : Some blue-green algae like *Nostoc* and *Anabaena* are important in the fixation of atmospheric nitrogen in soils.
- (iii) **Food** : The red alga *Porphyra* is used directly as food in China and Japan.
- (iv) **Fodder** : Some sea weeds such as *Laminaria* are used as fodder for sheep and cattle.

➤ **USES OF PROTOZOA**

- (i) Some free-living protozoa form an important link in an aquatic food chain. They feed on algae and are, in turn, eaten by bigger animals.
- (ii) Some forms of protozoa help in the final degradation of waste and sewage.
- (iii) Protozoa are used as research material for various biological activities.

➤ HARMFUL MICROORGANISM

The disease causing microorganisms are called **pathogens**. It is necessary to protect ourselves from the different diseases caused by microorganism or germs. The commonest mode of entry for these germs is the food we eat and the water we drink. Some harmful microorganisms and the diseases caused are given in Table :

Table		
Harmful Microorganisms		
Classification	Species/Name	Diseases caused
Bacteria	Salmonella, Clostridium	Food poisoning
	Mycobacterium, etc.	Tuberculosis, whooping cough, cholera, typhoid
Algae	Cephaleuros	Red rust of tea and coffee plants
Fungi	Moulds, mildews	Spoilage of food, rust of wheat, blight of potatoes
	Ringworm, etc.	Fungal infection, athlete's foot
Protozoa	E. histolytica	Amoebiasis, dysentery
	Plasmodium	Malaria
Viruses	Measles virus	Measles
	Polio virus	Poliomyelitis
	HIV	AIDS

Disease carrying germs are carried by other organisms. For e.g. The pathogen for malaria is carried by a mosquito (the femal Anopheles, mosquito) and enters the body when the mosquito bites. Here, the mosquito acts as a **carried** while the human is the **host**. Since mosquitoes are capable of carrying and spreading many diseases like malaria, dengue, etc. It is very important to control the reproduction or breeding of mosquitoes. Since mosquitoes breed on water, we must ensure that there is no standing rain water or water in coolers, etc. near our homes.

➤ METHODS OF FOOD PRESERVATION

What do you do with left-over food after dinner ? It is kept in the fridge. If left outside, the food can get spoiled, and can cause food poisoning if eaten. We have seen how dangerous microorganisms can be. That is why it is very important for us to be careful about food quality and preservation. Different methods used to prevent spoilage of food, by limiting the growth of microbes are :

◆ Refrigeration :

- Food is kept at low temperature to reduce the rate of reproduction of the microorganisms and prevent food spoilage.

◆ Dehydration or drying :

- Food items are dried in the sun or by spraying or freezing. This process is commonly used for

preserving fruits, although some nutrients are lost by drying.

◆ Addition of salt or sugar :

- Microbes need water for growth. By adding salt or sugar, water is made unavailable, thereby controlling microbial growth. Pickles and jams are preserved food items (fruits and vegetables) and can be kept for many months.

◆ Freezing :

- Frozen food is very popular nowadays as it has greater shelf life, without much loss of nutrients. Reduction in temperature and unavailability of water help to limit microbes.

◆ Smoking :

Meat products are preserved by the process of smoking which uses drying technique as well as some substances from smoke.

◆ Pasteurization and Homogenization :

- Pasteurization is a process by which microorganisms are destroyed by high temperature and sudden cooling. Milk is heated to around 70°C and then suddenly cooled. It is commonly used for milk, since other food items can lose heat-sensitive nutrients.

- Homogenization is the process of passing a substance (usually milk) under high pressure through thin tubes, which reduces the tendency of creaming of fat.

◆ Canning :

- Canned products are first subjected to high heat processing, then sealed in cans. While canning increases shelf life.

◆ Sterilization :

- Ionizing radiations are used to destroy microorganisms without affecting heat-sensitive nutrients. This process is commonly used for preservation of mushrooms, strawberries, potatoes, etc.

➤ NITROGEN FIXATION

The process of converting atmospheric nitrogen into compounds of nitrogen, mainly nitrates, which can be easily used by plants is called **nitrogen fixation**. It can be fixed in two ways.

1. Natural fixation or Atmospheric fixation
2. Artificial fixation or Industrial fixation.

◆ Natural Fixation of Nitrogen :

- In nature nitrogen of the atmosphere can be fixed by three methods.

Fixation of Nitrogen by Bacteria :

- The root nodules of certain leguminous plants contain nitrogen fixing bacteria called **Rhizobium**. The bacteria can directly fix nitrogen gas to nitrogen compounds which can be utilised by the plants.

Fixation of Nitrogen by Blue - Green Algae :

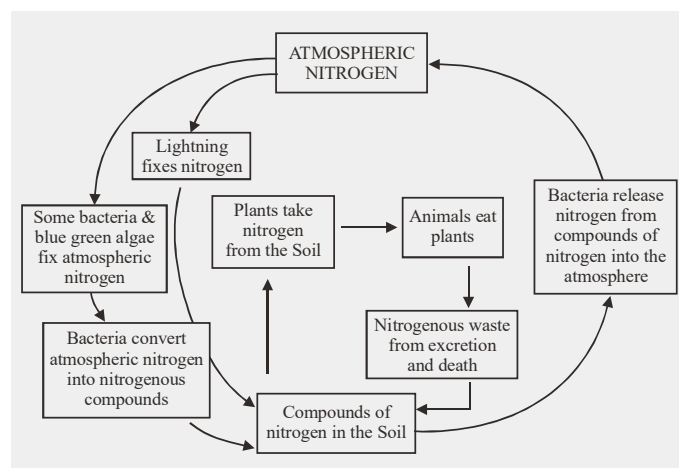
- Blue-green algae like Nostoc and Anabaena can also help in nitrogen fixation. The fixation of nitrogen by bacteria and algae is called **biological fixation** of nitrogen.

Fixation of Nitrogen by Lightning :

- During lightning in the sky, when high temperature is produced, the nitrogen gas of the atmosphere reacts with oxygen to form nitrogen oxide. This nitrogen oxide dissolves in rainwater to form a very dilute solution of nitric acid. The nitric acid thus formed reacts with alkalis present in the soil to form nitrates which are then absorbed by the plants.

◆ Artificial fixation of Nitrogen :

- In this method the atmospheric nitrogen is made to combine with hydrogen gas to form ammonia (Haber's process). This ammonia can be oxidized to make nitrates or react with acid to form ammonium salts. The nitrates as well as ammonium salts contain fixed nitrogen and are used as fertilisers.



◆ Nitrogen Cycle :

- The circulation of nitrogen through the living and non-living components of the biosphere (air, soil, water, plants and animals) is called **nitrogen cycle**. Nitrogen cycle maintain the percentage of nitrogen in the atmosphere more or less at a constant.

◆ Steps Involved in Nitrogen Cycle :

- The atmospheric nitrogen is fixed into nitrogen compounds like nitrates by Rhizobium bacteria, blue-green algae, lightning or industrial method.
- The plants absorb nitrate compounds from the soil and water and convert them into plant proteins.
- The plants are eaten up by animals and thus plant proteins are used for making animal proteins.
- When the plants and animals die, bacteria and fungi present in the soil decompose the proteins of dead plants and animal into ammonia. This process is called **ammonification**.
- Ammonia thus formed is converted first into nitrites and then into nitrates by the action of Nitrosomonas and Nitrobacter bacteria respectively. The process is called **nitrification**.
- The soil contains denitrifying bacteria called Pseudomonas which convert nitrate form of nitrogen into free nitrogen which goes back into the atmosphere. The process is called **denitrification**.

EXERCISE # 1

A. Single Choice Type Questions

- (C) Bacteria (D) Fungi
- Q.1** The Method of preserving food by adding salt is called -
 (A) Salting (B) Dehydration
 (C) Canning (D) Freezing
- Q.2** The microorganism which has the ability to fix nitrogen is -
 (A) Virus (B) *Euglena*
 (C) Rhizobium (D) Amoeba
- Q.3** The protozoa which can perform photosynthesis
 (A) Amoeba (B) *Paramoecium*
 (C) *Euglena* (D) Giardia
- Q.4** Formation of curd by milk is done by -
 (A) *Lactobacillus* (B) Moulds
 (C) Yeasts (D) algae
- Q.5** Yeast is used in the production of -
 (A) Sugar (B) Alcohol
 (C) Oxygen (D) None
- Q.6** We get CO₂ from sugar by the action of -
 (A) Bacterial (B) Algae
 (C) Fungi (D) Virus
- Q.7** A bacteria helpful in digestion of food is -
 (A) *Escherichia coli* (B) *Clostridium*
 (C) *Botulinum* (D) None of these
- Q.8** A disease caused by viruses in animal is -
 (A) Anthrax (B) Aspergillosis
 (C) Foot and mouth (D) None
- Q.9** *Amoeba*, *Euglena*, *Giardia* all are examples of -
 (A) Protozoa (B) Viruses
 (C) Algae (D) Fungi
- Q.10** Milk is converted into milk powder by -
 (A) Vacuum drying (B) Bottling
 (C) Canning (D) Dehydration
- Q.11** Lichens are composite organs, consisting of algae and -
 (A) Mosses (B) Protozoans
- Q.12** Mushroom is -
 (A) A plant consisting of fine green threads
 (B) An edible fungus
 (C) A bryophyte devoid of roots, stem and leaves
 (D) A flowering plant
- Q.13** Which of the following disease is caused by a fungus -
 (A) Small pox (B) Tuberculosis
 (C) Cancer (D) Aspergillosis
- Q.14** Yeast is -
 (A) Alga (B) Fungus
 (C) Bacterium (D) Liverwort
- Q.15** Fermentation of sugar occurs by -
 (A) *Saccharomyces* (B) *Mucor*
 (C) *Aspergillus* (D) *Penicillium*
- Q.16** The biological process carried on by the Rhizobium is called -
 (A) Nitrification (B) Ammonification
 (C) Nitrogen fixation (D) Fermentation
- Q.17** The smallest organisms which cause disease among plants are -
 (A) Viruses (B) fungi
 (C) Bacteria (D) Mycoplasma
- Q.18** Nif genes occur in -
 (A) *Penicillium* (B) *Aspergillus*
 (C) Rhizobium (D) *Streptococcus*
- Q.19** Black rust of wheat is caused by -
 (A) *Rhizopus* (B) *Ustilago*
 (C) *Penicillium* (D) *Puccinia*
- Q.20** Lichen represents -
 (A) Symbiotic association of an alga and a fungus
 (B) Parasitic association of an alga and a fungus
 (C) Mycorrhizal association
 (D) Commensalism

Q.21 Small pox is caused by

(A) Virus

(B) Bacteria

(C) Housefly

(D) Mosquito

EXERCISE # 2

A. Very Short Answer Types Questions

- Q.1** What are microorganisms ?
- Q.2** Name one example of each of the following :
(a) bacteria (b) virus (c) fungi (d) algae
(e) protozoa.
- Q.3** Name two food which are preserved by sun drying.
- Q.4** Name the microorganism which can fix atmospheric nitrogen.
- Q.5** Where do Rhizobium bacteria live ?
- Q.6** Name the two principles in which food preservation methods are based.
- Q.7** Which are the microorganisms that are useful in nitrogen cycle ?
- Q.8** Give one example of the process of fermentation as applied in our day-to-day life.

B. Short Answer Types Questions

- Q.9** What are antibiotics ? Give two examples.
- Q.10** State two advantages of food preservations.
- Q.11** Why do vegetables and fruits remain fresh for a few days when kept in a refrigerator ?
- Q.12** What is the process of irradiation ?
- Q.13** Why do farmers cultivate plants of legume family ?
- Q.14** List five methods of food preservation learnt by you.
- Q.15** What are algae and where would you find them growing.

Q.16 What are protozoa ?

Q.17 What is the economic importance of bacteria in agriculture ?

Q.18 Name three antibiotics known to you.

C. Long Answer Types Questions

- Q.19** What are viruses ? How do they differ from other microbes ?
- Q.20** What is the economic importance of fungi in agriculture and industry ?
- Q.21** In what respect are fungi different from algae ?
- Q.22** Describe the principles on which the various methods of food preservation are based.
- Q.23** Name the causal agent of the following diseases : tuberculosis, polio, athlete's foot, dysentery
- Q.24** How does bacteria play an important role in medicine as well as in several industries ?
- Q.25** Write the steps involved in N₂ cycle.