

2

Microorganisms: Friend and Foe

TOPICS COVERED

2.1 Microorganisms and Their Types

2.2 Effects of Microorganisms on Humans – Useful and Harmful

2.3 Food Preservation and Its Methods

2.4 Nitrogen Cycle

IMPORTANT POINTS TO REMEMBER

- Organisms that are too small to be seen with naked eyes and can only be observed through a microscope are called **microorganisms or microbes**.
- Four major groups of microorganisms are: **Bacteria, fungi, protozoa** and **algae**.
- Diseases caused by virus are cold, influenza (flu), coughs, polio and chickenpox.
- **Dysentery** and **malaria** are caused by protozoa.
- Typhoid and tuberculosis (TB) are **bacterial diseases**.
- Microorganisms are used for various purposes such as preparation of curd, bread, cake, alcohol, vinegar, antibiotics etc.
- **Fermentation** is the process of converting sugar into alcohol.
- **Pasteurisation** was discovered by Louis Pasteur.
- Microorganisms like amoeba **can live** alone while fungi and bacteria may live in colonies.
- Rhizobium, living in the root nodules of leguminous plants fixes nitrogen from air into soil and increases soil fertility.

2.1 MICROORGANISMS AND THEIR TYPES

Microorganisms:

- Organisms that are too small to be seen with naked eyes and can only be observed through a microscope are called **microorganisms or microbes**.
- They inhabit a wide range of habitats ranging from ice cold climate to hot springs and deserts to marshy lands.
- They are found in air, water and in the bodies of plants and animals including humans.
- They may be unicellular (single celled) or multicellular.
- Microorganisms include bacteria, fungi, protozoa and algae. Viruses though different from the mentioned living organisms, are also considered as microbes.
- Microorganisms are both useful and harmful for humans.
- They cause diseases in plants and animals and also spoil food items.
- They are used for various purposes like preparation of curd, bread, cake etc. and decomposition of organic waste.

Types of Microorganism: Microorganisms found on earth show differences in their characteristics. On the basis of these features, they are classified as:

- (i) *Bacteria* are the simplest single celled organisms that are found almost everywhere – in air, in water, in soil, in the bodies of living organisms including humans. They live in colonies. They are found in three different shapes:
 1. Rod-shaped cells called bacilli
 2. Spherical shaped cells called cocci
 3. Spiral shaped cells called spirilla
- (ii) *Algae* are simple plant like organisms with cell walls and chlorophyll. They make their own food by photosynthesis. They do not have roots, stems and leaves. They may be unicellular or multicellular. They are generally aquatic. E.g. *Spirogyra*, *Chlamydomonas* etc.
- (iii) *Protozoa* are unicellular organisms with animal like characteristics. They capture food. Some live in fresh water or salt water, soil and as parasites in the body of other organisms like humans. Eg *Amoeba*, *paramecium* etc.
- (iv) *Fungi* are plant like organisms that do not contain chlorophyll. They may be unicellular (yeast) or multicellular (bread mould). Though fungi are found in a wide variety of habitats, they grow best in dark, warm and moist places.
- (v) *Viruses* are smaller than any known living cell. They do not have a regular cell structure like other microbes. They cannot reproduce by themselves. When a virus enters the living cell of an organism like humans, it reproduces using the host's machinery and nutrition. A virus can multiply rapidly, kills the host cell and invades the other cells. As a large number of host cells dies away, the person will fall ill. Since reproduction is a very important characteristic of life, viruses are placed on the dividing line between the living and the non-living.

Conditions required for microbial growth: Generally need oxygen, water, moderate temperature, no direct light and suitable food supply.

Exercise 2.1

I. Very Short Answer Type Questions (1 Mark)

1. What are microorganisms?
2. Name any two groups of microorganisms.
3. We can see microorganisms with the help of a _____.
4. List any two habitats where bacteria are found.
5. Why are algae capable of photosynthesis?
6. Name the category of microbe that lives as parasite in the human body.
7. Name a unicellular and a multicellular fungus.

II. Short Answer Type Questions-1 (2 Marks)

8. Name the major groups of microorganisms.
 9. List the conditions required for the growth of microbes.
-

III. Short Answer Type Questions-2 (3 Marks)

10. Why are viruses considered to be on the border between living and non living?

ANSWERS

- | | |
|---|--|
| <p>1. The organisms that are too small to be seen with naked eyes.</p> <p>2. Bacteria, fungi, algae, protozoa. Viruses are different groups of microorganisms. (Any Two).</p> <p>3. Microscope</p> <p>4. Air, water, soil etc.</p> <p>5. They have chlorophyll.</p> <p>6. Protozoa</p> <p>7. Yeast and bread mould</p> <p>8. Bacteria, fungi, algae, protozoa, and viruses.</p> | <p>9. They generally need oxygen, water, moderate temperature, no direct light and suitable food supply.</p> <p>10. Viruses cannot reproduce by themselves. When a virus enters the living cell of a host, it reproduces using the host's machinery and nutrition. Since reproduction is a very important characteristic of life, viruses are placed on the dividing line between the living and the non-living.</p> |
|---|--|

2.2 EFFECTS OF MICROORGANISMS ON HUMANS: USEFUL AND HARMFUL

Useful Microbes: Microorganisms are useful in many ways:

- (i) *Increasing Soil Fertility:* Bacteria and fungi break down the dead organic matter and thus enables the nutrients to go back to the soil. This not only prevents accumulation of decomposed organic matter but also increases the soil fertility.
 - (ii) *Nitrogen Fixation:* Leguminous plants like pea, beans, pulses have swollen parts called nodules in their roots that harbour nitrogen fixing bacteria like *Rhizobium* which converts free nitrogen gas to nitrates, thus enriching the soil.
 - (iii) *Biogas Production:* Plants and animal wastes can be broken down by bacteria in the absence of oxygen to produce biogas which is a valuable fuel for cooking and lighting purposes.
 - (iv) *Commercial Use*
 - (a) Yeast is used to ferment sugar in grapes to make wine, in rice and barley to produce beer.
 - (b) Yeast is also used in bakeries to make bread, cakes etc. It is added to the dough to produce carbon dioxide which makes the dough soft and allow it to rise. This makes the bread and cakes soft and fluffy.
 - (c) *Idli, dosa, dhokla, bhature* are also made by fermentation using yeast.
 - (d) *Lactobacillus* bacteria is used in the formation of curd.
 - (e) Yeast breaks down the sugar found in fruit juices into alcohol which is acted on by the bacteria to form vinegar.
 - (v) *Medicinal Use*
 - (a) Antibiotics are the chemicals produced by microorganisms like bacteria and fungi that kills or retard the growth of other disease causing microbes, not only in humans but also in other animals and plants. For example, streptomycin, penicillin, tetracycline etc.
-

(b) When a disease causing microbe enters our body, it is called an **antigen**. Our body produces very specific proteins called **antibodies** to attack these antigens and kill them. The ability of a person's body to be able to resist the infections is known as **immunity**.

Immunity against some diseases may be natural, i.e, inherited from parents. Immunity against some diseases is acquired or induced in the body by introducing dead or weakened microbes of that disease. These dead or weakened microbes acts as a **vaccine**.

When a vaccine is introduced in the body, it activates our immune system to produce specific antibodies that attack the disease causing microbe (antigen) and eliminate it. This technique is called vaccination. It is now being possible to be protected against a number of infectious diseases like tetanus, typhoid, polio, measles , hepatitis B etc due to vaccination.

Antibodies persist in the body for a long period of time and provides immunity against the specific microbe.

Harmful Microbes: Disease causing microbes are called **pathogens**. Diseases which are caused by microorganisms and are being able to get transmitted from an infected person to a healthy person are called **communicable diseases** or **infectious diseases**.

Humans: These can be transferred from one person to the other through direct contact (chicken pox), through air (tuberculosis, pneumonia, common cold), through contaminated food and water (cholera, typhoid, gastroenteritis) , through insects (malaria, dengue) etc.

Table 2.1: Some Common Human Diseases Caused by Microorganisms

Human Disease	Causative Microorganism	Mode of Transmission	Preventive Measures (General)
Tuberculosis Measles Chicken Pox Polio	Bacteria Virus Virus Virus	Air Air Air/Contact Air/Water	Keep the patient in complete isolation. Keep the personal belongings of the patient away from those of the others. Vaccination to be given at suitable age.
Cholera Typhoid	Bacteria Bacteria	Water/Food Water	Maintain personal hygiene and good sanitary habits. Consume properly cooked food and boiled drinking water. Vaccination.
Hepatitis A	Virus	Water	Drink boiled drinking water. Vaccination.
Malaria	Protozoa	Mosquito	Use mosquito net and repellents. Spray insecticides and control breeding of mosquitoes by not allowing water to collect in the surroundings.

Animals: Microbes causes many diseases in animals also e.g. foot and mouth disease is a viral disease of cattle, while anthrax is a dangerous disease caused by bacteria in humans as well as cattle.

Plants: Microbes can cause many diseases in plants too. Some of these diseases, their causative microbe and transmission mode are written below:

Food Poisoning: Bacteria and fungi are decomposers. When they come in contact with food, they start breaking it down and release toxins (poisons). This contaminates the food and makes it unfit for consumption. This food, if consumed, can cause serious illness and even death.

Plant Diseases	Microorganism	Mode of Transmission
Citrus canker	Bacteria	Air
Rust of wheat	Fungi	Air, seeds
Yellow vein mosaic of <i>bhindi</i> (Okra)	Virus	Insect

Spoiled food emits foul smell, has a bad taste and its colour changes. Thus it is important to store food properly.

Exercise 2.2

I. Very Short Answer Type Questions (1 Mark)

1. If you are asked to find nitrogen fixing bacteria, where would you look for them?
2. Who discovered antibiotics?
3. What are pathogens?
4. Name the bacteria responsible for making curd out of milk.
5. Name a microorganism that can fix free atmospheric nitrogen.
6. What is food preservation?
7. Give one example each of:
 - (a) An edible fungus
 - (b) An antibiotic obtained from fungi
 - (c) A parasitic protozoan
8. Fill in the blanks.
 - (a) Cholera is caused by _____.
 - (b) Virus does not possess a _____ organisation.
 - (c) The bread or dough rises due to the growth of _____.
 - (d) Carrier of malaria causing protozoan is _____.

II. Short Answer Type Questions-1 (2 Marks)

9. What is fermentation? How is this technique useful?
10. How can we control the spread of malaria and dengue

III. Short Answer Type Questions-2 (3 Marks)

11. Mention two diseases caused by each of the following microbes in humans.
 - (a) Bacteria
 - (b) Protozoa
 - (c) Virus
12. List the precautions to be taken while taking antibiotics.
13. How does a vaccine work?
14. What are communicable diseases? Name two diseases each, spread through contaminated air and water.

IV. Long Answer Type Questions (5 Marks)

15. How do bacteria help in increasing soil fertility?

ANSWERS

- | | |
|---|---|
| <ol style="list-style-type: none"> 1. In the root nodules of leguminous plants 2. Alexander Fleming | <ol style="list-style-type: none"> 3. Disease causing microbes are called pathogens. 4. Lactobacillus |
|---|---|

5. Rhizobium, Nostoc, Anabaena etc
6. Techniques/ methods by which food can be kept for longer periods of time without spoilage.
7. (a) Mushroom (b) Penicillin
(c) Plasmodium
8. (a) bacteria (b) cellular (c) yeast cells
(d) female Anopheles mosquito
9. The process of conversion of sugar into alcohol. It is used in bakery industry, production of wine and alcohol.
10. Some of the preventive measures are: Prevent mosquitoes from breeding by not allowing water to stagnate.
 - Use mosquito nets, mosquito repellent creams.
 - Water should not be allowed to collect anywhere like in coolers, tyres, flower pots etc.
11. (a) Bacteria – cholera, typhoid.
(b) Protozoa – malaria, dysentery.
(c) Virus – chicken pox, AIDS, influenza.
12. Antibiotics should be only taken as and when prescribed by the doctor and in right dose. The course should be completed. They should not be taken indiscriminately as they may kill the beneficial bacteria present in our body.
13. When a vaccine is introduced in the body, it activates our immune system to produce a specific class of proteins called antibodies that attacks the disease causing microbe (antigen) and eliminates it. Antibodies persist in the body for a long period of time and provide immunity against the specific microbe.
14. Diseases which caused by microorganisms and transmitted from an infected to a healthy person, are called communicable diseases or infectious diseases.
Airborne infections – tuberculosis, pneumonia
Waterborne infections – cholera, typhoid, gastroenteritis
15. Some bacteria and blue green algae found in the soil fix free atmospheric nitrogen and converts it into a usable form for plants, thus increasing a soil fertility. They are called the biological nitrogen fixers.
Bacteria and fungi also acts on dead and decaying organic matter, convert them into simpler form that mixes with the soil that can be reused by the plants for nutrition.

2.3 FOOD PRESERVATION AND ITS METHODS

Food Preservation: Processing of food to prevent its spoilage and to retain its nutritive value for longer periods is called food preservation.

Food preservation helps in the following ways:

- (a) reduces wastage of food
- (b) increases the storage period
- (c) enables food to be transported to distant places without being spoiled
- (d) helps to store food for use in seasons when it is not available.

Methods of Food Preservation

- (a) *Chemical method:* Chemicals added to the food items to protect them from spoilage are chemical preservatives. Eg Sodium benzoate, sodium meta-bisulphite etc.
 - (b) *Salting:* Fruits and vegetables can be preserved by using salt and then drying in Sun. Salting and drying prevents the growth of microbes.
 - (c) *Adding sugar:* Fruits are preserved in the form of jams and jellies by adding sugar. Sugar removes water from the cells and hence prevents microbial growth.
 - (d) *Pickling:* Raw mangoes, lemons, gooseberries and vegetables like cauliflower are preserved in vinegar or brine to give a sharp, spicy flavour.
 - (e) *Refrigeration:* Freezing retards the growth and multiplication of microbes but
-

does not kill them. Frozen food after being removed from the refrigerator, should not be left in the open for a long time as microbes will start multiplying again.

- (f) *Heating*: Boiling kills many microorganisms. Pasteurization is a technique of preserving milk by heating it to 70°C for about 15 seconds and then suddenly chilling it. This prevents the growth of microbes. This process was discovered by Louis Pasteur and hence is called pasteurisation.
- (g) *Canning*: Canning is done to package or preserve food items or drinks by putting them in sealed, air-tight containers.

Exercise 2.3

I. Very Short Answer Type Questions (1 Mark)

1. List any one advantage of food preservation.
2. How does refrigeration prevent microbial growth?
3. Name any one technique of preserving milk.
4. How does adding sugar to a food sample preserves it?
5. Can salt and sugar be termed as preservatives?

II. Short Answer Type Questions-1 (2 Marks)

6. Briefly explain pasteurisation as a means of preserving milk.
7. What are chemical preservatives? Give examples.

III. Short Answer Type Question-2 (3 Marks)

8. What is food preservation? Explain any two methods of food preservation.

ANSWERS

- | | |
|--|---|
| <ol style="list-style-type: none">1. Food preservation helps in the following ways:<ol style="list-style-type: none">(a) reduces wastage of food(b) increases the storage period(c) enables food to be transported to distant places without being spoiled.(d) helps to store food for use in seasons when it is not available (<i>Any one</i>)2. Refrigeration retards the growth and multiplication of microbes due to low temperature.3. Pasteurisation4. Sugar removes water from the cells and hence prevents microbial growth.5. Yes6. Pasteurisation is the technique of preserving milk by heating it to 70°C for about 15 seconds and then suddenly chilling it. This prevents the growth of microbes.7. Chemicals added to food the items to protect them from spoilage. Sodium benzoate, sodium meta-bisulphite etc. | <ol style="list-style-type: none">8. Processing of food to prevent its spoilage and to retain its nutritive value for longer periods is called food preservation. Food can be preserved by<ol style="list-style-type: none">(a) <i>Salting</i>: Fruits and vegetables can be preserved by using salt and then drying in Sun. Salting and drying prevents the growth of microbes.(b) <i>Adding sugar</i>: Fruits are preserved in the form of jams and jellies by adding sugar. Sugar removes water from the cells and hence prevents microbial growth.(c) <i>Pickling</i>: Raw mangoes, lemons, gooseberries and vegetables like cauliflower are preserved in vinegar or brine to give a sharp, spicy flavour.(d) <i>Refrigeration</i>: Freezing retards the growth and multiplication of microbes but does not kill them. Frozen food after being removed from the refrigerator, should not be left in the open for a long times as microbes will start multiplying again. (<i>Any one</i>) |
|--|---|
-

2.4 NITROGEN CYCLE

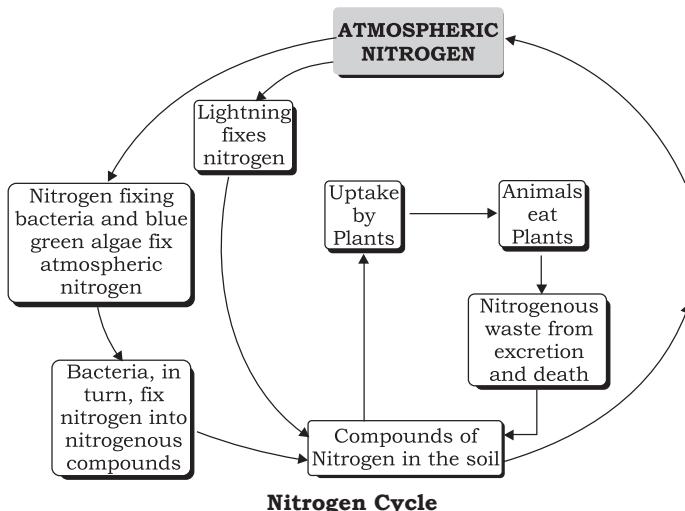
Nitrogen is the most abundant element in the earth's atmosphere (78%). It is vital for living organisms as it is an important component of proteins, nucleic acids, chlorophyll, vitamins and other biomolecules. However, atmospheric nitrogen cannot be used directly by most of the organisms.

Plants can use nitrogen in the form of nitrites and nitrates. Nitrogen fixing bacteria like *Rhizobium* present in the root nodules of leguminous plants helps to convert free atmospheric nitrogen into this usable form.

Nitrogen and oxygen combine in the atmosphere during lightning to form nitrogen

oxides that react with rain water and come down in the form of dilute nitric acid. The nitric acid reacts with minerals in the soil to form nitrates. Plants take up these nitrates to form their proteins. Animals obtain proteins that they need by eating plants or flesh of other animals.

When plants and animals eventually die, the nitrogen compounds are broken down to form ammonia (ammonification). Conversion of ammonia into nitrates is called nitrification. Nitrates can be used by the plants or it can be converted into free nitrogen and returned back to the atmosphere by the process of denitrification.



Exercise 2.4

I. Very Short Answer Type Questions (1 Mark)

1. What percentage of atmospheric gases consists of nitrogen?
2. Name a nitrogen fixing bacteria and its location.

II. Short Answer Type Question-1 (2 Marks)

3. Name any two biomolecules that contain nitrogen.

III. Short Answer Type Questions-2 (3 Marks)

4. How does atmospheric nitrogen fixation take place?
5. List the three ways of nitrogen fixation.
6. Draw a schematic representation of nitrogen cycle in nature.

ANSWERS

- | | |
|---|------------------------------------|
| 1. 78% | are present in the root nodules of |
| 2. Nitrogen fixing bacteria like <i>Rhizobium</i> | leguminous plants. |
-

3. Proteins, nucleic acids, chlorophyll, vitamins. (Any two)
4. Nitrogen and oxygen combine in the atmosphere during lightning to form nitrogen oxides that reacts with rain water and came down in the form of dilute nitric acid. The nitric acid reacts with minerals in the soil to form nitrates.
5. Biological, industrial and atmospheric fixation.
6. Refer diagram on page 24.

Did You Know?

- The bacterium *Clostridium* divides nearly every 10 minutes while *E. coli* takes 20 minutes to divide.
- Proto means first and zoan means animal in Greek.
- Many varieties of seaweeds consumed in China and Japan are gaining popularity due to their high nutritional value.
- Agar, a chemical obtained from algae is used in culture media for microbiological work. Agar can also be used as a substitute for gelatin, as a thickener in ice creams, and other desserts.
- Fungi are responsible for many skin infections.
- The *protozoan*, *Plasmodium* causes malaria.

HOTS & VALUE BASED QUESTIONS

1. Why are antibiotic not effective against viral infections? **(HOTS)**
2. Milk present in tetrapacks is safe for consumption directly. Why? **(HOTS)**
3. Veena went for a marriage party and enjoyed a variety of delicacies there. On reaching home, she experienced pain in her stomach followed by bouts of vomiting. What could be the reason for her condition? **(HOTS)**
4. The municipal corporation makes effort to segregate waste. What is the significance of using blue and green colored dustbins? **(VBQ)**
5. It is important to undertake fumigation during rainy season. Why? What values are shown by the people of a community that undertakes this activity on a regular basis? **(VBQ)**
6. Our government wants to ensure that all children below 5 years of age are vaccinated against POLIO. What this initiative taken by the government known as? List any two values associated with it. **(VBQ)**

ANSWERS

1. Antibiotic are not effective against viral infections as they do not have bio chemical pathways of their own.
2. Milk present in tetrapacks is safe for consumption directly as it has been pasteurized.
3. Food poisoning. The food she ate was contaminated with microbes/ microorganisms that led to these symptoms.
4. Blue dustbins are for non- biodegradable waste while green dustbins are for biodegradable waste.
5. Presence of moisture not only promotes the growth of pathogens but also provides a suitable ground for mosquitoes to breed. Fumigation prevents larvae of mosquitoes to develop thus preventing the spread of mosquito related infections like Dengue, chikanguniya, malaria etc
6. Pulse Polio Program. Social responsibility, health consciousness.