



You might have observed that during rainy season moist bread gets spoilt and its surface gets covered with greyish white patches. You have heard about different types of diseases like malaria fever, T.B., dengue fever, typhoid, viral fever, etc. There are also probiotic foods which are good for our health. All these are just due to microorganisms. Thus microorganisms are an important part of our life.

**In this chapter, we will learn about :**

1. Types of microorganisms
2. Useful microorganisms
3. Harmful microorganisms
4. Nitrogen cycle in the atmosphere

## MICROORGANISM

A microorganism is a living thing that is too small to be seen with the naked eye. Examples of microorganisms include bacteria, archaea, algae, protozoa and microscopic animals such as the dust mite.

We know that microorganisms are responsible for many things that happen in the world around us.

Microorganisms are found virtually everywhere, except for environments that have been made artificially sterile by humans. Even these must be constantly sterilized and carefully protected, lest microorganisms be tracked in from the outside world.



Activity

1

**Aim :** To show that microorganisms live everywhere.

**Materials required :** A beaker, dropper, microscope.

**Procedure :** Collect some soil in a beaker and add water to it. After the soil particles have settled down, absorb some water from the beaker in a dropper.

**Observation :** Observe a drop of water under a microscope.

**Conclusion :** We can see single-celled organisms moving around in water.

Microorganisms live in water, in soil and on the skin and in the digestive tracts of animals. This is why all living things must have immune systems, while many microorganisms can be helpful to them, some can be harmful and cause disease.



Activity

2

**Aim :** Observing microorganisms in water from a waterbody.

**Materials required :** A glass slide, microscope.

**Procedure :** Take a few drops of water from a pond. Spread it on glass slide and observe the slide under a microscope.

**Observation :** You will see tiny single celled organisms floating about swiftly across the length and breadth of the slide.

**Conclusion :** Microorganisms are of various shapes.

Like all organisms, microorganisms play important roles in the ecosystems they inhabit. Here are a few of their roles.

## TYPES OF MICROORGANISMS

### Bacteria

Bacteria, now sometimes called “eubacteria” or “true bacteria” to differentiate them from archae bacteria are the type of microorganism you probably hear about the most.



Interesting Fact

Bacteria living in caecum of rabbits, cows and buffaloes helps in the digestion of cellulose.

This is because they're the type most likely to make you sick. Bacteria are the cause of most skin infections and can also cause food poisoning, pneumonia, strep throat and many other illnesses.



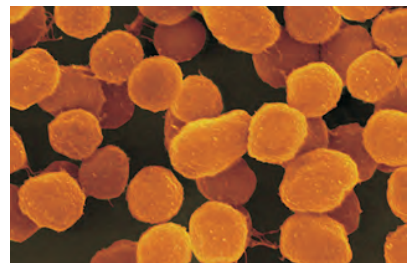
Bacteria

However, bacteria are also very helpful to humans. “Good bacteria” in our digestive tracts help us to extract nutrients from our food and help to fight pathogens that could hurt us.

### Archaea

Archaea, or archaeobacteria, were once thought to be part of the bacteria family. However, recent research has shown that they are much different from eubacteria and may even be more closely related to us than they are to modern bacteria.

Archaea can be found in many of the same places as bacteria in water, in soil and inside our digestive tracts, where they help us to stay healthy.



Archaea

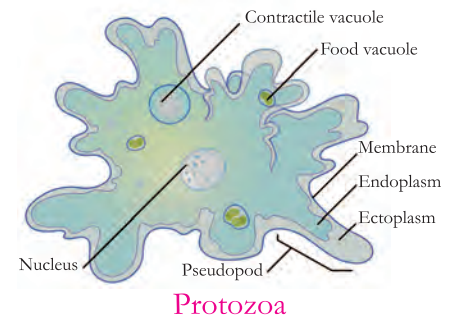
However, archaeobacteria can also be found in some unusual places, many are able to live in environments that are very hot, very cold, very acidic, or very salty.

This makes them a common finding inside hot springs and other places where other organisms cannot easily survive.

## Protozoa

Protozoa are a diverse group of unicellular eukaryotic organisms. Like bacteria and archaea, they are single-celled; but their cells resemble those of animals and plants more than those of bacteria or archaea.

Several dangerous human diseases including malaria, toxoplasmosis, giardia, African “sleeping sickness,” and Chagas disease are caused by protozoa.



Protozoa

## Fungi

Though some microscopic fungi can infect humans just like bacteria or protozoa, there’s one microscopic fungus that most humans like a lot: yeast!

Yeast is the fungus that is responsible for making baked goods rise; and for producing alcoholic beverages such as beer, wine and liquor.

Yeast feeds on sugars found in foods and converts it into carbon dioxide and yes, ethyl alcohol. The carbon dioxide can make our breads and cakes fluffy; and the alcohol can build up to intoxicating levels, if yeasts are bottled with a high concentration of sugar.



Fungi

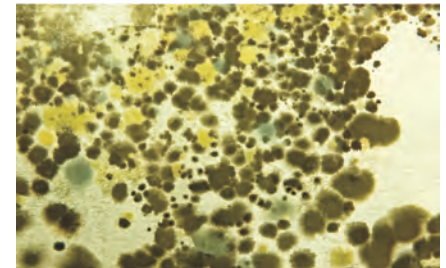
## Molds

Molds are microorganisms that share some properties of fungi, but are not true fungi.

These include pathogenic molds that infect plants and have caused devastating crop failures such as the Great Irish Famine of the 1840s.

They also include the fantastically weird class of slime molds single-celled organisms that are capable of cooperation so impressive that, during one stage of their life cycle, many slime mold cells gather together and operate like a single organism.

Slime mold intercellular cooperation is so impressive that scientists have been using slime molds to study intelligence and problem-solving!



Molds

## Algae

Microscopic algae were once thought to be plants, but recent studies have shown that algae don’t fit into the plant family. Instead, these single-celled photosynthetic organisms are thought to be relatives of the lineage that led to land plants.

Throughout history, algae have been important photosynthesizers.



Algae

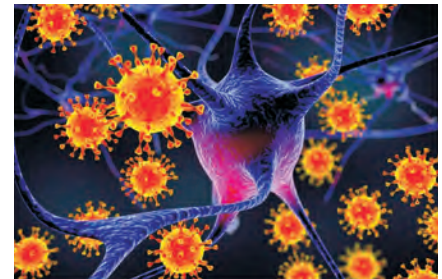


They likely evolved before land plants did and helped to pump oxygen into Earth's atmosphere along with their ancestors, the cyanobacteria.

Today algae can both help and hurt humans. Some species clean water and produce oxygen, while others produce dangerous toxins that can end up in our seafood and drinking water.

## Viruses

Viruses are acellular microorganisms, which means they are not composed of cells. Essentially, a virus consists of proteins and genetic material either DNA or RNA, but never both. They are inert outside of a host organism. However, by incorporating themselves into a host cell, viruses are able to co-opt the host's cellular mechanisms to multiply and infect other hosts.



Viruses

### Interesting Fact

Viruses reproduce only inside the cells of the host organisms which may be a bacterium, plant or animal.

Viruses can infect all types of cells, from human cells to the cells of other microorganisms. In humans, viruses are responsible for numerous diseases, from the common cold to deadly Ebola. However, many viruses do not cause disease.

## GROWTH OF MICROORGANISMS

We have already learnt in this chapter that microorganisms can survive in all types of environments like deserts, ice cold regions, marshlands, hot springs, etc. They are also found inside the bodies of animals and humans.

The following conditions are suitable for the growth of microorganisms.

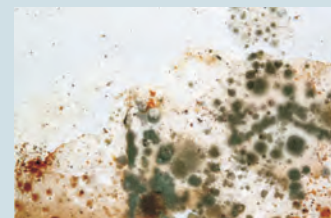
1. **Water :** This is the most essential requirement and is available as moisture.

### Activity 3

**Aim :** To check the effect of moisture on microbes.

**Material required :** A slice of bread.

**Procedure :** Moisten a slice of bread. Leave it exposed for a while and then cover it and leave it in a warm place for 2 days. After 2 days, check to see, if the mould growing on the bread has blackish dots. If not, wait for another couple of days and check again.



**Observation and conclusion :** There is a cottony growth with some black dots all over the slice of bread. Now, observe it under a microscope. We can see the hyphae clearly.

The round structure at the head of hyphae are the sporangia in which spores are present. When they burst, the spores are released into the air.

- Sunlight :** Most microorganisms thrive best in dark places and direct sunlight kills them.
- Oxygen :** Microorganisms which require oxygen for respiration are known as aerobic, e.g. streptococcus, staphylococcus, etc.
- Food :** Depending upon the food supply, microorganisms can be saprophytic, parasitic, photosynthetic, etc.
- Temperature :** The best temperature for the growth of microbes is between 25°C and 38°C.



**Aim :** To check the effect of temperature on microbes.

**Materials required :** 1 kg mango and a refrigerator.

**Procedure :** Purchase 1 kg mango. Keep half of them in refrigerator and half at room temperature for a few days.

**Observation :** The mangoes that were kept outside were spoilt and rotten, but the mangoes kept in refrigerator were fresh.

**Conclusion :** Microorganisms were active at room temperature. They spoiled the mangoes and changed their colour, taste and smell. It is a chemical reaction because enzymatic reaction has taken place inside the pulp of mangoes.

## USEFUL MICROORGANISMS

Microorganisms have uses and benefits across all aspects of human life. From the bacteria that help humans digest food to the viruses that help plants resist heat, bacteria, viruses and fungi. When used properly, they are key components in food, medicine, agriculture and other areas. In the future, they may even be core components of infrastructure and other new technologies.

Microorganisms, in the form of viruses, fungi and bacteria, are everywhere. It's impossible to avoid them when the human body contains 10 times more bacteria than human cells. They have uses everywhere, from agriculture to cutting-edge medical technology. Every year, researchers are finding new uses and benefits of microorganisms to be applied in medicine, infrastructure, cooking and other areas.

### Environmental Benefits

Bacteria and fungi are required to maintain a healthy environment. Not only do they recycle natural wastes and dead animal and plant matter, they also produce many of the nutrients that plants need to grow. Bacteria, in particular, are the only living things that can fix nitrogen for use in plants. At the same time, microorganisms work in tandem with certain plants to aid them. Some viruses have



been found to provide heat resistance to grasses in arid locations and many plants store bacteria in their roots to help absorb certain nutrients more easily.

## Commercial Uses

In addition to their direct environmental benefits, microorganisms are important partners when it comes to the work of creating food. They can be used to increase the fertility of the soil and increase crop yields and they are necessary when making products like bread, beer and cheese and when growing coffee. At the same time, foods with probiotic properties, such as yogurt and certain types of chocolate, deliver helpful microorganisms to our digestive systems.

- 1. Production of Dairy Products :** Bacteria are the key players here. Bacteria help in fermentation which helps in making different forms of dairy products from milk like curd, buttermilk, butter, cheese. *Lactobacillus* is the most common genus of bacteria that are used in the commercial production of this product.
- 2. Bread Baking :** A species of *Streptococcus* is added to the dough before making bread to bring about the required fermentation.
- 3. Alcoholic Drinks :** Alcoholic drinks are prepared or manufactured by the process of fermentation. Each drink is derived from a different starting product such as potato and grapes. Then it is fermented, distilled and alcohol is prepared. The commonly used microorganism here is different types of fungus like yeast. Some even use bacteria and fungus. Alcoholic drinks include wine, rum, vodka, etc.

## Medical Benefits

We regularly aid the microorganisms in our bodies by adding more. Though certain species of microorganisms can make you sick like strep throat. The flu and measles are nothing to laugh at. Modern medicine would not exist if not for the careful study of microorganisms. Bacteria and viruses are the key components of the vaccines that prevent the spread of once-deadly diseases like smallpox. Today microorganisms allow us to artificially grow helpful substances such as insulin and human growth hormones and reprogrammed viruses are frequently used as drug-delivery mechanisms.

- 1. Steroid Production :** Some bacterial and fungal species are used in the preparation of steroids that are then injected into the human body for different purposes.
- 2. Production of Vitamins :** An essential vitamin that people need for proper digestion is Vitamin B 12. Fungi are responsible for manufacturing B12.
- 3. Production of Antibiotics and Antivirals :** Bacteria and viruses are isolated and their antigens and enzymes are extracted. These antigens help in the development of antibiotics and antivirals.

## Agricultural Uses

- 1. Help in Sewage Treatment :** Not only are microorganisms helpful to our body, they are also helpful to the environment. They help in the secondary treatment stage of sewage treatment.
- 2. Used as Insecticides :** Certain bacterial and fungal species are used to keep certain insects and pests away from crops.

- 3. Fertility of Soil :** Microorganisms play a very important role in maintaining the fertility of the soil. They help in the composting process which forms manure. Also, microorganisms present in the soil help aerate it and enrich the soil with nitrates and other nutrients. These nutrients are needed by the crops for an abundant harvest.



**Aim :** To test the functions of microbes on biodegradable waste.

**Materials required :** Two pots, soil, some plant waste, Polythene bags, plastic bags.

**Procedure :** Take two pots. Fill half portions of each pot with soil. Put plant wastes in the first pot and polythene bags along with broken plastic toys in the second pot.

**Observation and conclusion :** After 3-4 weeks, the plant wastes in the first pot decomposes to form manure, by the action of microbes. Plant grows well in the first pot but cannot grow in the second pot because plastic toys and polythene do not degrade and remain as such in the soil. The plant waste is biodegradable waste while the polythene and other waste are non-biodegradable.

## Bodily Benefits

Microorganisms known as gut flora help us digest food and regulate the production of vitamins and nutrients essential for keeping our bodies strong and healthy. Bacteria are the first line of defense the human body has against infection. The bacteria in our bodies produce natural antibiotics to repel harmful microorganisms and if a foreign virus does infect us, many people are host to a beneficial virus that slows the rate of viral spread in the body.

## Technology and the Future

Applications of microorganisms in our world are constantly being studied. Certain fungi have been theorized to have anti-cancer properties and the CRISPR Cas9 gene found in certain types of bacteria is currently being used as a gene-editing tool. Viruses have the potential to act as the future of nanotechnology and bacteria are currently being tested as the core component of self-repairing concrete that could revolutionize infrastructure and the way we build buildings.

**Biotechnology and Research :** So many labs use bacteria, fungi and especially viruses for research studies. Non- virulent forms of these microorganisms are injected into subjects going through clinical trials. This in future helps in the development of medicines, vaccinations and cure for diseases. And DNA and RNA studies also make use of them.

## HARMFUL MICROORGANISMS

Harmful microorganisms are the ones that we need to stay clear of because they make us fall ill by causing diseases.

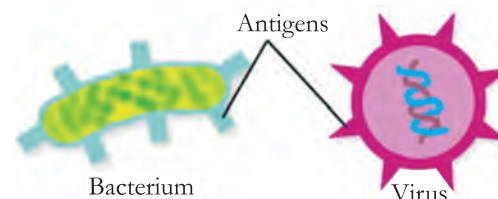
Disease-causing micro-organisms can be classified into four main groups :

- ❖ Bacteria
- ❖ Virus
- ❖ Fungus
- ❖ Protozoa

These harmful micro-organisms or disease causing microorganisms are always looking for a chance to enter our body and cause a disease. Most diseases in the world are caused by these micro-organisms, for example, the common cold and flu, malaria, diarrhoea, pneumonia, urinary tract infections, chicken pox, hepatitis, polio, etc.

Disease causing microorganisms outnumber our body cells in a large way. They are present on the skin and various orifices of our body through which they can enter into the system such as:

- ❖ Respiratory Tract
- ❖ Genital Tract
- ❖ Urinary Tract



Once these microbes enter the system, depending on their own constitution, they look for their target site and attach themselves there. Once they firmly attach themselves, they release toxins and enzymes to stay grounded and at the same time start multiplying and increase in number. The microbes derive nutrition from the host's body. The toxins and enzymes released by these microbes make the cells of the host weak or 'ill' or affected. These toxins can even be spilt into the bloodstream and reach other parts of the body which can also be affected. This way the microbes are able to make the body, they are in, sick! The manifestation of these toxins and enzymes released on the tissues are varied such as inflammations, swellings, bleeding, wounds, pustules, fever, sneezing, itching and general weakness in the body.

## Transmission

Microbes can be transmitted through different routes: few are airborne, few are waterborne, some travel on top of other animals, some are transmitted through human touch, some through touching contaminated surfaces or objects and some through ingesting contaminated water and food. Keeping clear of obvious contaminated or infected areas is important.

In case of plants, there is a host defence mechanism that helps fight these microorganisms as in the case of animals. But, the microorganisms that affect plants and animals are very different. Different species of bacteria, virus and fungi affect plants.

Disease causing pathogens are therefore present everywhere. Whether they are able to enter our body and cause a disease is in our hands to a large extent. Advances in medicine have been made to make our body's immune system stronger with preventive medicines and vaccinations. There have been biotechnological advances to protect plants as well from infestations and plant diseases.

## Food Spoiling Microbes

**Food Spoilage :** It is the change of look, consistency, flavour and odour of foods and is caused by bacteria, moulds and yeasts.

**Bacteria :** Examples of action of bacteria involved in food spoilage:

1. **Lactic acid formation :** Lactobacillus, Leuconostoc
2. **Lipolysis :** Pseudomonas, Alcaligenes, Serratia, Micrococcus



Food Spoilage



3. **Pigment formation** : Flavobacterium, Serratia, Micrococcus
4. **Gas formation** : Leuconostoc, Lactobacillus, Proteus
5. **Slime or rope formation** : Enterobacter, Streptococcus

**Moulds** : Some strains produce mycotoxins under certain conditions.

1. Aspergillus produces aflatoxin, ochratoxin, citrinin and patulin
2. Fusarium
3. Cladosporium
4. Alternaria

### Interesting Fact

A bread slice left for 2-3 days under moist conditions gets covered with white cottony fluffy mass. It is a fungus.

Mycotoxins can penetrate into the parts of food that are not visibly mouldy as well. It is therefore necessary to throw away all of the food if any part of it is mouldy. They are also notoriously difficult to destroy as they are stable to both heat and chemicals.

- ❖ **Hepatotoxins** : aflatoxins, sporidesmins, luteoskyrin
- ❖ **Nephrotoxins** : ochratoxin, citrinin
- ❖ **GIT Toxins** : trichocetens
- ❖ **Neuro- and Myotoxins** : tremorgens, citreoviridin
- ❖ **Dermatotoxins** : verukarins, psoralen, sporidesmins, trichocetes
- ❖ **Respiratory Tract Toxins** : patulin

Foods most at risk for moulds :

1. Grains and grain products—many mycotoxin types
2. Peanuts, nuts and pulses—aflatoxin
3. Fruits and vegetables (raw and preserved)—patulin
4. Milk and milk products—aflatoxin

It is important to note that if any contaminated fodder is fed to animals, this is metabolized and the toxic derivatives can be found in animal products consumed by humans, e.g. milk and meat.

## Food Preservation

Food preservation is a process by which edible items such as fruits and vegetables are prevented from getting spoilt. The nutritive value, flavour and colour of the foods preserved remain intact. This is done to increase the life of the food product and enable its storage and supply.

The main aim of food preservation is to prevent the food that is being preserved from decay by microorganisms.

The principles it works on are:

1. Preventing microorganisms in the food that is being preserved, i.e. maintaining asepsis.

2. Removal of microorganisms.
3. Preventing or hindering the growth of microorganisms by various methods such as low temperatures, drying, use of chemicals, etc.
4. Killing the microorganisms by various methods such as heating and radiation.

Some food substances can self-decompose due to the enzymes that are present in them. In these cases, the enzymes are deactivated at the time of food preservation.

Some foods are also susceptible to insects or animals and so the utilisation of appropriate chemicals is done to kill them and prevent them from destroying the food.

## Methods Used for Food Preservation

Food preservation methods are broadly divided into three:

1. Biological
2. Physical
3. Chemical

The commonly used methods of food preservation fall into one of the above categories. The main purpose of all these methods is to either prevent or retard spoilage of food items.

1. **Filtration** : This is done for liquids such as juices. The process applies pressure while the liquid is passed through a very fine sieve. This results in the liquid passing through while the microbes cannot and thus the liquid obtained is sterile.
2. **Heat Treatments** : There are different kinds of heat treatments that can be done such as boiling at 100 degrees Celsius, boiling above 100 degrees Celsius (sterilisation) or pasteurisation (as done in case of milk)
3. **Low-temperature Treatments** : The most commonly used method even in households—using a refrigerator. The refrigerator maintains a low temperature such that it slows down the growth of microbes and keeps food fresh for longer. Freezing is another low-temperature method used to preserve food where the temperature is maintained at -18 degrees Celsius.
4. **Using Chemicals or Preservatives** : These are substances that are added to foods to prevent or slow down their spoilage. The preservatives that are added, need to fulfill certain criteria before they are deemed fit to be added to foods. Few properties of preservatives are : they should be able to inhibit a wide range of microbes, should be safe for human consumption, should not affect the taste, flavour, colour or properties of the food being preserved, should not activate any other change in the food being preserved. Commonly used preservatives are sulfites, sorbic acids, sodium nitrate and benzoic acid.
5. **Acids** : Citric acid and Acetic acid are commonly organic acids that are used to preserve food substances such as pickles, sauces, chutneys and vegetables. Being acidic, they inhibit the growth of the micro-organisms and thus are effective food preservatives.



6. **Drying** : Many foods such as chips, papad, vegetables like methi or ginger are dried or dehydrated and preserved. By dehydrating, the moisture inside these substances is removed and thus microorganisms are unable to thrive on them, thus, preserving them.
7. **Radiation** : This method of preservation is used commonly for increasing the shelf life of meat, seafood and poultry. Irradiating these food substances helps to kill any pathogens and microbes that are present in them and prevent the growth of others.



Humans have always tried and preserved their food items and other perishable items. The methods have either changed or evolved, but the purpose remains the same.

## NITROGEN FIXATION AND NITROGEN CYCLE

The air we breathe contains 78% nitrogen, 21% oxygen and remaining are other trace gases. The nitrogen component of air is inert. So this means plants and animals cannot use it directly. To be able to use nitrogen, plants convert atmospheric nitrogen to nitrates, nitrites and ammonia compounds by a process called the nitrogen cycle. Animals derive their nitrogen requirements from plants.

### The Steps Involved In The Nitrogen Cycle

Nitrogen cycle consists of four main steps namely:

1. Nitrogen Fixation
2. Ammonification/Decay
3. Nitrification
4. De-nitrification

### Interesting Fact

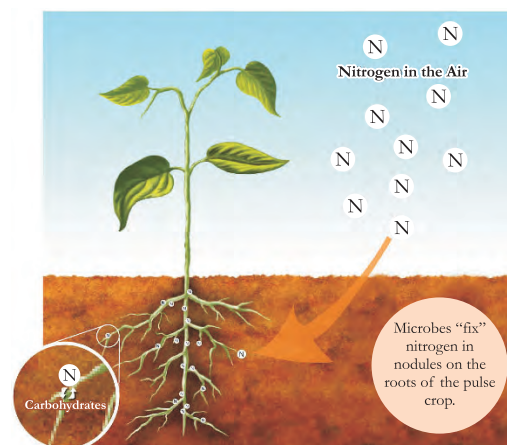
Nitrogen fixation by microorganisms produces about 178 million tones of Nitrogen compounds per year.

It is important to note that microorganisms play an important role in each of these steps.

### The Mechanism of Each of These Steps

**Nitrogen Fixation** : This is the first step of the nitrogen cycle. This step is characterised by the conversion of atmospheric  $N_2$  into ammonia ( $NH_3$ ). Bacteria like Azotobacter and Rhizobium have a major role in this process. They are harbored in the roots of the leguminous plants and help convert inert nitrogen to ammonia. Nitrogen fixation can occur in any of the following ways: atmospheric fixation (involves lightening), industrial fixation (manufacturing ammonia under high temperature and pressure condition).

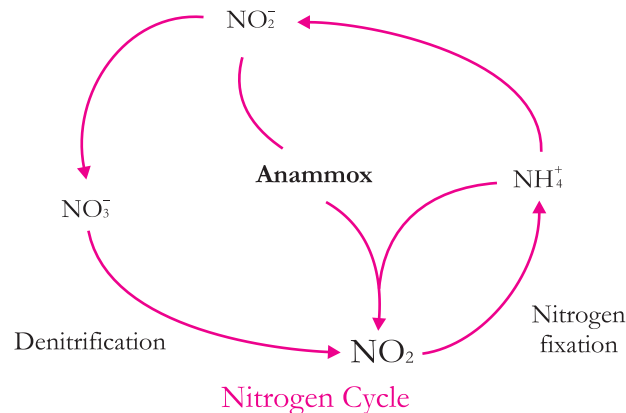
**Assimilation** : Once nitrogen has been fixed in the soil, plants can absorb nitrogen through their roots. This process of absorption is known as **assimilation**.



Pulse Crop with Root Nodules

**Ammonification :** This is another process by which ammonia can be generated. Organic remains of plants and animals are broken down in the soil by some bacteria to release ammonia into the soil. These dead and waste matter is used by these microorganisms as food and they release ammonia into the soil.

**Nitrification :** This occurs in two steps. The first step is in which  $\text{NH}_3/\text{NH}_4^+$  is converted to  $\text{NO}_3^-$  (nitrates). The bacteria *Nitrosomonas* and *Nitrococcus* present in the soil convert  $\text{NH}_3$  to  $\text{NO}_2^-$  and another bacterium, *Nitrobacter* converts  $\text{NO}_2^-$  to  $\text{NO}_3^-$ . These bacteria gain energy through these conversions.



**Denitrification :** It is the reverse of nitrification that occurs in the deep layers of soil where the bacteria convert  $\text{NO}_3^-$  into  $\text{N}_2$  and other gaseous compounds like  $\text{NO}_2$ . This occurs because in deep layers of soil, oxygen is not available and the soil bacteria use these nitrogen compounds instead of oxygen.

### Importance of the Nitrogen Cycle

- ❖ As we all know by now, the nitrogen cycle helps bring in the inert nitrogen from the air into the biochemical process in plants and then to animals.
- ❖ Plants need nitrogen to synthesise chlorophyll and so the nitrogen cycle is absolutely essential for them.
- ❖ During the process of ammonification, the bacteria help degrade decomposing animal and plant matter. This helps in naturally cleaning up the environment.
- ❖ Due to the nitrogen cycle, nitrates and nitrites are released into the soil which helps in enriching the soil with nutrients needed for cultivation.
- ❖ As plants use nitrogen for their biochemical processes, animals obtain the nitrogen and nitrogen compounds from plants. Nitrogen is needed as it is an integral part of the cell composition. It is due to the nitrogen cycle that animals are also able to utilise the nitrogen present in the air.

### Key Words

<b>Microbes</b>	: Very small living organisms which can only be seen through a microscope
<b>Vaccine</b>	: A small dose of weakened or killed disease-causing microbe to immunise the body against a particular disease
<b>Carriers</b>	: Insects/animals which carry the disease causing microorganisms from one place to another

- Pathogens** : The disease-causing microorganisms  
**Pasteurization** : Heating-cooling treatment given to milk to sterilise it  
**Nitrogen Fixation** : The conversion of atmospheric nitrogen into useful nitrogen compounds

## Important Points

1. Microorganisms are too small and are not visible to the unaided eye.
2. They can live in all kinds of environment, ranging from ice cold climate to hot springs and deserts to marshy lands.
3. Microorganisms are found in air, water and in the bodies of plants and animals.
4. Microorganisms include bacteria, fungi, protozoa and some algae. Viruses, though different from the above mentioned living organisms are considered microbes.
5. Viruses are quite different from other microorganisms. They reproduce only inside the host organism; bacterium, plant or animal cell.
6. Some microorganisms decompose the organic waste and dead plants and animals into simple substance and clean up the environment.
7. Some microorganisms are useful for commercial production of medicines and alcohol.
8. Protozoans cause serious diseases like African 'sleeping sickness' and malaria.
9. Some microorganisms reside in the root nodules of leguminous plants. They can fix nitrogen from air into soil and increase the soil fertility.
10. Some bacteria present in the soil fix nitrogen from the atmosphere and convert it into nitrogenous compounds.
11. Some of the microorganisms grow on our food and cause food poisoning.
12. Certain bacteria convert compounds of nitrogen present in the soil into nitrogen gas which is released into the atmosphere.

## Exercise

### Multiple Choice Questions (MCQs)

#### A. Tick (✓) the correct option :

1. Which one of the following is not a bacterial infection?  
 (a) whooping cough  (b) typhoid  (c) pneumonia  (d) measles
2. In legumes, the root nodules contain the bacterium :  
 (a) Rhizobium  (b) Spirocheta  (c) Bacilli  (d) Diplococcus
3. Lactobacillus is a :  
 (a) bacterium  (b) virus  (c) protozoan  (d) fungus
4. Which of the following is used to make bread soft and porous?  
 (a) yeast  (b) aspergillus  (c) bacteria  (d) chlorella



5. Which of the following is responsible for making bread soft and fluffy?
- (a) finely ground flour  (b) CO<sub>2</sub> gas released during fermentation of sugar
- (c) sugar  (d) alcohol given off during fermentation of sugar
6. Radiation of food items helps in preservation by :
- (a) killing microbes  (b) removing water from the cells
- (c) lowering temperature  (d) increasing acidity

**B. Fill in the blanks :**

- \_\_\_\_\_ and \_\_\_\_\_ are preserved by Acids.
- Conversion of nitrates present in the soil or water into free molecular nitrogen is called \_\_\_\_\_.
- Ammonification is another process by which \_\_\_\_\_ can be generated.
- Protozoa are a diverse group of \_\_\_\_\_ organisms.
- Viruses are \_\_\_\_\_ which means they are not composed of cells.
- \_\_\_\_\_ of milk destroys bacteria.

**C. Match the following :**

**Column A**

- Immunisation
- Food poisoning
- Fungi
- Lactobacillus
- Infectious disease

**Column B**

- Clostridium botulinum
- vaccine
- Microorganism
- Curd
- Cholera

**D. Very Short Answer Questions :**

- Define algae with one example.
- What is a microorganism?
- What is fermentation?
- Name the instrument used to see microorganisms.
- Name a disease caused by bacteria.

**E. Short Answer Questions :**

- Define the term pathogens.
- Some microorganisms act as decomposers. How are they useful to us?
- What is the use of bacteria that reside in the caecum of rabbits, cows and buffaloes.
- What are the medical benefits of useful microorganisms.
- Name the modes of transmission of microbes.
- Name two food preservatives used for preserving fruit juice, jam and jellies.

**F. Long Answer Questions :**

- Why do mangoes get spoiled, but not the jam prepared from them?
- What is nitrogen fixation and nitrogen cycle?
- Describe the commercial use of useful microorganisms.
- Explain any two methods of food preservation.
- Explain the process of nitrogen fixation.



6. Write the beneficial actions of :

- (a) bacteria      (b) fungi      (c) algae



## Assignments

### A. Read the passage and answer the following questions.

Although there are both helpful and harmful bacteria. The helpful bacteria assist with the digestion of foods in several kinds of animals including cows, deer, sheep and others. The bacteria help break down some of the foods the animals eat. In humans, a bacteria called E. coli also occur in the digestive system breaking down many kinds of foods. It is responsible for producing vitamin K and certain B vitamins.

Other bacteria are decomposers in the food chain, which attack dead animals and break them down. They are then used as nutrients by plants. Bacteria is also part of the production of many foods eaten by people. Bacteria causes milk to become sour which helps in the production of buttermilk, cottage cheese and yogurt. Bacteria is involved in the production of sauerkraut and vinegar too.

Unfortunately, bacteria are best known by the disease it causes. It can directly attack the tissues in a plant or animal. Sometimes fruits or vegetables become discolored due to the attack by bacteria. Bacteria can also cause harm to organisms by releasing chemicals that are poisonous to plants and animals. One type is responsible for a disease known as tetanus, which can paralyze the muscles of a person. The condition when this occurs is called lockjaw. Finally, the worst type of food poisoning is caused by a bacterium releasing a toxin. This type of food poisoning is called botulism.

There are also harmful bacteria living on the skin, but are not dangerous unless they enter the bloodstream through a cut in the skin. If E. coli, though helpful with digestion, enters the bloodstream it can cause cramping, diarrhea and maybe even death.

1. Where is bacteria E. coli occur?
2. What is the function of decomposers?
3. Why the fruits or vegetables are discoloured?
4. What is lockjaw?