*Book Name: NCERT Solutions*

## Question 1:

Bacteria cannot be seen with the naked eyes, but these can be seen with the help of a microscope. If you have to carry a sample from your home to your biology laboratory to demonstrate the presence of microbes under a microscope, which sample would you carry and why?

## Solution 1:

Curd can be used as a sample for the study of microbes. Curd contains numerous lactic acid bacteria (LAB) or Lactobacillus. These bacteria produce acids that coagulate and digest milk proteins.

A small drop of curd is carried to the biology laboratory because it contains multitude of bacteria, which can be easily observed under a microscope which are of various shapes and sizes.

## Question 2:

Give examples to prove that microbes release gases during metabolism.

## Solution 2:

The examples of bacteria that release gases during metabolism are:

(a) The dough used for making idli and dosa gives a puffed appearance. This is because of the action of bacteria which releases carbon dioxide. This $CO_2$ released from the dough gets trapped in the dough, thereby giving it a puffed appearance.

(b) During the digestion of sludge during waste water treatment, bacteria produce a mixture of gases such as methane, hydrogen sulphide and carbon dioxide.

## Question 3:

In which food would you find lactic acid bacteria? Mention some of their useful applications.

## Solution 3:

Lactic acid bacteria can be found in curd.

Some of their useful applications are as follows:

(i) It is this bacterium that promotes the formation of milk into curd.

(ii) The bacterium multiplies and increases its number, which converts the milk into curd.

(iii) They also increase the content of vitamin $B_{12}$ in curd.

(iv) Lactic acid bacteria are also found in our stomach where it keeps a check on the disease-causing micro-organisms.

## Question 4:

Name some traditional Indian foods made of wheat, rice and Bengal gram (or their products) which involve use of microbes.

## Solution 4:

(i) In the making dosa and idli, rice powder is fermented by bacteria and for making bread (from wheat), yeast (Saccharomyces cerevisiae) is used.

(ii) Gutta (made from black gram) also uses bacteria.

(iii) Microbes are also used to ferment fish, soyabean and bamboo shoots to make foods.

## Question 5:

In which way have microbes played a major role in controlling diseases caused by harmful bacteria?

## Solution 5:

(i) Several micro-organisms are used for preparing medicines. Antibiotics are medicines produced by certain micro-organisms to kill other disease-causing micro-organisms.

(ii) These medicines are commonly obtained from bacteria and fungi. They either kill or stop the growth of disease-causing micro-organisms.

(iii) Antibiotics have been used to treat deadly diseases such as plague, whooping cough (kali khansi), diphtheria (galghotu) and leprosy (kusht rog) and many other common infections Streptomycin, tetracycline, and penicillin are common antibiotics.

(iv) Penicillium notatum produces chemical penicillin, which checks the growth of staphylococci bacteria in the body.

(v) Antibiotics are designed to destroy bacteria by weakening their cell walls. As a result of this weakening, certain immune cells such as the white blood cells enter the bacterial cell and cause cell lysis. Cell lysis is the process of destroying cells such as blood cells and bacteria.

## Question 6:

Name any two species of fungus, which are used in the production of the antibiotics.

## Solution 6:

Penicillium notatum and Streptomyces are two species offungus, which are used in the production of the antibiotics.

## Question 7:

What is sewage? In which way can sewage be harmful to us?

## Solution 7:

Sewage is the municipal waste matter that is carried away in sewers and drains. It includes both liquid and solid wastes, rich in organic matter and microbes. Many of these microbes are pathogenic and can cause several water- borne diseases. Sewage water is a major cause of polluting drinking water. Hence, it is essential that sewage water is properly collected, treated, and disposed.

## Question 8:

What is the key difference between primary and secondary sewage treatment?

## Solution 8:

Primary treatment involves physical removal of large and small particles from the sewage through filtration and sedimentation. Whereas, secondary sewage treatment involves biological digestion of organic matter by microbes. Primary treatment is inexpensive and relatively less complicated where as secondary sewage is a very expensive and complicated process.

## Question 9:

Do you think microbes can also be used as source of energy? If yes, how?

## Solution 9:

Yes, microbes can be used as a source of energy. Bacteria such as Methane bacterium is used for the generation of gobar gas or biogas.

(i) The generation of biogas is an anaerobic process in a biogas plant, which consists of a concrete tank (10-15 feet deep) with sufficient outlets and inlets.

(ii) The dung is mixed with water to form the slurry and thrown into the tank. The digester of the tank is filled with numerous anaerobic methane-producing bacteria, which produce biogas from the slurry.

(iii) Biogas can be removed through the pipe which is then used as a source of energy, while the spent slurry is removed from the outlet and is used as a fertilizer.

## Question 10:

Microbes can be used to decrease the use of chemical fertilisers and pesticides. Explain how this can be accomplished.

## Solution 10:

Microbes can be used as biofertilisers, organisms that enrich the nutrient quality of the soil. The main sources of bio-fertilisers are bacteria, fungi and cyanobacteria. They help in increasing the fertility of the soil in many ways

(i) Rhizobium that forms nodules on the roots of leguminous plants(a symbiotic association) fixes atmospheric nitrogen into organic forms, which is used by the plant as nutrient.

(ii) Azospirillum and Azotobacter fix atmospheric nitrogen, while living freely, and enriching the nitrogen content of the soil.

(iii) Many members of the genus Glomus (fungi) form symbiotic associations with plant known as mycorrhiza that

(a) Absorption of phosphorus from soil and pass it to the plant.

(b) Help the plants to develop resistance to root-borne pathogens.

(c) Increase their tolerance to salinity and drought and thus, help in overall increase in plant growth and development.

(iv) Cyanobacteria autotrophic microbes, e.g., Anabaena, Nostoc, Oscillatoria can fix atmospheric nitrogen, in aquatic and terrestrial environment and also add organic matter to the soil and increase its fertility.

## Question 11:

Three water samples namely river water, untreated sewage water and secondary effluent discharged from a sewage treatment plant were subjected to BOD test. The samples were labelled A, B and C; but the laboratory attendant did not note which was which. The BOD values of the three samples A, B and C were recorded as 20mg/L, 8mg/L and 400mg/L, respectively. Which sample of the water is most polluted? Can you assign the correct label to each assuming the river water is relatively clean?

## Solution 11:

Sample A (BOD 20mg/L) is secondary effluent discharged from a sewage treatment plant.
Sample B (BOD 8mg/L) is river water.
Sample C (BOD 400mg/L) is the untreated sewage water.
As BOD is the direct measure of the organic matter present in water, higher the BOD, more polluted the water.

## Question 12:

Find out the name of the microbes from which Cyclosporin A (an immunosuppressive drug) and Statins (blood cholesterol lowering agents) are obtained

## Solution 12:

(i) Cyclosporin-A is obtained from the fungus Trichoderma polysporum.
(ii) Statins is obtained from Monascus purpureus.

## Question 13:

Find out the role of microbes in the following and discuss it with your teacher.
(a) Single cell protein (SCP)
(b) Soil

## Solution 13:

(a) Single Cell Protein (SCP) refers to harmless microbial cells that can be used as an alternate source of good protein. Just like mushrooms (a fungus) is eaten by many people and yeast issued by athletes as a protein source; similarly, other forms of microbial cells can also be used as food rich in protein, minerals, fats, carbohydrate and vitamins. Microbes like Spirulina and Methylophilus methylotrophus are being grown on an industrial scale on materials containing starch like wastewater from potato processing plants, straw, molasses, animal manure and even sewage. These single cell microbes can be used as source.

(b) Soil: Microbes play an important role in maintaining soil fertility. They help in the formation of nutrient-rich humus by the process of decomposition. Many species of bacteria and cyanobacteria have the ability to fix atmospheric nitrogen into usable form. Rhizobium is a symbiotic bacteria found in the root nodules of leguminous plants. Azospirillium and Azotobocter are free living nitrogen-fixing bacteria, whereas Anabena, Nostoc, and Oscillitoria are examples of nitrogen-fixing cyanobacteria.

## Question 14:

Arrange the following in the decreasing order (most important first) of their importance, for the welfare of human society. Give reasons for your answer.
Biogas, Citric acid, Penicillin and Curd

## Solution 14:

Penicillin > Biogas > Curd > Citric acid

- Penicillin is an antibiotic that helps kill pathogens that cause infections and diseases and thus, saves lives.
- Biogas is a non-polluting clean fuel that is produced as a byproduct of sewage treatment. It is used for cooking and lighting up the homes in rural areas.
- Curd has good nutrient value, provides vitamin-$B_{12}$ and replaces harmful bacteria of the stomach with helpful ones.
- Citric acid it is used as preservative of food.

## Question 15:

How do biofertilisers enrich the fertility of the soil?

## Solution 15:

Bio-fertilizers are living organisms which help in increasing the fertility of soil. It involves the selection of beneficial micro-organisms that help in improving plant growth through the supply of plant nutrients. These are introduced to seeds, roots, or soil to mobilize the availability of nutrients by their biological activity. Thus, they are extremely beneficial in enriching the soil with organic nutrients. Many species of bacteria and cyanobacteria have the ability to fix free atmospheric nitrogen. Rhizobium is a symbiotic bacteria found in the root nodules of leguminous plants. Azospirillium and Azotobocter are free living nitrogen-fixing bacteria, whereas Anabena, Nostoc, and Oscillitoria are examples of nitrogen-fixing cyanobacteria. Bio-fertilizers are cost effective and eco-friendly.