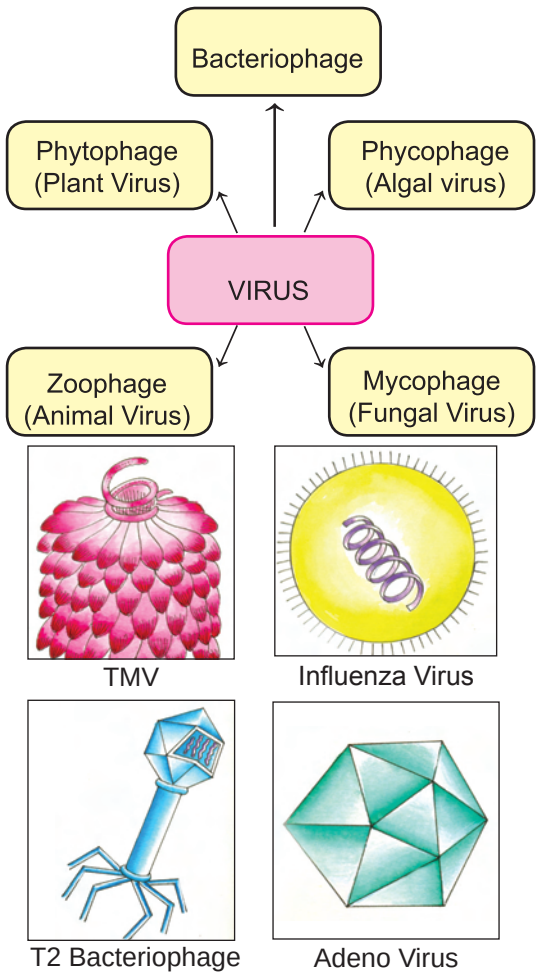
as being on the border line between living and non-living organisms. The living cell inside which the virus grows and multiplies is known as host cell. Outside the host cell, viruses do not show any of the characteristics of living organisms.

Based on their host, viruses are classified into five types.



BACTERIA

The curd contains *Lacto bacillus* bacteria which helps to change the milk into curd. Let us now study about bacteria. Bacteria are unicellular and

ACTIVITY 4.1

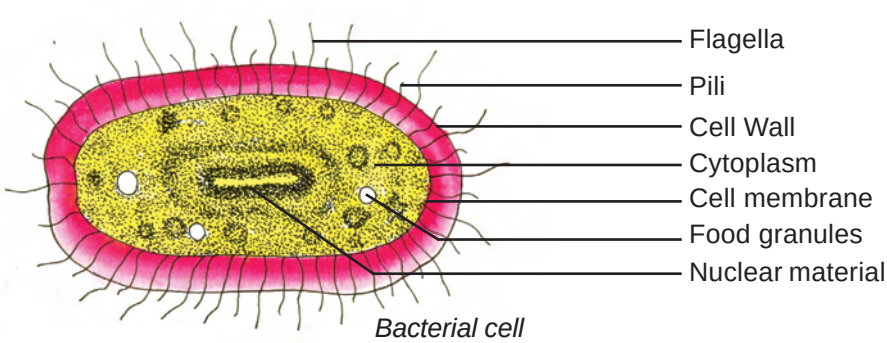
Have you seen your mother adding a little curd to warm milk to set the curd for the next day? Why?

microscopic, belonging to the world of microbes. The study of bacteria is called **Bacteriology.** Bacteria were first observed under a microscope by the Dutch Scientist Anton Von Leeuwenhoek in 1675. Later, Louis Pasteur, Robert Koch and Lord Lister carried out detailed studies on bacteria.

The structure of bacteria can be studied with the help of an electron microscope. The bacterial cell is a prokaryotic cell. It has a rigid cell wall protecting the cell and giving a definite shape to it. The living material inner the cell wall is called protoplasm. It is differentiated into cell membrane,

Anton Von Leeuwenhoek

nuclear material and cytoplasm. Membrane bound organelles like golgi bodies, mitochondria, endoplasmic reticulum, lysosomes are absent. It contains bacteriochlorophyll



Bacterial cell

pigments. The nuclear material of a bacterial cell is made of a circular, DNA molecule. It is not bound by nuclear membrane. There are thread like appendages which are called flagella, the organs of motility. Pili are minute, straight, hair like appendages and are considered to be organs of attachment.

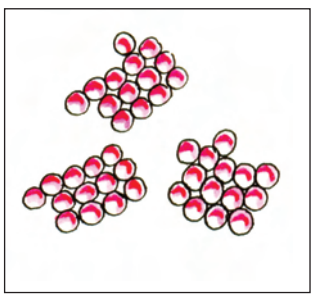
Bacteria are measured in microns. 1 micron = 1/1000 millimetre.

Four types of bacteria are recognised based on shape. They are

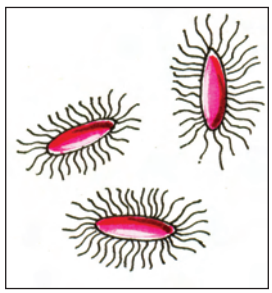
1. Cocci (Spherical shaped)
2. Bacilli (Rod shaped)
3. Spirillum (Spiral or cork screw)
4. Vibrio (Comma Shaped)

On the basis of the number and arrangement of the flagella, bacteria are classified as

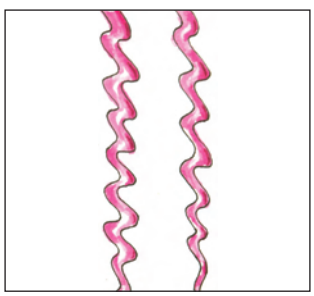
1. Monotrichous (Single flagellum at one end)



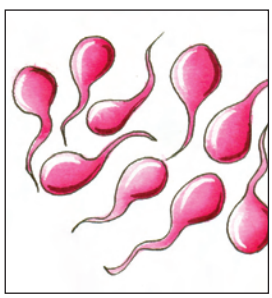
1. Cocci (Spherical shaped)



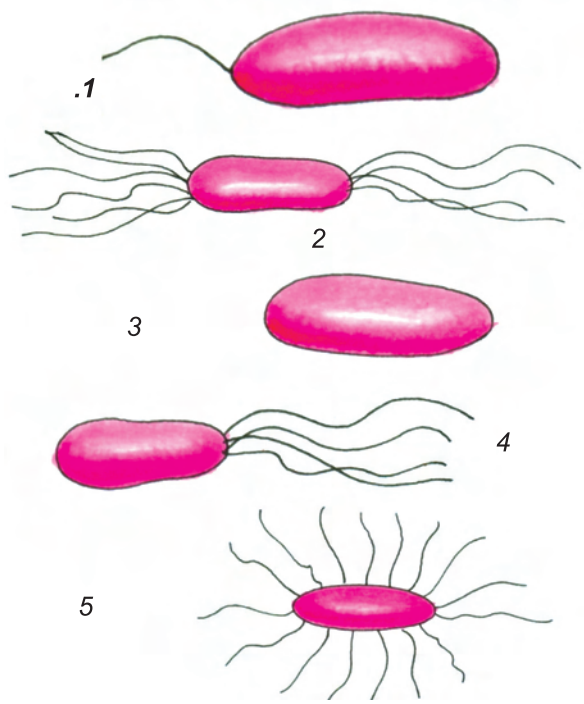
2.Bacilli (Rod shaped)



3. Spirillum
(Spiral or cork screw)



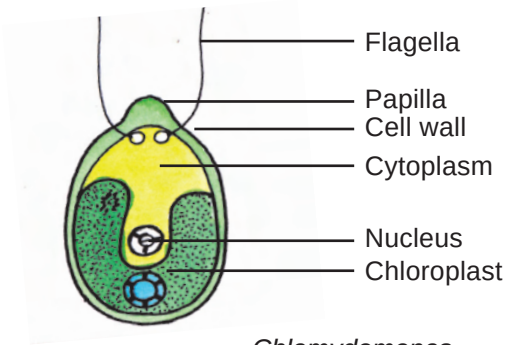
4.Vibrio (Comma Shaped)



SCIENCE

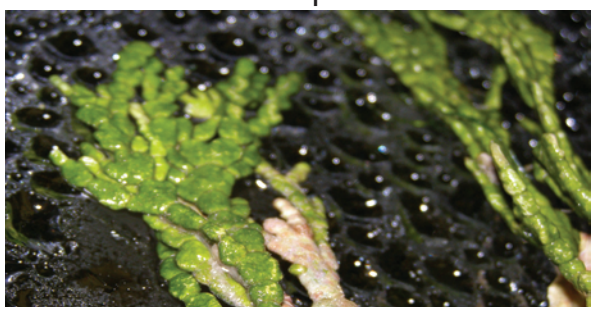
2. Amphitrichous (Tuft of flagella arising at both ends).
3. Atrichous (Without any flagella).
4. Lophotrichous (Tuft of flagella at one ends).
5. Peritrichous (Flagella all around).

ALGAE



Chlamydomonas

Chlamydomonas is a unicellular green algae. It is spherical or oval in shape. The protoplasm is surrounded by a cellulose cell wall. The cell wall may have a pectic sheath around it. There is a single large cup-shaped chloroplast. Inside the chloroplast a pyrenoid which contains starch may be present. There are two flagellae at the narrow end of the cell which helps in locomotion. There may be a vacuole at the base of the flagella. An eye spot is located at the anterior end. Based on the presence of other pigments, algae are classified into four classes. The study of algae is called **Phycology** which you have studied in the previous chapter.

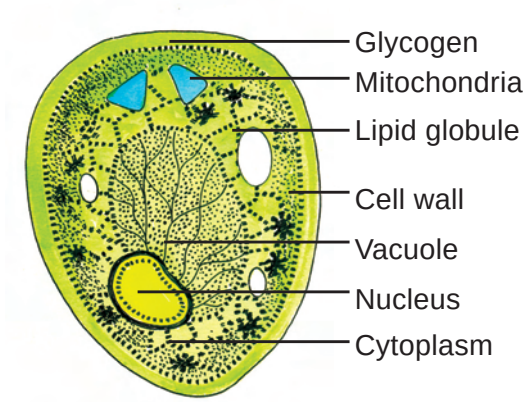


ACTIVITY 4.2

Take a 250 ml beaker filled up to ¾ with water. Dissolve 2 table spoon of sugar in it. Add a pinch of yeast powder to the sugar solution. Keep it covered in a warm place for 4 –5 hours. Now take and smell the solution.

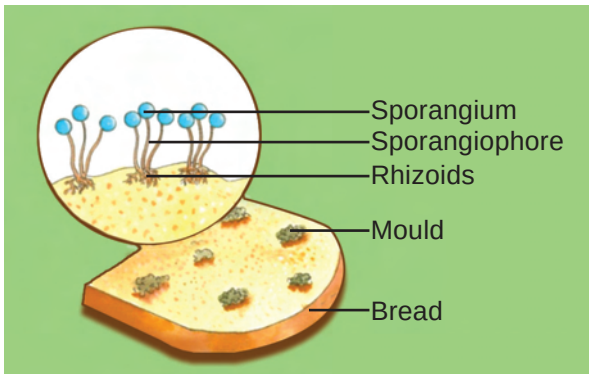
FUNGI

The conversion of sugar solution into alcohol and liberation of carbon di - oxide is known as **fermentation**. Here the sugar solution is fermented and gives a smell. Wine, alcohols are prepared from the molasses by the fermentation activity of the yeast. etc.



Yeast cell

Keep a bread slice in a moist place. Observe if there is any change in colour. Why?



Bread mould

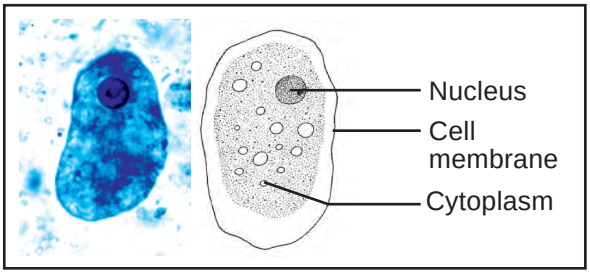
Yeast is a unicellular, saprophytic fungus. The cell is oval shaped. The nucleus is seen at one end of the vacuole. The cytoplasm shows the presence of organelles like endoplasmic reticulum, ribosome, mitochondria, etc., Fungi do not possess chlorophyll. Hence they are incapable of photosynthesis. The study of fungi is called **Mycology**. They lead a parasitic or saprophytic mode of life.

A black powdery spot with a network of thread like filaments, called hyphae is called mycelium (bread mould) which changes the colour of the bread.

Entamoeba histolytica - Amoebic dyscentery

Plasmodium vivax
Plasmodium falciparum
} Malaria

Trypanosoma gambiense - African sleeping sickness



Entamoeba histolyitica

PROTOZOA

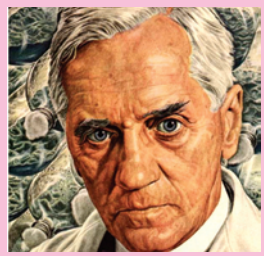
Protozoans are unicellular organisms. Metabolic activities are done by organelles. Protozoans show mainly two modes of life, free living and parasitic. Free living organisms inhabit fresh and salt water. Parasitic forms live as ectoparasites or endoparasites. They cause diseases.

4.2. USES OF MICRO ORGANISMS IN MEDICINE, AGRICULTURE, INDUSTRY AND DAILY LIVING.

Micro-organisms are used in the manufacture of antibiotics, linen,

MORE TO KNOW

When a cut or wound occurs in your body, you will be treated by the doctor. Your body temperature is recorded. If you have fever, doctor will give you some **antibiotic.**



Alexander Fleming of Britain in 1928 discovered the 'Wonder' Drug 'Penicillin'.

Alexander Flemming

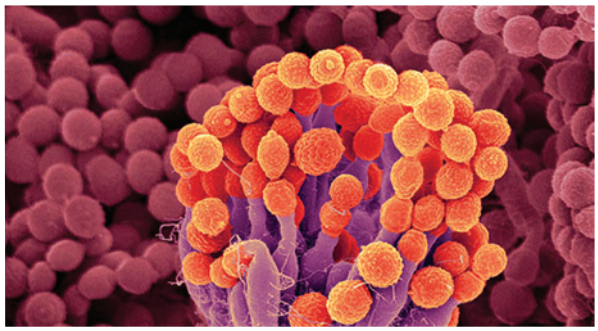
SCIENCE

bread, wine, beer and the other industries. Microorganisms are used to enrich the soil fertility.

What is antibiotic?

Antimicrobial agents which are useful medicines or drugs and are extracted from the micro-organisms.

Name of the Species		Antibiotic
Bacteria	Streptomyces griseus Bacillus subtilis	Streptomycin Bacitracin
Fungi	*Penicillium notatum* *Penicillium chrysogenum*	Penicillin



Penicillium notatum

Penicillin

Have you observed dead plants, small dead animals in your surroundings? What happens to them? Do they emit smell? Why?

are called **antibiotics**. Bacteria, Fungi are used to make antibiotics, vaccines, etc.

AGRICULTURE

It may be defined as the science or practice of farming. Agriculture depends on soil fertility. Micro-organisms like bacteria, fungi, few algae enrich the soil fertility. Nitrogen is essential for all life.

Agriculture :- The science that deals with the growth of plants and animals for human use is called agriculture.

Bacteria convert complex proteins in the dead bodies of plants and animals into ammonia, nitrites and nitrates. Bacteria play a major role in the cycling of elements like carbon, oxygen, nitrogen and sulphur as biological scavengers. They oxidize the organic compounds and set free the locked up carbon as carbon di-oxide due to which we smell the foul odour.

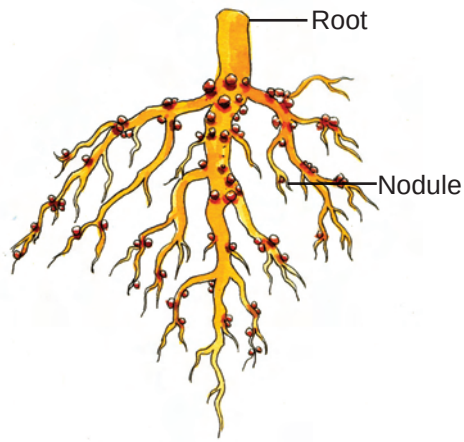
Farming

The following bacteria are involved to enrich the soil fertility:

Ammonifying bacteria:- e.g., *Bacillus ramosus*

Nitrifying bacteria:- e.g.,*Nitrobacter Nitrosommonas.*

Nitrogen-fixing bacteria:- e.g., *Azatobactor, Clostridium, Rhizobium* (Root nodules bacteria). Various blue green algae like Oscillatoria, Anabaena and Nostoc increase the soil fertility by fixing atmospheric nitrogen.



Root nodule

Role of micro organisms in industry and daily living.

Let us know how we get a good flavour when we drink coffee or tea?

The leaves of tea, tobacco, the beans of coffee and cocoa are fermented by the activity of *Bacillus megaterium* to impart the characteristic flavour. This is called **curing.**

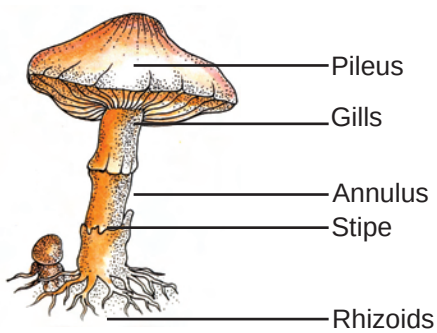
Vinegar is a good preservative. Pickles do not get spoilt. How do we get vinegar?

In the world today many industries totally depend upon the microbial activities of micro organisms such as Lactic acid bacteria.

Streptococcus lactis (lactic acid bacteria) converts milk protein into curd. Vinegar is manufactured from sugar solution employing *Acetobacter aceti*.

Butyl alcohol, methyl alcohols are prepared from molasses by the fermentation activity of *Clostridium acetobutylicum.* Alginic acid is obtained from brown algae.

Oxalic acid is the fermentation product of fungi *Aspergillus niger*. Yeast is the best source of vitamin B complex and vitamin Riboflavin. Mushroom is also an edible (e.g.) *Agaricus, Morchella* are edible and are cultivated.



Edible mushroom

Chlorella and *Spirulina* are used as protein sources. Hence they are known as **single cell protein**.

SCIENCE

4.3. HARMFUL MICRO ORGANISMS

Micro organisms cause damage to the plants and food materials. They contaminate food, which leads to food poisoning. Influence of micro organism on plants and animals reduce the market value of their product. The various harmful activities of bacteria, fungi and virus are given in the table.

- Fruits. Vegetables, fish, meat, milk, etc., are perishable foods.
- Wheat, rice, maize, pulses, sugar are non-perishable foods. Some times food is unfit for our consumption. Why?

S. No	Micro-organisms	Name of the Species	Diseases
1	BACTERIA	*Xanthomonas citri* *Pseudomonas solanacearum* *Xanthomonas oryzae*	Citrus Canker Wilt of Potato Bacterial blight in Rice
2	FUNGI	*Cercospora personata* *Cercospora arachidicola* *Pyricularia oryzae*	Tikka disease of groundnut Blast disease of rice
3	VIRUS	Bunchy Top Virus Tobacco Mosaic Virus Cucumber Mosaic Virus	Bunchy top of Banana Tobacco Mosaic disease Cucumber Mosaic disease.

PLANT DISEASES

Citrus Canker

Blast disease of rice

Cucumber Mosaic disease

Microbes affect human lives and pose a challenge to human health. Health is wealth is just a saying. But today we hear of **Rat fever, Malaria, Swine Flu. Birds Flu**, etc., How do we get infected?

Viruses, bacteria, fungi, protozoa and certain worms are the main organisms causing diseases.

To cause disease, they must first gain entry into the body. Such entry must be either through the skin or through the nose into the respiratory system or through the mouth to the alimentary canal.

The method of carrying these disease organisms to the body is varied. The carriers of disease organisms are called vectors. They are said to transmit diseases.

Some organisms pass directly through the surface of the skin. Such is the case with the spores of the fungus which causes ring worm. Bacteria frequently enter the skin through a wound, causing inflammation of the wound.

Many micro-organisms enter through the nose or mouth and penetrate the delicate membranes of the respiratory system. Virus causing colds and influenza enter this way.

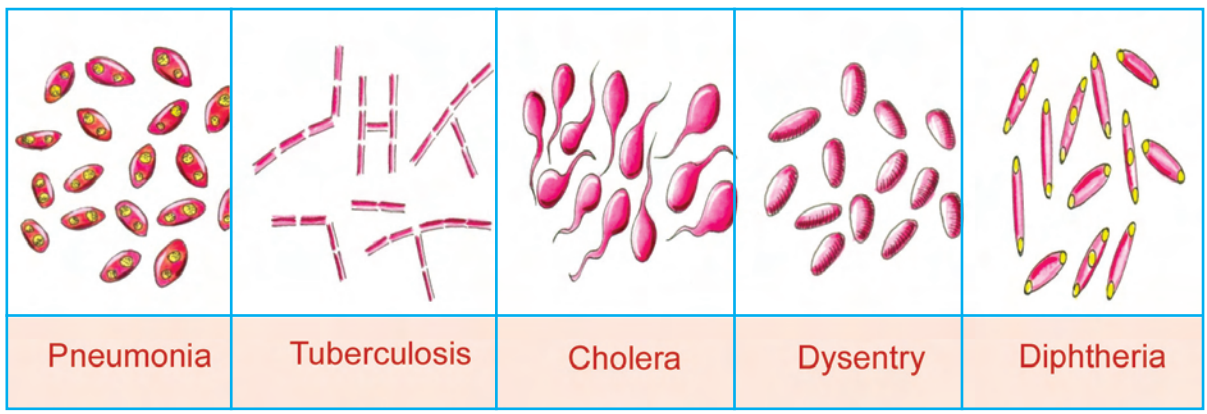
Parasitic bacteria, protozoans, viruses, etc., cause various communicable diseases in man.

Communicable diseases are pathogenic diseases which spread from, person to person, either directly or indirectly. The following table shows some of the common communicable diseases in man.

PATHOGEN	DISEASES	MODE OF TRANSMISSION
VIRUS	Common cold, Polio. Hepatitis, Influenza, Jaundice.	Air water, direct contact
	AIDS	Sexual Contact
BACTERIA	Cholera, typhoid	Contaminated water.
	Tetanus	Cuts and wounds
	Leptospirosis	Contact of animal's urine. (Rat and Squrriel)
	Leprosy	Contact (vector)
FUNGI	Athlete's feet	Spores in water and in ground.
PROTOZOAN	Malaria	Vector example mosquito

ACTIVITY 4.3

1. Collect the pictures of viral diseases in man.
2. Collect the pictures of fungal diseases in man.
3. Collect the pictures of bacterial diseases in man.
4. Collect the pictures of protozoan diseases in man.



Disease causing microbes

Harmful micro-organisms in food and drink can be taken in through the alimentary canal unless high standards of hygiene are followed. The food may be contaminated in a variety of ways. Bacteria may enter the food causing it to go bad, if food is not properly stored. The bacteria causing cholera and typhoid and the protozoan causing amoebic dysentery are easily picked up from the infected food and water.

Disease causing microbes

Due to chemical reaction, butter milk gets spoilt if kept in a brass vessel. The starchy foods get spoilt due to change of starch into sugars by the enzymes present in the food articles.

4.4. MICROBES IN FOOD PRESERVATION

Food preservation is the process of treating and handling food to stop or greatly slow down spoilage (loss of quality, edibility or nutritive value) caused or accelerated by micro-organisms. Canning, Pasteurization, refrigeration, dehydration, the use of preservatives, heating, boiling and drying are the effective methods of controlling micro-organisms.

Bottling and Canning

The right types of containers have to be chosen. They are then sterilized. Preservatives such as vinegar, sodium benzoate, oil, citric acid are added to the food stuff, which is then packed and sealed properly.

Milk pouch

- **Aavin milk** etc., that comes in packets is not spoilt. Why?
- This milk is **pasteurised.** What is Pasteurisation?

Pasteurisaton is used to preserve milk. Milk is heated to 72˚C for 30 minutes and then suddenly cooled to 12˚C. Microbes are killed without causing damage to the taste, quality of milk for a longer time and packed in polythene pouches.

Why do we keep fish, meat and vegetables with salt in the hot sun?

Dehydration: Fish, meat and vegetables with salt can be dried in the sun to reduce the moisture content and the growth of micro-organisms. These are dehydrated under controlled conditions.

4.5. RELATIONSHIP BETWEEN MAN AND MICROBES

Balances, imbalances and uses

All existing things in the world and the universe around it made up of five basic elements, the earth, water, fire, air and space.

Human life and the knowledge of science as growing concern, have come into being almost simultaneously. In the past, man found that living in large groups was to his advantage. In this way, he had much better protection from his enemies. Man involved himself in many group activities, as a result ended up with many problems. The greatest problems of today are disease, population growth and pollution. Today in our present time, it is too late for any preventive measures

because the diseases are already with us, and therefore, good medical services, conservation methods, and socio biological approaches are required.

Social Biology

Social biology is the study of how man lives with other men, with animals and plants and how he affects each of these.

Man of course has developed his knowledge and understanding about microbes and to a greater extent and made use for his benefits in agriculture, soil fertility, medicine, industry and in genetic engineering.

Microbes are used as biological control. How?

Certain *Bacillus* species such as *B.thuringiensis* infect and kill the caterpillars of some butterflies and related insects. Since the bacteria do not infect other animals or plants they provide an ideal means of controlling many serious crop pests. This control measures is called as Biological control.

The role of microbes in genetic engineering

Viruses are used in eradicating harmful pests like insects. Vaccines are produced to prevent serious viral infections.

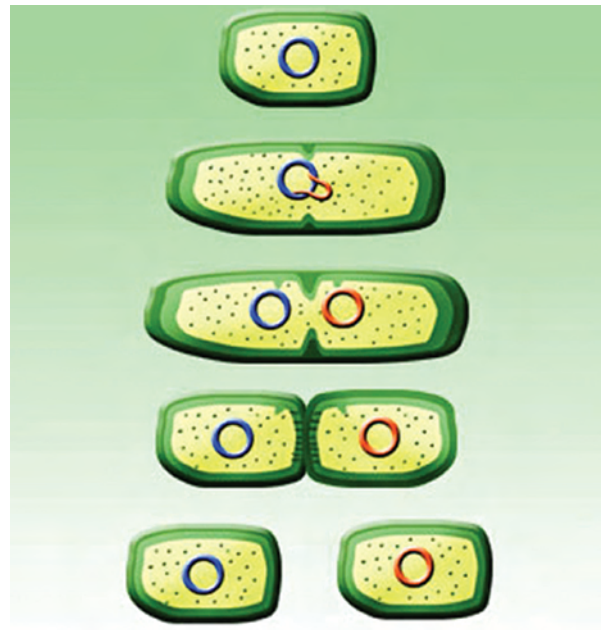
Viruses are useful too. Their ability to move genetic information from one cell to another makes them useful for cloning DNA and could provide a way to deliver gene therapy (transformation). In order to attain the desirable character such as insulin gene, nif gene the bacterial host such as *E.coli, Bacillus subtilis* and *streptomyces* are introduced.

Viruses are very much used as biological research tools due to their simplicity of structure and rapid multiplication.

Reproduction in bacteria by binary fission in which many bacteria multiply rapidly, explains the cause of spoilage of food stuffs, turning milk into curd, etc.

By conjugation method, the plasmid of donor cell, which has the fertility factor, undergoes replication. Fungi reproduce mostly by spore formation.

However sexual reproduction (conjugation) also takes place.



Binary fission in bacteria

ACTIVITY 4.4

Take two glass bottles and mark it A and B. Keep the vegetable waste, food wastes, in bottle A and cover the mouth of the bottle. Keep the damaged, plastic toys, metal toys in bottle B and close the mouth of the bottle with a lid. Observe the two bottles A and B after a week. Write your observation.

Saprophytic bacteria and fungi cause decay and decomposition of dead bodies of plants and animals. They release gases and salts to the atmosphere and soil. Hence, the micro-organisms like bacteria and fungi are known as Nature's scavengers many bacteria like *Rhizobium, Acetobacter* and *Clostridium* can fix atmospheric nitrogen as ammonia. This phenomenon is called **biological nitrogen fixation.**

Thus microorganisms maintain carbon, nitrogen and mineral cycles in nature.

The cyclic movements of chemicals of Biosphere between the organisms and the environment are referred as **Bio - geo cycle**.

Algal bloom: Under certain conditions, algae produce "blooms" i.e. dense masses of materials that cover the water surface, thereby decrease the oxygen content of water. This is followed by the death of aquatic organisms. Algal bloom leads to loss of species diversity which is known as **Eutrophication.**

Death of the coral reef in the ocean produces new pathogenic bacteria. Any septic operation theatre (Surgical arena) produces number of disease causing pathogens (disease causing microbes). Surgical wastes, medical wastes are dumped in catchment areas such as lakes, ponds and river banks cause communicable diseases.

Pathology is a science which deals with diseases of plants, animals and human beings caused by viruses, bacteria and fungi.

Man and microbes are in the biosphere. Man's interference with nature has caused imbalance in the biosphere. Man has to bring certain healthy changes in the field of agriculture and in industry in order to make a better habitat for his happy living with micro organisms. Let us start to create an eco-friendly nature for our better future.

Algal bloom

SCIENCE

Earth provides enough to satisfy everyman's need, but not every man's greed. **- M.K. GANDHI**

- Butter milk gets spoilt if kept in a brass vessel. Why?
- The starchy foods get spoilt at room temperature if kept more than a day. Why?

EXTENDED ACITIVITY:

Two loaves of same kind of bread were purchased for a family. One loaf was set out in a basket for breakfast. The other loaf was refrigerated at once. Some of the bread in the basket was not eaten and was later refrigerated. The family went away on vacation for ten days. When they returned one of the loaves was covered with mould. The other was mould free. Which loaf do you think was mouldy?

Account for the differences in the loaves.

EVALUATION

1. Choose the best answer :

   a). Algal bloom leads to loss of species diversity which is known as _____. (Eutrophication, Pasteurisation)

   b). Which one of the following cause amoebic dysentery? (Entamoeba histolytica, Plasmodium vivax, Plasmodium falciparum)

   c). Milk is heated to 72^{o} C for 30 minutes and then suddenly cooled to12^{o} C. Microbes are killed without causing damage to the taste and quality of milk. Name this process (dehydration, pasteurisation)

   d). Nodules are responsilble for nitrogen fixation. Name the bacteria present inside the root nodules. (*Acetobactor, Rhizobium, Clostridium*)

2. Living organisms show a great degree of diversity in their size. A considerable number of species are not visible to naked eye. They can only be seen with the help of a microscope. How will you measure the size of micro organisms?

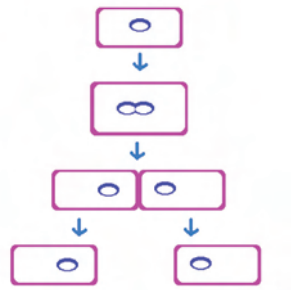
3. Fungi do not possess chlorophyll. Hence they are incapable of photosynthesis. So, they depend on either living organisms or non-living things. Name the two types of modes of nutrition in fungi.

4. Communicable diseases are pathogenic diseases which are spread from person to person either directly or indirectly. Write the mode of transmission of the following diseases.

   Cholera and typhoid

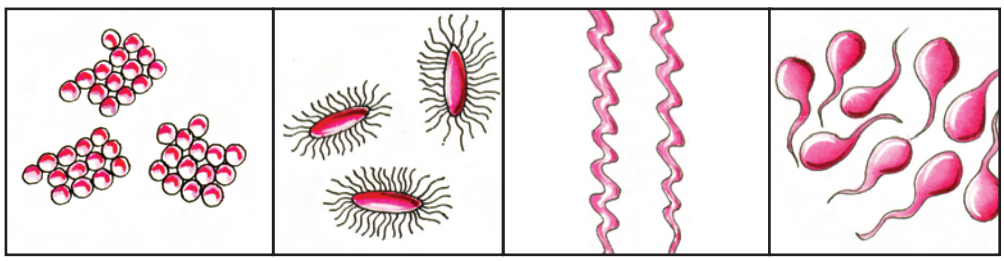
   Malaria

5. Find out the type of bacterial reproduction given in these diagrams.



6. The conversion of sugar solution into alcohol and liberation of carbon dioxide is known as fermentation. Which microorganism is responsible for this process?

7. i) Identify the following bacteria based on its shape.



   ii) Draw and label the following parts of the bacteria.

   a) Flagella b) pili c) cell wall cytoplasm cell membrane

8. In the world today many industries totally depend upon the microbial activities. For example, oxalic acid is the fermented product of fungi Aspergillus niger. Name any two bacteria used in industry with their product.

9. Farmers consider microorganisms such as bacteria, fungi and virus a menace on their fields and gardens because they cause disease to their crops. Name any one of the bacterial disease, viral disease and fungal disease.

SCIENCE

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	Biology- Wallace, Sanders and Ferl - Harper collins college publishers.
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