

8th Science Lesson 6 Notes in English

6] Micro Organisms

Introduction:

Microorganisms are very small in size that they cannot be seen through naked eye. These organisms can be seen only with the help of a microscope. Therefore, they are also known as microbes. The science that deals with the study of microorganisms is known as microbiology. Microorganisms are found everywhere. They are found in air, water (ponds, lakes, rivers and oceans) and soil and even inside our bodies. They remain inactive under unfavourable conditions and become active during favourable conditions. Microorganisms can be studied under five categories. They are: virus, bacteria, fungi, algae and protozoa. Let us study about them in detail.

Virus:

A virus is a tiny particle made up of genetic material and protein. They are intermediate between living and non living things. Virus means 'poison' in Latin. Viruses are intracellular obligatory parasites. The study of virus is called virology. Viruses are 10,000 times smaller than bacteria. Viruses have different shapes. They can be rod shaped, spherical or of other shapes.

Structure of Virus:

A virus contains a core DNA or RNA. Surrounding that core is a protein coat. In some viruses, the protein coat is covered by an envelope made of proteins, lipids, and carbohydrates. These envelopes have spikes that help the virus particles attach to the host cells. Viruses cause many diseases to plants, animals and human beings.

Characteristics of Virus:

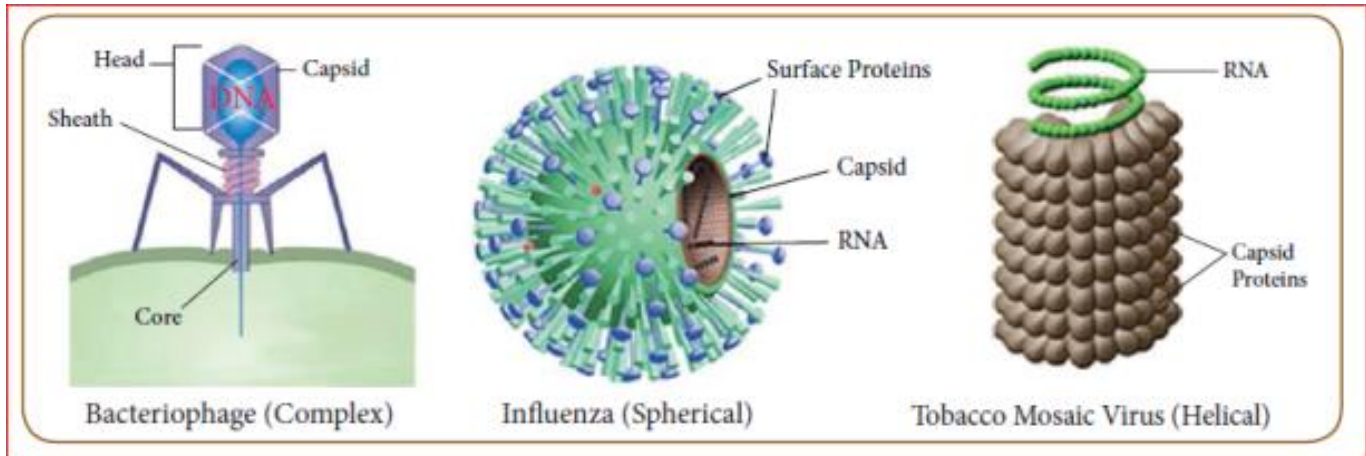
Viruses show both living and non living characters.

Living characters:

- They respond to heat, chemicals and radiations.
- They reproduce inside the host cells and produce copies of themselves.

Non-living characters:

- They are inactive when present freely in the environment.
- They can be crystallized and stored for a very long time, like other non-living things.



Shapes of Virus

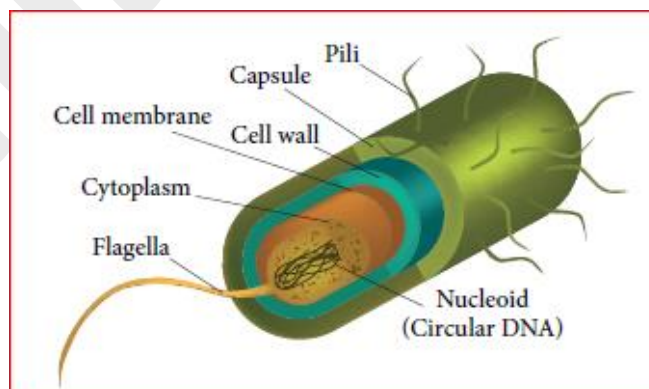
Bacteria:

Bacteria are single-celled prokaryotes (cells without nuclei). They are considered to be the first living organisms on earth. Bacteria are grouped under the kingdom Monera. The study of bacteria is called bacteriology. The size of bacteria ranges from $1\mu\text{m}$ to $5\mu\text{m}$ (micrometer). Bacteria are of two types based on respiration. They are:

- Aerobic bacteria (requires oxygen).
- Anaerobic bacteria (does not require oxygen).

Cell structure of Bacteria:

A bacterium has an outer covering known as the cell wall. Nuclear material is represented by a nucleoid without nuclear membrane. An extra chromosomal DNA called plasmid is present in the cytoplasm. Protein synthesis is carried out by 70S ribosomes. Other cell organelles (mitochondria, golgi body, endoplasmic reticulum etc.,) are absent. Flagella aids in locomotion.

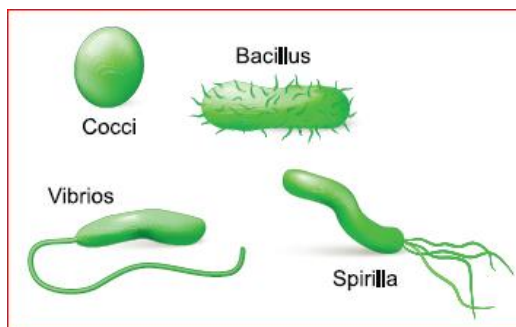


Cell Structure of Bacteria

Bacteria are classified according to the shape of their cells. They are:

- Bacilli: Rod shaped bacteria. Eg. *Bacillus anthracis*
- Spirilla: Spiral shaped bacteria. Eg. *Helicobacter pylori*

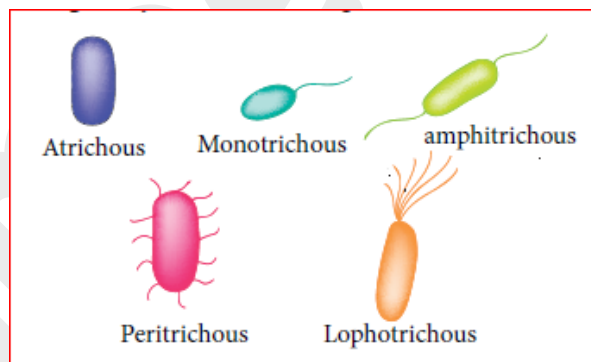
- Cocci: Spherical or ball shaped bacteria. They can stick together in pairs (diplococcus) or form a chain (streptococcus) or occur in bunches (staphylococcus).
- Vibrio - Comma shaped bacteria. Eg. Vibrio cholera.



Shapes of Bacteria

Bacteria are also classified according to the number and arrangement of flagella. They are as follows.

- Monotrichous: Single flagella at one end. Eg. Vibrio cholera
- Lophotrichous: Tuft of flagella at one end. Eg. Pseudomonas.
- Amphitrichous: Tuft of flagella at both ends. Eg. Rhodospirillum rubrum.
- Peritrichous: Flagella all around. Eg. E.coli.
- Atrichous: Without any flagella. Eg. Corynebacterium diptherae.



Flagellation types in Bacteria

Bacteria get their food in many ways. Photosynthetic bacteria make their own food (Eg. Cyanobacteria). Bacteria that live in harsh environment use chemicals (Ammonia, Hydrogen sulphide) to produce their food instead of utilizing energy from the sun. This process is called chemosynthesis. Some bacteria exhibit symbiotic relationship (Eg. E.coli lives in the intestine of man). Bacteria reproduces by fission (Binary and multiple fission).

Fungi:

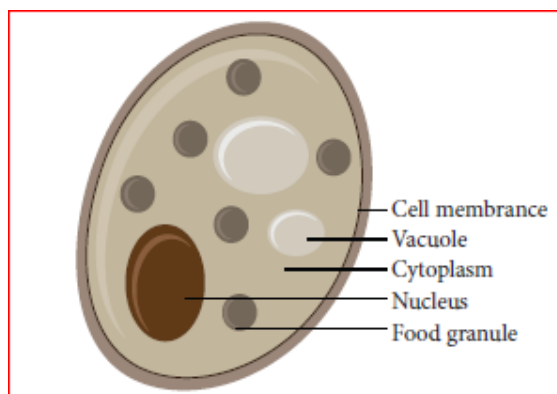
Fungi are a group of eukaryotic organisms that lack chlorophyll. They grow in dark environments. They may be either unicellular (Eg. Yeast) or multicellular (Eg. Penicillium). They are found in all kinds of habitats. They are included under kingdom Fungi. The study of fungi is

called mycology. Some fungi are macroscopic (Eg. Mushroom). There are around 70,000 species of fungi, living in the world.

Here, we will study about yeast which is a unicellular fungi. You will study about multi-cellular fungi elaborately in next chapter.

Cell structure of Yeast:

Yeasts are found freely in the atmosphere. Yeast grows in all kinds of media containing sugar. The cell is ovoid in shape, containing cell wall and a nucleus. The cytoplasm is granular, and has vacuoles, organelles and glycogen or oil globules. Yeast aids in fermentation with the help of the enzyme zymase. It respire anaerobically and reproduces by budding.

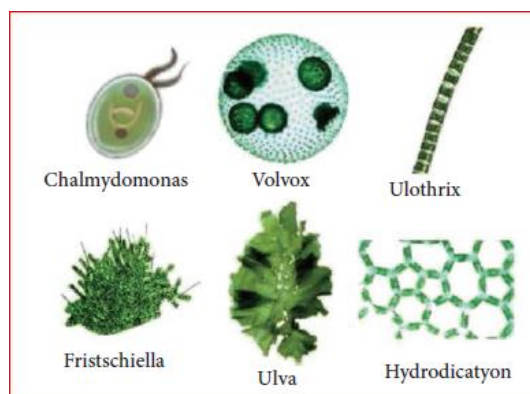


Structure of Yeast

Algae:

Algae are very simple plant like eukaryotic organisms. They are found in moist habitats. They are rich in chlorophyll and can be seen as thin film on the surface of lakes and ponds. Therefore they are known as 'grass of water'. They are autotrophic and they produce their own food with the help of chloroplast. Chloroplast

contain chlorophyll (green pigments) for photosynthesis. The study of algae is called algology (phycology).



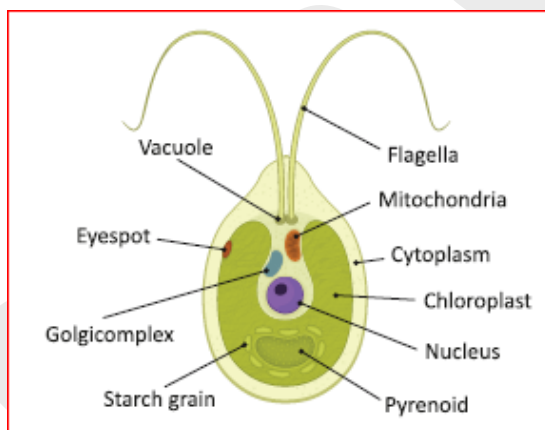
Different types of Algae

Their size varies from 1 micron to 50 meter. Algae may be unicellular and microscopic (Eg. Chlamydomonas) or multicellular and macroscopic (Eg. Sargassum). Unicellular algae exhibits variety of shapes (i.e., spherical, rod, spindle), where as multicellular algae are in the form of filaments and branches. In this section we will study about unicellular algae (Chlamydomonas) alone. Multicellular algae are explained in detail in the next chapter.

Cell structure of Chlamydomonas:

Chlamydomonas is a simple, unicellular, motile fresh water algae. They are oval, spherical or pyriform in shape. The pyriform (pear shape) is a common one found in ponds, ditches and water tanks. They have a narrow anterior end and a broad posterior end.

The cell is surrounded by a thin and firm cell wall made of cellulose. The cytoplasm is seen in between the cell membrane and the chloroplast. The cell contains large dark nucleus lying inside the cavity of the cup shaped chloroplast. The anterior part of the cell bears two flagella which helps in locomotion. Two contractile vacuoles are seen at the base of each flagellum. The anterior side of the chloroplast contains a tiny red coloured eyespot. Chlamydomonas exhibits sexual and asexual modes of reproduction.



Structure of Chlamydomonas

Protozoa:

A protozoan (In Greek, 'protos' means first and 'zoan' means animal) is a singlecelled eukaryote. They are included under the kingdom Protista. The study of protozoa is called Protozoology. They are found in ponds, ocean, in moist soil, and in the cells and tissues of plants and animals causing diseases. They range from 2 to 200 microns. Protozoans have specialized organelles. These organelles are used for movement, feeding, and other functions. The types of protozoans are as follows:

Ciliates: Presence of cilia for locomotion.

Eg. Paramecium

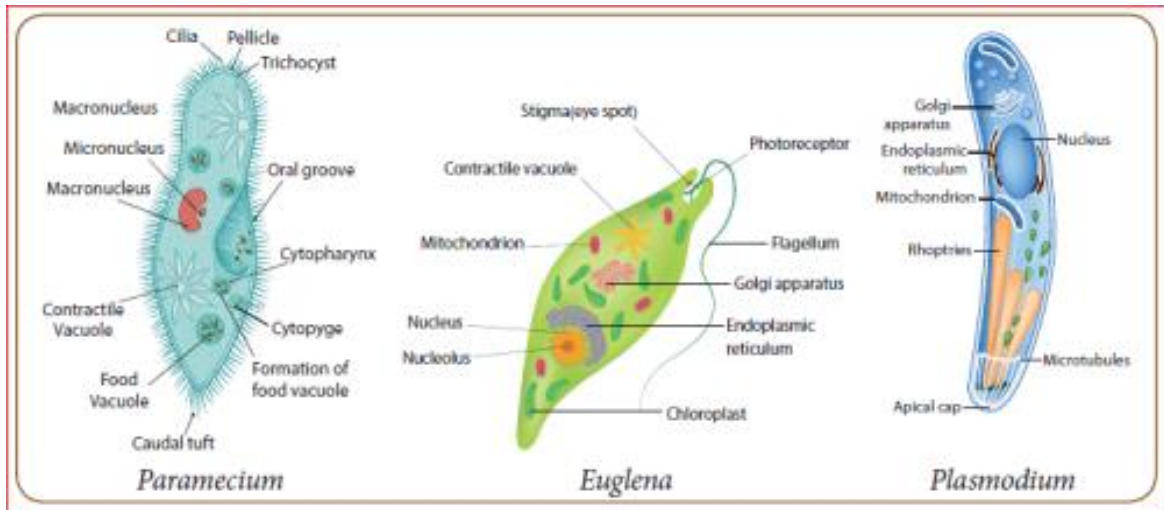
Flagellates: Presence of flagella for locomotion.

Eg. Euglena

Pseudopods: Presence of pseudopodia for locomotion. Eg. Amoeba

Sporozoans: Parasites.

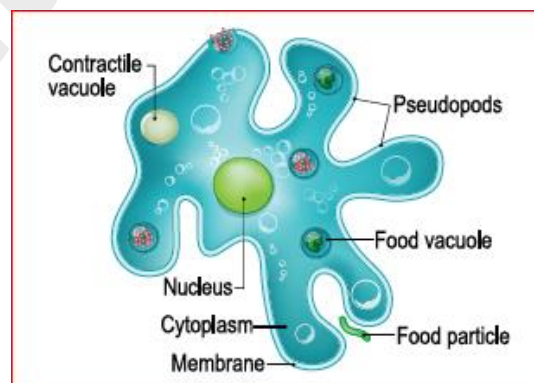
Eg. Plasmodium



Common Protozoans

Cell structure of Protozoa:

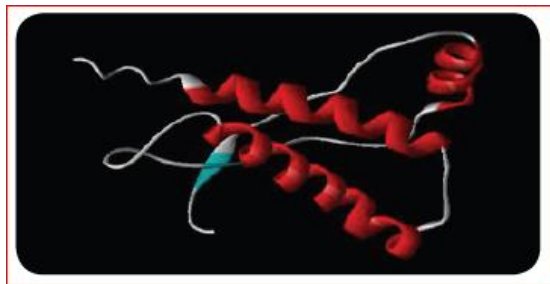
Amoeba is a unicellular microscopic organism. It is found in ponds. Amoeba is irregular in shape. It has cell membrane, cytoplasm and nucleus. It is a protozoan that moves by means of pseudopodia (In Latin, 'false feet'). Pseudopodia are the extended part of cell membrane. It helps to catch its prey (Algae). The body flows around the food particle and engulfs it forming food vacuoles. Contractile vacuoles are seen in the cytoplasm that help in excretion. Amoeba reproduces by means of fission and sporulation.



Amoeba

Prions:

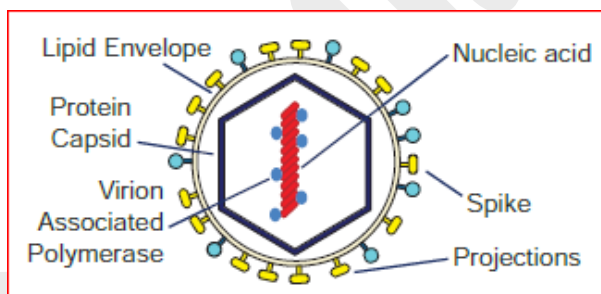
The word prion is derived from 'proteinaceous infectious particle'. Prions have neither DNA nor RNA to transmit infection. A prion is a mutated form of a usually harmless protein. Prions cause diseases by affecting brain or neural tissue. Eg. Creutzfeldt-Jacob disease. Another example is Kuru- associated with cannibalism.



Structure of Prion

Virions:

Virion is an entire virus particle consisting of an outer protein shell called a capsid and an inner core of nucleic acid (RNA or DNA). If the virus is found outside the cell (extracellular) it is known as virion. Virion has the capacity to infect the living tissue.



Structure of Virion

Uses of Microorganisms:

Microorganisms are useful in different fields such as medicine, agriculture and industry. Some of them are given below.

Medicine:

We obtain antibiotics and vaccines from microbes.

Antibiotics:

The word 'anti' means 'against'. Antibiotic is a substance produced by living organisms which is toxic for other organisms.



Penicillium chrysogenum

Sir Alexander Fleming was the first person to discover the antibiotic penicillin in the year 1928. The antibiotic penicillin was obtained from the fungi *Penicillium chrysogenum*. It is used to treat diseases such as tetanus and diphtheria. The antibiotic, streptomycin is obtained from *Streptomyces* bacteria to cure various bacterial infections. Eg. Plague

Vaccines:

Vaccines are prepared from dead or weakened microbes. Edward Jenner was the first person to discover small pox vaccine. He coined the term vaccination. When the vaccine is injected to the body of a patient, the body produces antibodies to fight against the germs. These antibodies remain inside the body and protect from future invasion of the germs. Therefore, vaccination is otherwise called as immunization. Eg: MMR vaccine is given for preventing Measles, Mumps and Rubella. BCG (Bacille Calmette Guerin) vaccine is given for preventing Tuberculosis.

Agriculture:

Natural fertilizer:

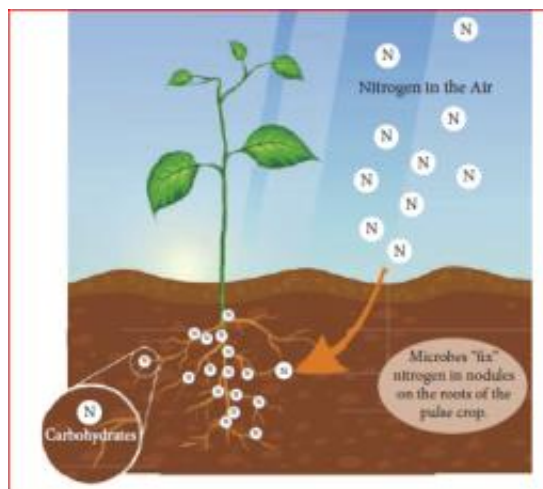
Microorganisms are called as decomposers because they act upon degradable wastes. During the process, nitrates and other inorganic nutrients are released into the soil, making the soil fertile. This compost is called as natural fertilizer.



Types of Bio-fertilizers

Nitrogen fixation:

Rhizobium bacteria living in the root nodules of leguminous plants enrich the soil by fixing the atmospheric nitrogen as nitrates which are essential for the growth of plants. Some free living bacteria in soil, like Cyanobacteria Nostoc can also fix nitrogen biologically.

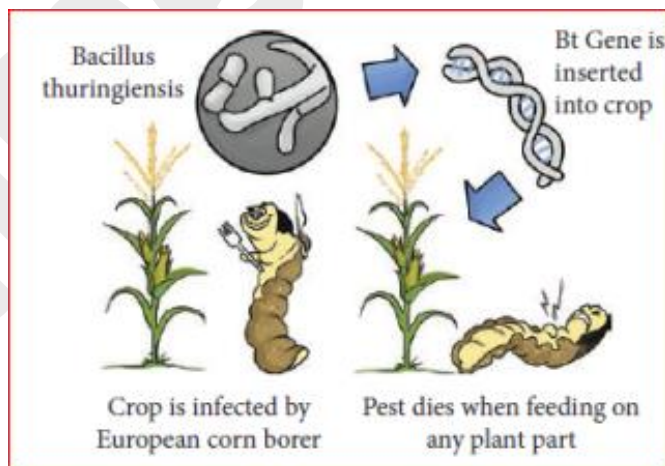


Nitrogen fixation in plants

Bio-control agents:

Microbes are used to protect the crops from pests. Some of them are given below.

- Bacillus thuringiensis (Bt cotton) helps to control insects.
- Trichoderma (Fungi) helps to protect roots and controls plant pathogens.
- Baculoviruses (Virus) attack insects and other arthropods.



Biocontrol agents

Industry:

Sewage treatment:

Aerobic microbes are allowed to grow in the primary effluent during the secondary stage of waste water treatment. These microbes consume the major part of the organic matter in the effluent. Eg. Nitrobacter sps. In the anaerobic treatment of sewage Methanobacterium is used.

Production of biogas:

Human and animal faecal matter and plant wastes are broken down by anaerobic bacteria to produce methane (biogas) along with carbon dioxide and hydrogen. These bacteria are called as methanogens.

Production of alcohol and wine:

Alcoholic drinks are prepared by fermentation process using yeast. Sugars present in grapes are fermented by using yeast. Beer is produced by the fermentation of sugars in rice and barley.

Microbes in retting and tanning:

Flax plants are tied in bundles and kept in water. Bacteria loosen the supporting fibres of the stem by acting on the stem tissues. This process is known as retting. Linen thread is made from these fibres. Eg. Pseudomonas aeruginosa.

In tanning industry bacteria act upon the skin of animals and makes it soft and therefore it becomes pliable.

In daily life:**Making bread:**

Yeast is used in bakeries to make bread and cakes. They are added to the dough to produce carbon dioxide which makes the dough rise. Bread and cakes are soft due to carbon dioxide gas. Chlorella (green algae) which is rich in proteins and vitamins is added to the dough to enrich the bread with nutrients.

Preparation of curd and cottage cheese:

Lactose in the milk gets turned into Lactic acid by the action of Lactobacillus (bacteria). Therefore, milk becomes thick (curd). It gives the sour taste. When curd is processed cottage cheese (panneer) is obtained.

In Human Intestine:

- Lactobacillus acidophilus that lives in the human intestine helps in digestion of food and fights against harmful disease causing organisms.
- E.coli bacteria living in human intestine help in synthesizing vitamin K and vitamin B complex.

Microbes in Food Process:

Microorganisms commonly used for food processing are yeast, bacteria, and moulds. Fermentation process which is carried out by microorganisms results in the production of organic acids, alcohol and esters. They help to preserve food and generate distinctive new food products.

a. Food preservation:

Two techniques are followed in food preservation. They are:

- Traditional techniques
- Modern techniques

1. Traditional techniques:

Fermentation, pickling, boiling and sugaring are the traditional techniques followed in food preservation.

Fermentation:

Fermentation is the microbial conversion of starch and sugars into alcohol. It makes foods more nutritious and palatable.

Pickling:

Pickling is a method of preserving food in an edible antimicrobial liquid. It is of two types: chemical pickling and fermentation pickling.

In chemical pickling, food is placed in an edible liquid that kills bacteria and other microorganisms. Eg. Vinegar, alcohol, vegetable oil (pickling agents). In fermentation pickling, bacteria in the liquid produce organic acid as preservation agent that produces lactic acid due to the presence of *Lactobacillus*.

Boiling:

Boiling liquid food items kill all the microbes. Eg. Milk and Water.

Sugaring:

Sugar is used to preserve fruits in antimicrobial syrup with fruits such as apples, pears, peaches, plums or in a crystallized form, so that the product is stored in dry condition.

2. Modern techniques:

Pasteurization:

It is a process for preservation of liquid food. This method was invented by Louis Pasteur in 1862. Milk is preserved by this method. It is heated up to 70 °C to kill the bacteria and it is cooled to 10 °C to prevent the growth of remaining bacteria. Then milk is stored in sterilized bottles in cold places.

b. Food production:

Probiotics:

Probiotics are live food supplements used in yoghurt and other fermented milk products. Eg. *Lactobacillus acidophilus* and *Bifidobacterium bifidum*. These bacteria improve the microbial spectrum in the gut and thus contribute to the following effects.

- Decrease the risk of colon cancer
- Decrease cholesterol absorption
- Prevent diarrheal diseases by increasing immunity.

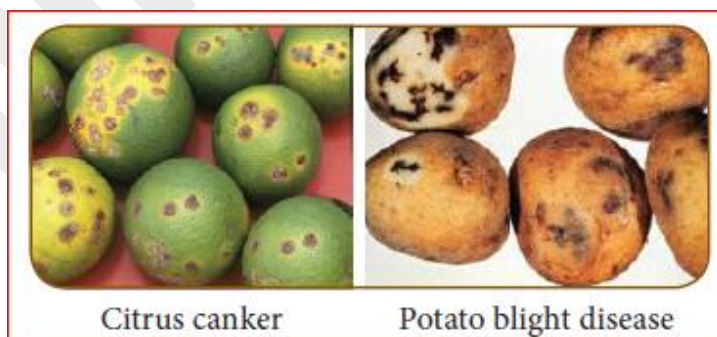
Harmful Microorganisms:

A few microorganisms are harmful to plants, animals and humans. They cause diseases and hence they are called as pathogens. Pathogens enter into the body through cuts and wounds in the skin, mouth or nose and cause diseases. Viruses causing 'flu' are spread through air. When the patient sneezes droplets containing viruses spread in air and it gets entered to another person when he breathes. Some of the diseases caused by the microorganisms in plants, animals and humans are given in the tables below:

Diseases caused by microorganisms in plants

Plant diseases	Causative microorganisms	Mode of transmission	Symptoms	Preventive measures/Treatment
Citrus canker	<i>Xanthomonas axonopodis</i> (Bacteria)	Air, water	Lesions on leaves, stems and fruit	Copper based bactericides can be used
Potato blight disease	<i>Phytophthora infestans</i> (Fungi)	Air	Brown lesions on the surface of tubers	Fungicides are used

Disease in plants



Diseases caused by microorganisms in animals

Animal diseases	Causative microorganisms	Mode of transmission	Symptoms	Preventive measures/Treatment

Anthrax (also affects humans)	Bacillus anthracis (Bacteria)	Through contaminated soil and food	Difficulty in breathing, unconsciousness, loss of appetite	Anthrax vaccine
Foot and mouth disease	Aphthovirus (Virus)	Through air and animal vectors	Fever, blisters in mouth, weight loss, decreased milk production	FMD vaccine

Diseases caused by microorganisms in humans

Human diseases	Causative microorganisms	Mode of transmission	Symptoms	Preventive measures/Treatment
Tuberculosis	Mycobacterium tuberculosis (Bacteria)	Through air and sputum of infected person	Persistent cough, blood mucus, loss of weight, breathlessness	BCG Vaccine
Cholera	Vibrio cholera (Bacteria)	By flies and contaminated food and water	Watery diarrhoea, vomiting, rapid dehydration	Anticholera vaccine, maintaining personal hygiene
Common cold	Influenza (virus)	Through air	Running nose, sneezing	Isolation of patient
Rabies	Rhabdo viridae (Virus)	Animal bite	Fever, hallucination, paralysis, inability to swallow	Anti-rabies vaccine
Amoebic dysentery	Entamoeba histolytica (Protozoa)	Food water and flies	Severe diarrhea and blood in stool	Proper sanitation to be followed and metronidazole antibiotic to be administered
Malaria	Plasmodium (Protozoa)	Female anopheles mosquito	Nausea, vomiting, high fever	Antimalarial drugs like quinine and chloroquine to be taken and usage of mosquito repellents and nets.

Relationship Between Man and Microbes-Balances, Imbalances and Uses:

Thousands of bacteria, fungi and other microbes that live in our gut are essential contributors to a good health. They break down toxins, manufacture some vitamins and essential amino acids and form a barrier against invaders. Gut microbes are the bacteria in human gut. They are one of the most important allies in our overall health and well being. Gut ensures that the body is absorbing all the important nutrients, to function at its highest level. Many different aspects of health are attached to it.

Points to Remember:

- The organisms which can be seen only with the help of microscope are called microorganisms.
- Virus show both living and non living characteristics.
- Bacteria are a prokaryotic, single celled organism.
- Fungi are a eukaryotic, non-photosynthetic, spore-forming organism. They range from single celled organisms to very complex multi-cellular organisms.
- Algae are a single-celled or multi-cellular eukaryotic, photosynthetic organism.
- Protozoa is a eukaryotic, single celled organism that usually lacks chlorophyll.

Glossary:

Antibiotic - A chemical that kills or inhibits the growth of micro organism and is used to treat infections.

Bacteria - A prokaryotic, single celled organism.

Capsid - The protein coat surrounding a virus.

Fermentation - Conversion of organic compounds such as carbohydrate into simpler substances by microbes, usually under anaerobic conditions (with no oxygen present).

Hyphae - A very fine thread that is the basic structure of fungi.

Microorganism - A small living thing which includes bacteria, protozoa, algae, fungi and viruses.

Pathogen - An organism that causes disease.

Vaccine - A special type of medicine that is given to both people and animals to artificially increase immunity to a particular disease and to prevent an infectious disease from developing.