

MICROORGANISMS

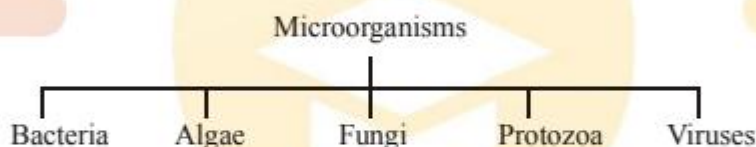
Definition

The organisms which cannot be observed with the naked eye and can be seen only through a microscope are called **microorganisms** or microbes.

Food and water become unsafe for consumption due to the presence of harmful organisms, commonly referred to as **germs**. These germs are so small that they are invisible to the naked eye, but can often cause dangerous diseases. Since these organisms can be seen only through a microscope, they are called **microorganisms** or microbes. When the body is attacked by germs or pathogens, medicines called **antibiotics** are given. Antibiotics act against the bacteria within the body, without harming the person.

Microorganisms

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



Classification of Microorganism

Microbes are mainly classified into five major groups :

◆ Bacteria :

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

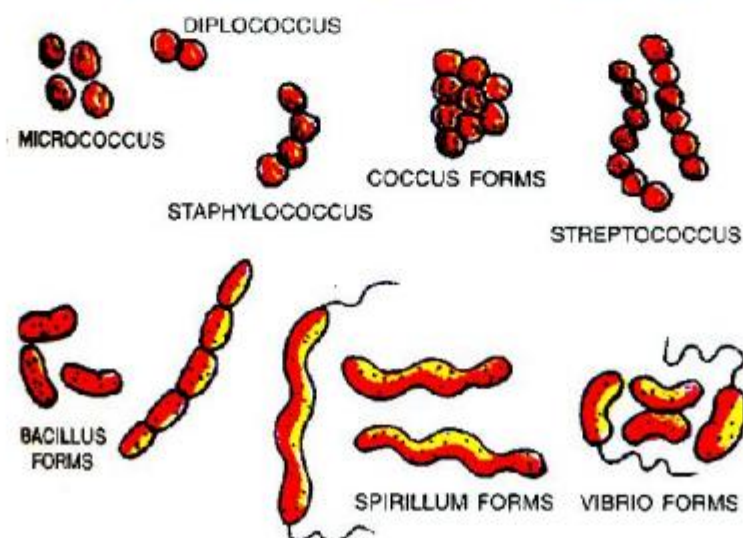


Fig. Different types of bacteria

◆ **Algae :**

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

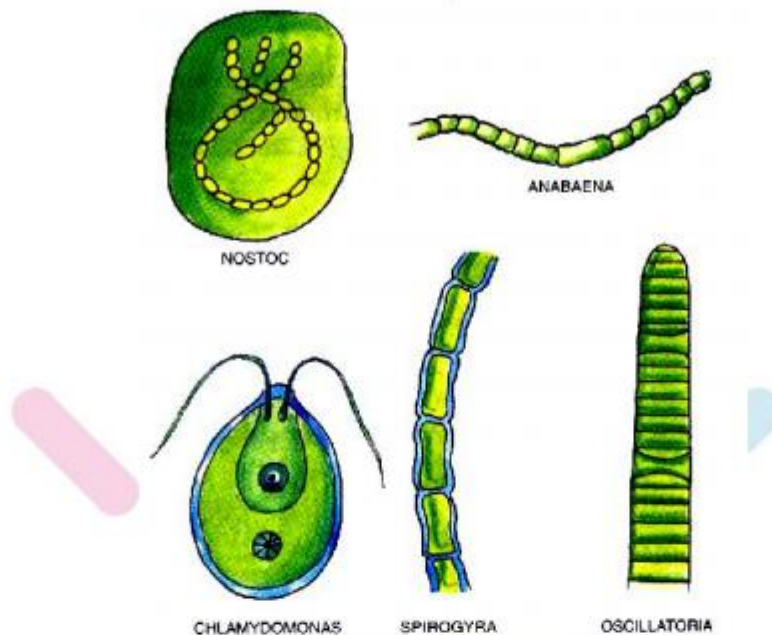


Fig. Some forms of algae

◆ **Fungi :**

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

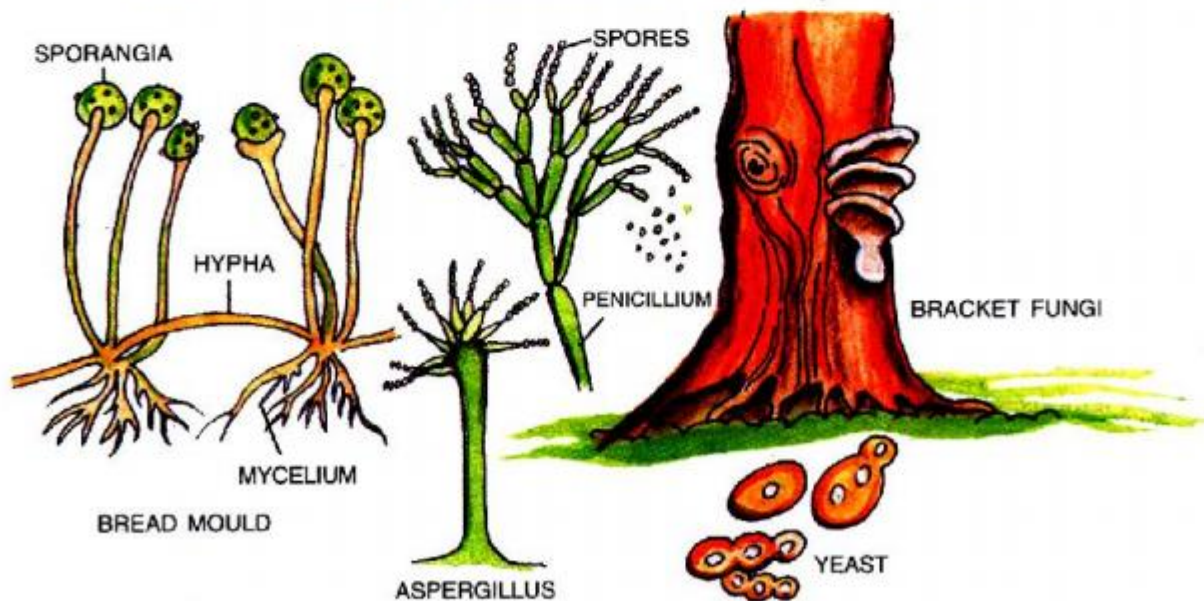


fig. Some forms of fungi

◆ **Protozoa :**

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

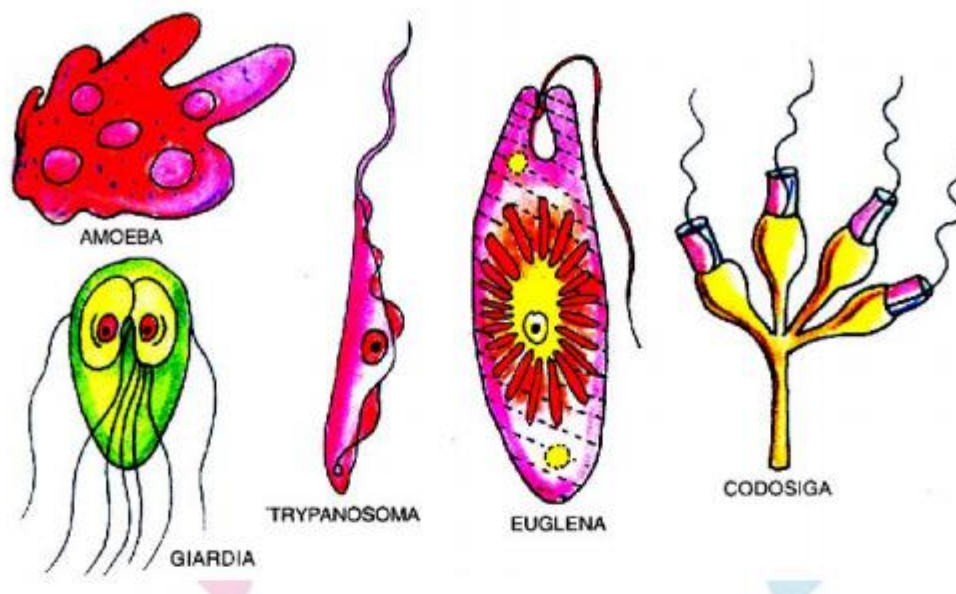


fig. Some forms of Protozoa

◆ Viruses :

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



fig. Some forms of viruses

Useful Microorganisms

Humans have many microorganism in their in their digestive system that contribute to overall health. The microbial community in humans not only protects us from disease, but also provides necessary vitamins. Bacteria also help in nitrogen fixation in production of antibiotics, etc. Algae are also useful in a number of industries. Therefore, even through microbes are responsible for food spoilage and many diseases, they can also be very helpful.

Some microorganisms and their uses are listed in Table :

Useful Microorganisms		
Classification	Species/Name	Use
Bacteria	E.coli, Clostridium sp.	Production of vitamins in the large intestine
	Rhizobium	Nitrogen fixation
	Lactobacillus	Production of dairy products, like yoghurt, cheese, etc.
Algae	Chlorella, Chlamydomonas	Sewage disposal system
	Red and brown algae	Manufacturing culture medium called 'agar' used in laboratories and hospitals
Fungi	Mushroom	Used as food item
	Aspergillus flavus	Aspergillic acid
	Penicillium notatum	Antibiotics (Penicillin)
	Yeast	Preparation of Vitamin B Complex, fermenting for making bread, cakes

Yoghurt or curd (dahi) is the commonest example of beneficial use of microbes. Yoghurt is a part of our daily diet and we eat it in various forms, with different flavour. This dahi is made from milk by the action of a bacterium called lactobacillus or lactic acid bacteria. It converts the sugar in milk (lactose) to lactic acid, giving curd its sour taste. This process was initially used as a way to preserve milk.



Curdling of milk takes place naturally, due to heat (specially in summer).

Curdling of milk also takes place due to addition of any of the acid products such as sour curd, lemon juice and even tomato juice.

Harmful Microorganisms

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

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

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

◆ **How is food spoiled ?**

Some foods get perished easily, if not stored in refrigerators. For example, foods like fruits, vegetables, cooked food get spoiled if kept at room temperature. Fungal growth on bread (called bread mould) is seen commonly, especially in rainy season. Spoilage of food is due to the action of microorganisms present in the food or outside. In summers milk goes rancid (curdled) due to high temperature, that's why it needs to be stored in a cool and dry place. Find out the reason why pulses, grains and spices do not get spoiled, like fruits & vegetables.

Methods of Food Preservation

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

◆ **Refrigeration**

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

◆ **Dehydration or drying**

Food items are dried in the sun or by spraying or freezing. This process is commonly used for preserving fruits, although some nutrients are lost by drying.

◆ **Addition of salt or sugar**

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

◆ **Freezing**

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

◆ **Smoking**

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

◆ **Pasteurization and Homogenization**

Pasteurization is a process by which microorganisms are destroyed by high temperature and sudden cooling. Milk is heated to around 70°C and then suddenly cooled. It is commonly used for milk, since

other food items can lose heat-sensitive nutrients.

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

◆ **Canning**

Canned products are first subjected to high heat processing, then sealed in cans. While canning increases shelf life, care must be taken to ensure that the cans are not damaged or bulging, which would indicate spoilage.

◆ **Sterilization**

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

The microbial world is fascinatingly vast, with different species and types of organisms, ranging from the helpful intestinal bacteria to the deadly viruses. The presence of microorganism in food must be examined and care must be taken to ensure proper cooking and preservation of food.

Nitrogen Fixation

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

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

◆ **Natural Fixation of Nitrogen**

In nature nitrogen of the atmosphere can be fixed by three methods which are listed below.

◆ **Fixation of Nitrogen by Bacteria :** The root nodules of certain leguminous plants like peas, beans, etc. contain nitrogen fixing bacteria called **Rhizobium**. The bacteria can directly fix nitrogen gas to nitrogen compounds which can then be utilized by the plants. Some non-leguminous plants like *Alnus* and *Ginkgo* also fix atmospheric nitrogen.

◆ **Fixation of Nitrogen by Blue - Green Algae :** Blue-green algae like *Nostoc* and *Anabaena* can also help in nitrogen fixation. These are usually found in paddy fields.

The fixation of nitrogen by bacteria and algae is called **biological fixation** of nitrogen. Most of the nitrogen in nature is fixed by this method

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

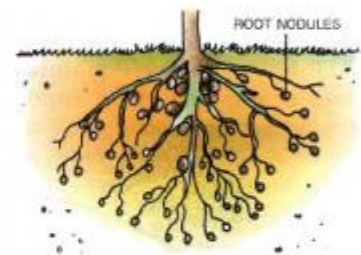


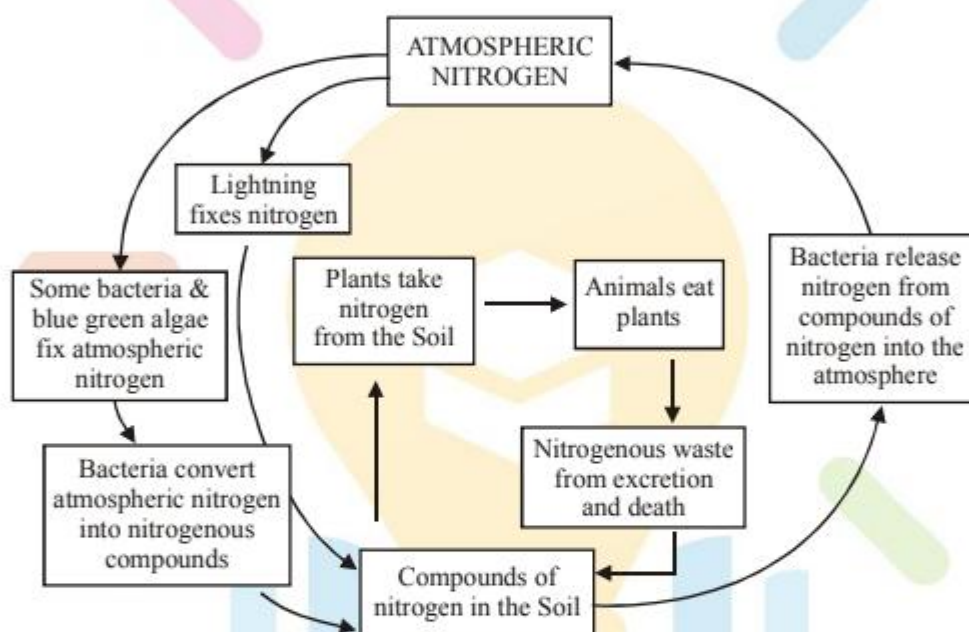
Fig. Root Nodules

◆ Artificial fixation of Nitrogen

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

Nitrogen Cycle

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



◆ Steps Involved in Nitrogen Cycle

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

EXERCISE - 1

Objective Question.

- Q.1** Lichens are composite organs, consisting of algae and
(A) mosses (B) protozoans
(C) bacteria (D) fungi
- Q.2** Mushroom is -
(A) a plant consisting of fine green threads
(B) an edible fungus
(C) a bryophyte devoid of roots, stem and leaves
(D) a flowering plant
- Q.3** Which of the following diseases is caused by a fungus
(A) small pox (B) tuberculosis
(C) cancer (D) aspergillosis
- Q.4** Yeast is
(A) alga (B) fungus
(C) bacterium (D) liverwort
- Q.5** Fermentation of sugar occurs by
(A) *Saccharomyces* (B) *Mucor*
(C) *Aspergillus* (D) *Penicillium*
- Q.6** The biological process carried on by the *Rhizobium* is called
(A) nitrification (B) ammonification
(C) nitrogen fixation (D) fermentation
- Q.7** The smallest organisms which cause disease among plants are
(A) viruses (B) fungi
(C) bacteria (D) *Mycoplasma*
- Q.8** *nif* genes occur in
(A) *Penicillium* (B) *Aspergillus*
(C) *Rhizobium* (D) *Streptococcus*

- Q.9** Black rust of wheat is caused by
(A) Rhizopus (B) Ustilago
(C) Penicillium (D) Puccinia
- Q.10** The fungal partner in lichen is
(A) symbiotic
(B) parastitic
(C) has no nutritional relationship with alga
(D) does good to the alga without getting anything in return
- Q.11** Lichen represents
(A) symbiotic association of an alga and a fungus
(B) parasitic association of an alga and a fungus
(C) mychrrhizal association
(D) commensalism
- Q.12** Small pox is caused by
(A) virus (B) bacteria
(C) housefly (D) mosquito
- Q.13** Which of the following is true of viruses ?
(A) They multiply only in the host cell
(B) They invariably contain DNA
(C) They occur only inside bacteria
(D) Their genetic material is RNA and not DNA
- Q.14** Genetic material of viruses is
(A) DNA only
(B) RNA only
(C) DNA or RNA
(D) None of these
- Q.15** Viruses are essentially made up of
(A) protein and nucleic acid
(B) starches and carbohydrates
(C) proteins and lipids
(D) starch, protein carbohydrates and lipids

Q.16 Nitrifying bacteria

- (A) reduce nitrate to free nitrogen
- (B) oxidise ammonia to nitrates
- (C) convert free nitrogen to nitrogen compound
- (D) convert protein into ammonia

Q.17 Nodules with nitrogen fixing bacteria are found in

- (A) mustard (B) pea
- (C) wheat (D) cotton

Q.18 Organisms which can fix atmospheric nitrogen are

- (A) mosses (B) bacteriophages
- (C) cyanobacteria (D) green algae

Q.19 Which of the following can be a good protein rich food

- (A) Spirogyra (B) Spirulina
- (C) Sphacelaria (D) Chlamydomonas

Q.20 In rice fields the soil fertility can be improved by addition of

- (A) gypsum
- (B) sodium chloride
- (C) Archaeobacteria
- (D) Cyanobacteria

Q.21 Ability to fix atmospheric nitrogen is found in

- (A) Red algae (B) Brown algae
- (C) Green algae (D) Blue-green algae

Q.22 Cyanobacteria are chiefly used as bio-fertilizer in the crop of

- (A) wheat
- (B) gram
- (C) paddy
- (D) mustard

Q.23 Bacteria which convert the dissolved nitrate of the soil into free nitrogen are

- (A) nitrate bacteria
- (B) nitrifying bacteria
- (C) denitrifying bacteria
- (D) ammonifying bacteria

Q.24 Which of the following is a bacterial diseases

- (A) Tuberculosis
- (B) Measles
- (C) Small pox
- (D) Rabies

Q.25 The bacterium associated with denitrification

- (A) Azotobacter
- (B) Rhodospirillum
- (C) Pseudomonas
- (D) Rhizobium



EXERCISE - 2

MATCH THE FOLLOWING

- | | | |
|-----------------|--------------------------|-------------------------|
| 1. Tuberculosis | <input type="checkbox"/> | a) Incubator |
| 2. Smoking | <input type="checkbox"/> | b) High heat processing |
| 3. Canning | <input type="checkbox"/> | c) Protozoa |
| 4. Amoebiasis | <input type="checkbox"/> | d) Meat products |
| 5. Microwave | <input type="checkbox"/> | e) Bacetria |

FILL IN THE BLANKS

- Q.1 Disease causing microorganisms are called _____.
- Q.2 _____ are used in the preparation of penicillin.
- Q.3 The sugar present in milk is _____.
- Q.4 Blight of potato is caused by _____.
- Q.5 The process of food preservation using ionizing radiations is _____.

STATE TRUE OR FALSE

- Q.1 Whooping cough is a diseases caused by a virus.
- Q.2 Meat products can be preserved by smoking.
- Q.3 Pasteurized milk has a longer shelf life than fresh milk.
- Q.4 Microorganisms help plants in nitrogen fixation.
- Q.5 Reprodcution of microbes reduces with increase in temperature.

ANSWER IN ONE WORD

- Q.1 Organism used in the production of cheese.
- Q.2 Disease caused by eating spoiled food.
- Q.3 Method used for preserving strawberries.
- Q.4 Microorganisms exhibiting both and non-living characteristics.
- Q.5 Mode of nutrition of algae.

LONG ANS. TYPE

- Q.1 Give examples from daily life about the beneficial effects of microorganism.
- Q.2 Explain the differences between algae and fungi.
- Q.3 How is curd formed ? What are the benefits of eating curd ?
- Q.4 What is food poisoning and how can it be prevented ?
- Q.5 What is the use of antibiotics for fighting an infection ?

GIVE REASONS

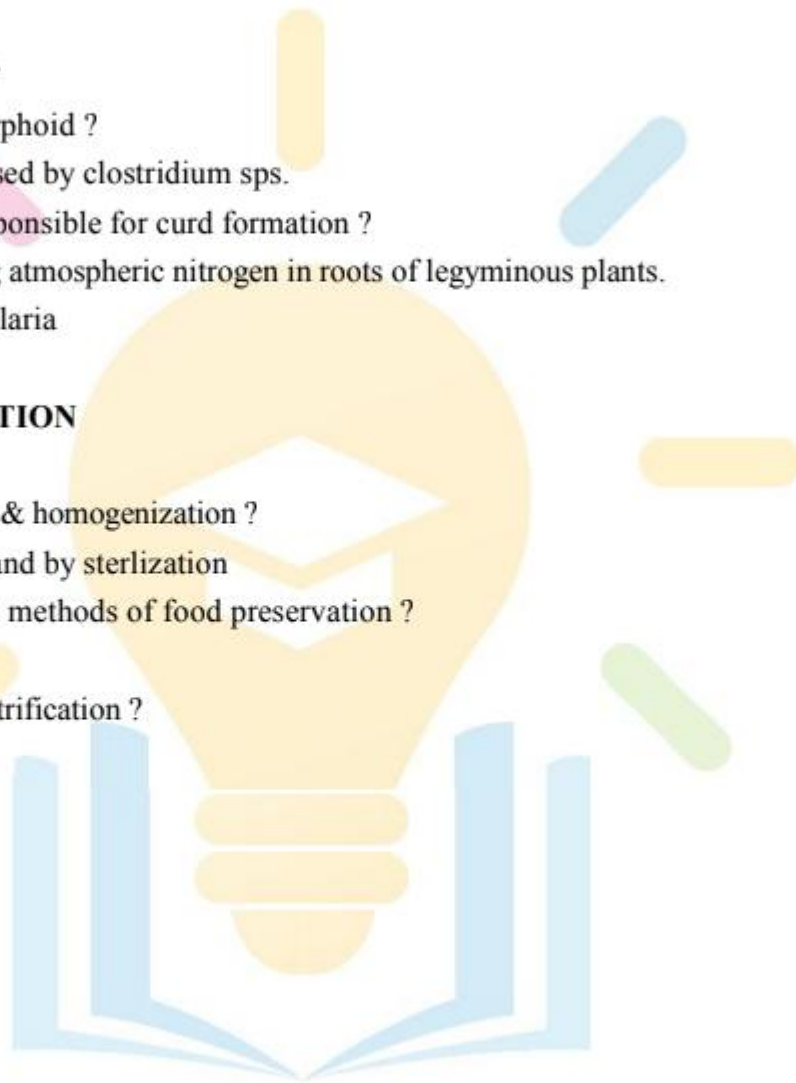
- Q.1** Viruses are considered on the borderline of living and non living.
- Q.2** Yeast is used in bread
- Q.3** Salt is added to pickles in larger amount.
- Q.4** Algae is called grass of water.
- Q.5** Microorganisms are called friends and for

VERY SHORT ANS.

- Q.1.** Name the causes of typhoid ?
- Q.2.** Name the disease caused by clostridium sps.
- Q.3.** Name the bacteria responsible for curd formation ?
- Q.4.** Name a bacteria fixing atmospheric nitrogen in roots of leguminous plants.
- Q.5.** Name the cause of malaria

SHORT ANS QUESTION

- Q.1.** What is pasteurization & homogenization ?
- Q.2.** What do you understand by sterilization
- Q.3.** What are the common methods of food preservation ?
- Q.4.** What is Nitrification
- Q.5.** What is meant by denitrification ?



ANSWER KEY EXERCISE-1

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	D	B	D	B	A	C	D	C	D	A	A	A	A	C	A
Ques.	16	17	18	19	20	21	22	23	24	25					
Ans.	B	B	C	B	D	D	C	C	A	C					

EXERCISE-2

MATCH THE FOLLOWING

- Sol.1 e
Sol.2 d
Sol.3 b
Sol.4 c
Sol.5 a

FILL IN THE BLANKS

- Sol.1 Pathogens
Sol.2 *Penicillium notatum*
Sol.3 lactose
Sol.4 moulds
Sol.5 sterilization

STATE TRUE OR FALSE

- Sol.1 False
Sol.2 True
Sol.3 True
Sol.4 True
Sol.5 False

ANSWER IN ONE WORD.

- Sol.1** Lactobacillus
Sol.2 Food poisoning
Sol.3 Sterlization
Sol.4 Virus
Sol.5 Autotrophic

GIVEN REASONS

- Sol.1** Virus do not have only cell machinery and can reproduce only inside host.
Sol.2 Preparation of bread requires fermentation.
Sol.3 Water required for growth of microorganism is made unavailable.
Sol.4 It occurs abundantly like grass in aquatic habitats.
Sol.5 Some microorganisms are pathogens while other are useful to human.

VERY SHORT ANS.

- Q.1** Salmonella typhi
Q.2 Food poisoning
Q.3 Lacto bacillus
Q.4 Rhizobium
Q.5 Plasmodium vivax

