Microbes in Human Welfare

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?

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 contains millions of bacteria, which can be easily observed under a microscope.

2. Give examples to prove that microbes release gases during metabolism.

The examples of bacteria that release gases during metabolism are:

Bacteria and fungi carry out the process of fermentation and during this process, they release carbon dioxide.

Fermentation is the process of converting a complex organic substance into a simpler substance with the action of bacteria or yeast.

Fermentation of sugar produces alcohol with the release of carbon dioxide and very little energy.

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.

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

Lactic acid bacteria can be found in curd. It is this bacterium that promotes the formation of milk into curd.

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

They also increase the content of vitamin B12 in curd.

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

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

(a) Wheat Products: Bread, cake
(b) Rice Products: Idli, dosa
(c) Bengal gram Products: Dhokla, Khandvi

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

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

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

Streptomycin, tetracycline, and penicillin are common antibiotics.

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

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

Antibiotics are medicines that are produced by certain micro-organisms to kill other disease-causing micro-organisms.

These medicines are commonly obtained from bacteria and fungi.

The species of fungus used in the production of antibiotics are:

Antibiotic	Source of fungus
Penicillin	Penicillium notatum
Cephalosporin	Cephalosporium acremonium

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

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.

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

Primary treatment involves the removal of large-sized floating and suspended solids by physical methods, while secondary treatment involves decomposition of organic matter by microbial action which produces methane, hydrogen sulphide and carbon dioxide.

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

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.

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.

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.

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

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

Microbes play an important role in organic farming, which is done without the use of chemical fertilizers and pesticides.

Bio-fertilizers are living organisms which help increase the fertility of soil.

It involves the selection of beneficial microorganisms that help in improving plant growth through the supply of plant nutrients.

Bio-fertilizers are introduced in seeds, roots, or soil to mobilize the availability of nutrients.

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.

Microbes can also act as bio-pesticides to control insect pests in plants.

An example of bio-pesticides is Bacillus thuringiensis, which produces a toxin that kills the insect pests.

Dried bacterial spores are mixed in water and sprayed in agricultural fields.

When larvae of insects feed on crops, these bacterial spores enter the gut of the larvae and release toxins.

Trichoderma are free living fungi. They live in the roots of higher plants and protect them from various pathogens.

Baculovirus is another bio-pesticide that is used as a biological control agent against insects and other arthropods.

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?

The BOD values of the three samples A, Band C were recorded as 20 mg/L, 8 mg/L and 400 mg/L.
Greater the BOD of waste water more is its polluting potential. So, sample C is more polluting as compared to sample A.
Hence, sample A is the secondary effluent, sample B is river water and sample C is untreated sewage water.

12. Find out the name of the microbes from which cyclosporin A (an immunosuppressive drug) and statins (blood cholesterol-lowering agents) are obtained.

(a) Cyclosporin A is produced by the fungus *Trichoderma polysporum*.

(b) Statins are produced by the yeast *Monascus purpureus* which acts as a blood cholesterol-lowering agent.

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

(b) Soil

(a) Single cell protein (SCP)

A single cell protein is a protein obtained from certain microbes, which forms an alternate source of proteins in animal feeds.

The microbes involved in the preparation of single cell proteins are algae, yeast, or bacteria.

These microbes are grown on an industrial scale to obtain the desired protein. For example,

Spirulina can be grown on waste materials obtained from molasses, sewage, and animal manures.

It serves as a rich supplement of dietary nutrients such as proteins, carbohydrate, fats, minerals, and vitamins.

Micro-organisms such as Methylophilus and methylotrophus have a large rate of biomass production.

Their growth can produce a large amount of proteins.

(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.

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

The order of arrangement of products according to their decreasing importance is: Penicillin - Biogas – Citric acid – Curd.

Penicillin is the most important product for the welfare of human society. It is an antibiotic, which is used for controlling various bacterial diseases.

The second most important product is biogas. It is an eco-friendly source of energy. The next important product is citric acid, which is used as a food preservative.

The least important product is curd, a food item obtained by the action of lactobacillus bacteria on milk.

Hence, the products in the decreasing order of their importance are as follows: Penicillin- Biogas – Citric acid – Curd

15. How do biofertilisers enrich the fertility of the soil?

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.

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