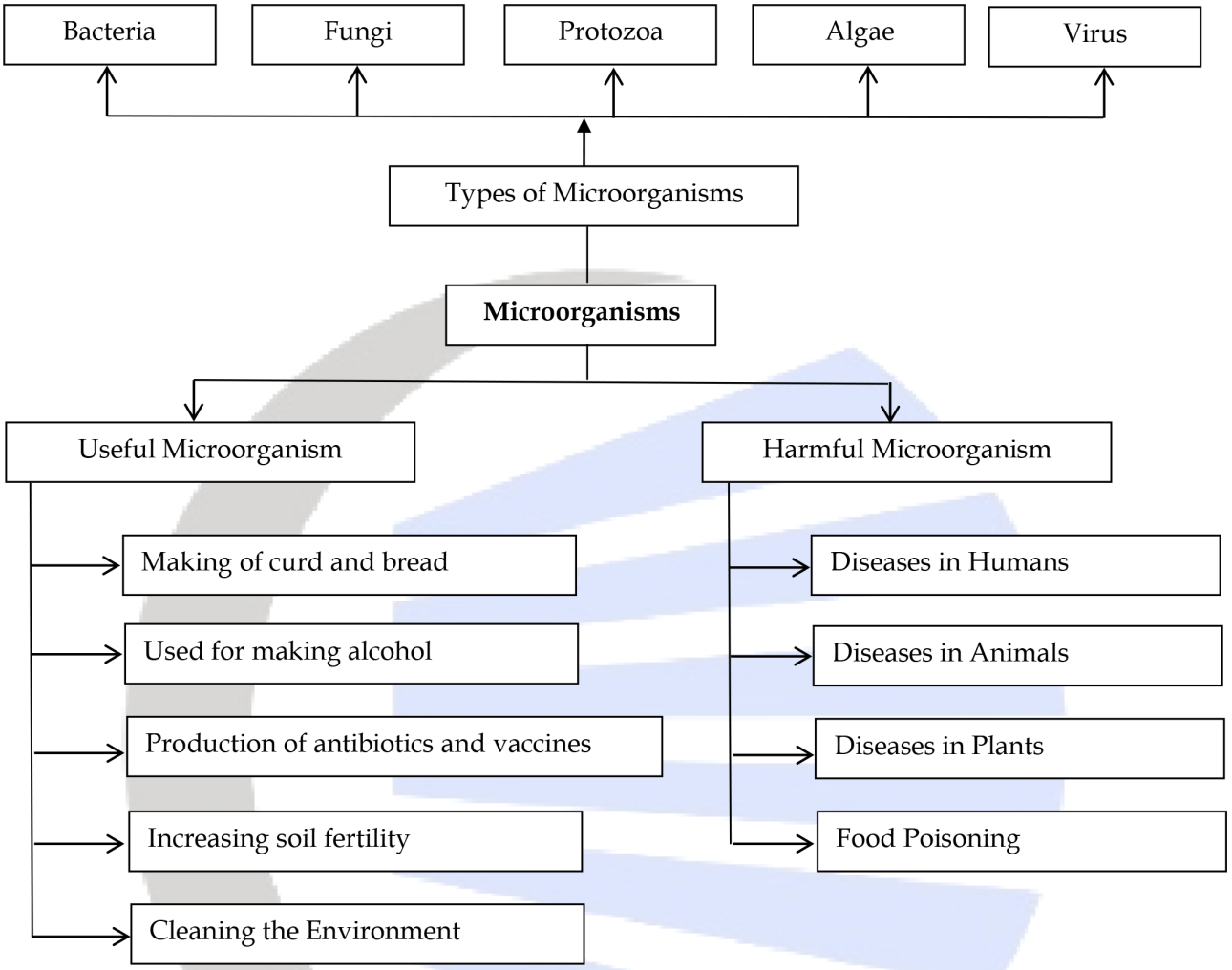
## MIND MAP




## QUICK RECAP

- **Micro-Organisms –** Organisms which are not visible to unaided eye and can be seen only under a microscope.
- **Antibiotics –** A chemical substance that is produced by microbes and have the ability to kill or stop the growth of pathogens.
- **Pathogens –** Deadly microorganisms causing diseases in plants, animals and humans.
- **Antibodies –** Chemical substance formed by the white blood cells in the body to fight against diseases.
- **Vaccine –** Introduction of dead and weak microbes in a healthy body orally or through injection to initiate antibody production which protect from the disease –causing microbes in the body.
- **Fermentation –** Conversion of natural sugar into alcohol by the yeast.
- **Nitrogen cycle –** Circulation of nitrogen through the living and non-living components of the biosphere.

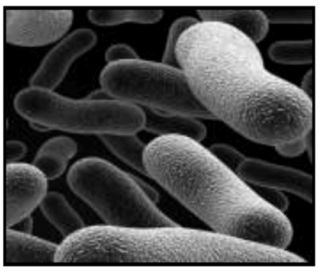
# 1. MICROORGANISMS

Organisms which are not visible to unaided eye but can be seen under a microscope are called **microorganisms** or **microbes**. The study of such microorganisms is called *microbiology*.

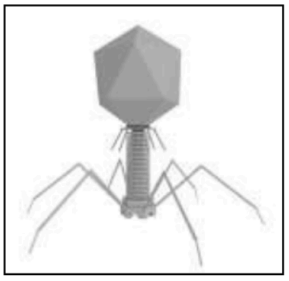
Microorganisms are classified into four major groups:

- **Bacteria**
- **Fungi**
- **Protozoa**
- **algae**
- Microorganisms may be single-celled like bacteria, some algae and protozoa or multicellular such as algae and fungi.

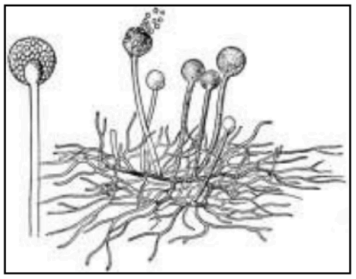
Viruses are also microscopic but are said to be on the borderline of living and non-living organisms as they show characteristics of both living and non-living organisms. They become active, once they enter a host organism which may be a bacteria, plant or animal. Viruses are parasitic in nature and can cause serious diseases like polio and chicken pox.



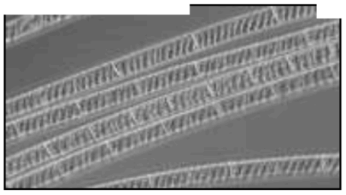
Bacteria



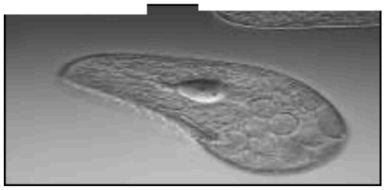
Bacteriophage (Virus)



Bread Mould (Fungi)



Spirogyra (Algae)



Protozoa

## 1.1 WHERE DO MICROORGANISMS LIVE?

Microorganisms are found in air, water, soil and even inside our bodies. They can be found in sandy deserts, cold ice-caps, fertile plains, hot springs, lakes, ponds, wells; almost everywhere they are found.

Many microorganisms can resist extreme climatic conditions as well. However, those which cannot resist, form a hard covering around themselves, called the *cyst*.

## 1.2 MICROORGANISMS AND US

Microorganisms play an important role in our lives. Some of them are beneficial in many ways whereas some others are harmful and cause diseases.

## 2. Friendly/ Useful Microorganisms

Microorganisms are used for various purposes like in preparation of curd, bread and cake. Microorganisms like bacteria are decomposers and help in decomposing dead plants and animals; hence, clean up the environment. Some microorganisms are also used in the preparation of medicines and even used in agriculture for increasing the soil fertility by fixing nitrogen.

### 2.1 MAKING OF CURD AND BREAD

Certain microorganisms are used in making food items like curd, cheese, bread, pickles, etc. *Lactobacillus* bacteria promote the formation of curd. It multiplies in milk and converts it into curd.

Yeast is used in the baking industry for making breads, pastries and cakes. It reproduces rapidly and produces carbon dioxide gas during respiration. Bubbles of the gas fill the dough and increase its volume.

### 2.2 COMMERCIAL USE OF MICROORGANISMS

Microorganisms are used for the large scale production of alcohol, wine and acetic acid (vinegar). Yeast is used for commercial production of alcohol and wine. Here, yeast is grown on natural sugars present in grains like barley, wheat, rice and crushed fruit juices, etc. and convert them into alcohol. This process of conversion of sugar into alcohol is known as *fermentation*.

The process of fermentation was discovered by Louis Pasteur.

### 2.3 MEDICINAL USE OF MICROORGANISMS

#### 2.3.1. Antibiotics:

Certain microorganisms like bacteria and fungi are used in the production of many antibiotics like penicillin, streptomycin, tetracycline and erythromycin. These antibiotics kill or stop the growth of disease-causing microorganisms in our body.

Antibiotics are also mixed with the feed of livestock and poultry to check microbial infection in animals and are also used to control many plant diseases.

Alexander Fleming discovered the first antibiotic Penicillin in 1929 while working on a disease causing bacteria.

> Antibiotics should be taken only on the advice of a qualified doctor and we must complete the course prescribed. If antibiotics are taken when not needed or in wrong doses can make the drug less effective when we might need it in future. Also, antibiotics taken unnecessarily may kill the beneficial bacteria in our body.
>
> Antibiotics are not effective against cold and flu as these are caused by viruses.

#### 2.3.2. Vaccines:

Vaccines are made on a large scale from microorganisms to protect humans and other animals from several diseases. In our childhood, we must have been given injections to protect ourselves from several diseases like polio, smallpox, hepatitis, tuberculosis, etc.

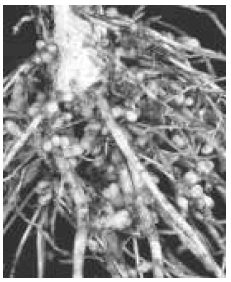
Edward Jenner discovered the first vaccine for smallpox in 1798.

***How a vaccine works?***

When a disease-carrying microbe enters our body, the body produces antibodies to fight the invader and also remembers how to fight the microbe if it enters again in future. In vaccination, dead or

weak microbes are introduced in a healthy body orally or through injection which cannot initiate disease in our body but can definitely initiate antibody production. This antibody remains in our body and we are protected from the disease–causing microbes.

### 2.3.3 Increasing Soil Fertility



Some bacteria like *Rhizobium* and *blue green algae* present in the root nodules of leguminous plants fix the atmospheric nitrogen as an usable form (nitrates) in the soil which can be absorbed by the roots of the plants along with water and other dissolved minerals and hence, increases soil fertility. These microbes are commonly called as biological nitrogen fixers.

**Cleaning the Environment**

We often see large amounts of dead organic matter in the form of decaying plants and sometimes dead animals on the ground which disappear after some days. This is because the microorganisms decompose the dead organic waste of plants and animals converting them into simple substances releasing the nutrients trapped inside their body in the surroundings. The nutrients released in the process can be used by other plants and animals. Thus, microorganisms can be used to degrade the harmful and smelly substances and thereby clean up the environment.

## 3. Harmful Microorganisms

Microorganisms are harmful in many ways. Some of the microorganisms cause diseases in human beings, plants and animals while some others spoil food, clothing and leather.

### 3.1 Disease causing Microorganisms in Humans

Disease causing microorganisms are often referred to as pathogens. Pathogens enter our body through the air we breathe, the water we drink or the food we eat. They can also get transmitted by direct contact with an infected person or carried through an animal.

Microbial diseases that can spread from an infected person to a healthy person through air, water, food or physical contact are called as communicable diseases. Example: Cholera, common cold, chicken pox and tuberculosis.

There are some insects and animals which act as carriers of disease-causing microbes. Housefly is one such carrier. The flies sit on the garbage and animal excreta. Pathogens stick to their bodies and when these flies sit on uncovered food, they may transfer the pathogens. Whoever eats the contaminated food is likely to get sick. So, it is advisable to always keep food covered and avoid consuming uncovered food items.

| Human Disease | Causative Microorganisms | Mode of Transmission | Preventive Measures |
|---|---|---|---|
| Tuberculosis | Bacteria | Air | • Keep the patient in complete isolation.<br>• Keep the personal belongings of the patient away from those of the others.<br>• Vaccination to be given at suitable age. |
| Measles | Virus | Air | |
| Chicken Pox | Virus | Air/Contact | |
| Polio | Virus | Air/Water | |

| | | | |
|---|---|---|---|
| Cholera | Bacteria | Water/Food | • Maintain personal hygiene and good sanitary habits.<br>• Consume properly cooked food and boiled drinking water.<br>• Vaccination. |
| Typhoid | Bacteria | Water | |
| Hepatitis B | Virus | Water | • Drink boiled water.<br>• Vaccination. |
| Malaria | Protozoa | Mosquito | • Use mosquito net and repellents.<br>• Spray insecticides and control breeding of mosquitoes by not allowing water to collect in the surroundings. |

### 3.2 Disease causing microorganisms in Animals

Several microorganisms not only cause diseases in human but also in other animals. Anthrax is a dangerous human and cattle disease caused by a bacterium. Foot and mouth disease of cattle is caused by a virus.

### 3.3 Disease causing microorganisms in Plants

Several microorganisms cause diseases in plants like wheat, rice, potato, etc. Plant diseases may result in a decrease in the crops yield. They are controlled by the use of certain chemicals which kill the microbes.

| Plant Disease | Microorganism | Mode of transmission |
|---|---|---|
| Citrus canker | Bacteria | Air |
| Rust of wheat | Fungi | Air, seeds |
| Yellow vein mosaic of bhindi (Okra) | Virus | Insect |

### 3.4 Food Poisoning

Food poisoning is the result of consumption of food spoilt by some microorganisms that grow on food and produces toxic substances. It may cause serious illness and sometimes even death. So, it is very important to preserve food and prevent it from being spoilt.

## 4. FOOD PRESERVATION

The food that is prepared in our houses, at times, gets spoilt very soon. At the same time, there are some food items like pickles, jams and jellies that do not get spoilt for a very long period of time. It has also been observed that food remains fresh for a longer period when kept in the fridge. During summer, the food gets spoilt faster in comparison to winters as microorganisms grow faster in warm and humid climate.

There are various techniques of preserving food so that the freshness of the food is maintained for a longer period of time. Some of them are discussed below.

### 4.1 Chemical Method

There are some chemicals that are added to food so that it remains unspoiled for a longer period. These chemicals are called preservatives. Some common preservatives are *Acetic acid (vinegar), Sodium Benzoate, Sodium Metabisulphite,* etc. These preservatives keep food items fresh and are used to check the spoilage of food items like jams and jellies.

### 4.2 Addition of Salt

Common salt is used in preserving meat and fish. The layers of dry salt on these food items prevent the growth of bacteria on them. Fruits like amla, raw mango and tamarind are also preserved in the same way.

### 4.3 Addition of Sugar

Jams and jellies are preserved by the addition of sugar in the form of sugar syrup. Sugar reduces the moisture content and thereby, prevents the growth of bacteria.

### 4.4 Use of oil and Vinegar

Use of oil and vinegar prevents the spoilage of pickles because bacteria cannot live in such environment. Vegetables, fruits, fish and meat are also preserved by this method.

### 4.5 Heat and Cold treatment

Boiling kills many microorganisms and hence, prevents food from getting spoilt. Similarly, low temperature inhibits the growth of microbes.

### 4.6 Pasteurization

In this method, milk is heated to about 700C for 15 to 30 seconds and then suddenly chilled and stored. This prevents the growth of microbes in milk. This process of preservation was discovered by Louis Pasteur.

### 4.7 Canning

After sterilizing the food, it is canned into airtight containers to prevent the attack of microbes. Now a day, many canned food items are available in the market.

## 5. NITROGEN CYCLE

- The Nitrogen Cycle: A sequence of processes by which nitrogen moves from the atmosphere through living and dead organisms, into the soil and back to the atmosphere.
- There are four main types of bacteria involved in the Nitrogen Cycle:
- **Decomposer bacteria** – decomposes proteins and urea and turns them into ammonia.
- **Nitrifying bacteria** – converts ammonia to nitrites and then into nitrates.
- **Nitrogen-fixing-bacteria –** turns atmospheric nitrogen into nitrogen compounds.
- **Denitrifying bacteria** – turns nitrogen compounds back into nitrogen gas. No help to living organisms.
- Nitrogen gas takes up **78%** of the air and is very unreactive. As a result, it cannot be used by organisms directly. Nitrogen is necessary for making proteins for growth, so it is essential they get it.
- Nitrogen in the air is turned into nitrogen compounds by nitrogen-fixing bacteria which is called nitrogen fixation. Nitrogen fixation also occurs with lightning as there is so much energy in a bolt of lightning that it's enough to make nitrogen react with oxygen to give nitrates.

- Nitrogen compounds, such as nitrates, can be absorbed by plants through the soil and use them to make amino acids (then to proteins). As animals can only get nitrogen compounds from eating plants, nitrogen compounds are passed along the food chain.
- Decomposer bacteria turn the proteins and urea in dead plants and animals and waste into ammonia. This ammonia can be converted into nitrites and then nitrates by nitrifying bacteria. As nitrates can be absorbed by plants, the nitrogen in these organisms is recycled.
- Some nitrogen-fixing bacteria live in the soil. Others live in nodules of the roots of leguminous plants. This is why leguminous plants are so good at putting nitrogen back into the soil, and for this reason they are often planted in a field before the main crop is planted in the same field so the main crop has a lot of nitrogen.
- If soils are lacking in oxygen, such as when they are waterlogged, then some denitrifying bacteria will convert the nitrates back into nitrites and others convert nitrites back to nitrogen gas.

## 5.1 Diagram of Nitrogen Cycle