Economic Importance of Bacteria & Fungi

General Study of Bacteria and Fungi

A General Study of Bacteria

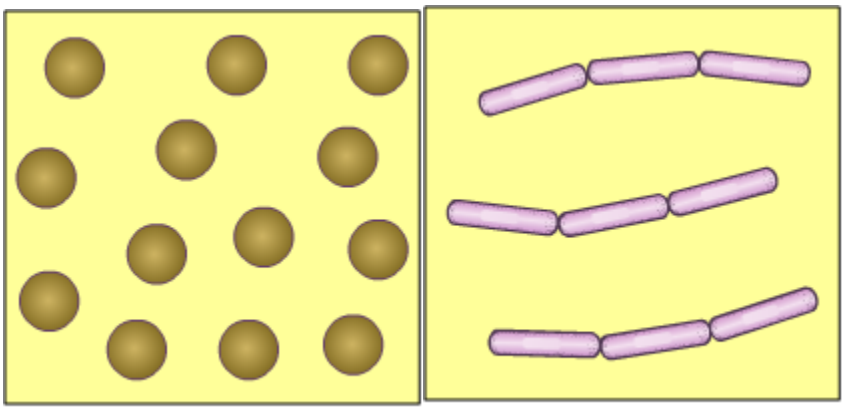
Bacteria are the most primitive and diverse unicellular organisms found in living world. They are prokaryotic in nature as their genetic material, i.e. DNA, is not enclosed within a nuclear membrane. Because of their unique biochemical pathways and properties, they are of high economic importance to the human beings. Let us take a look at a general account of various features of bacteria.

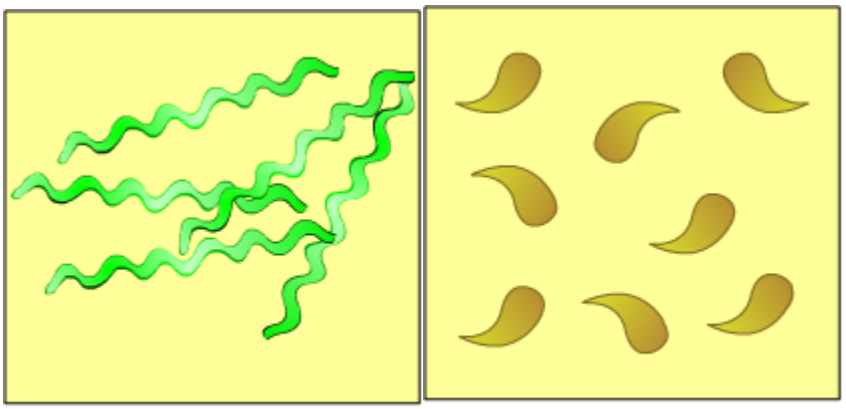
Occurrence

- Bacteria are known to exist in almost every corner of the Earth.
- There are several thousands of bacteria in the air we breathe, water we drink and food we eat. In fact our own body is a home to various bacteria.
- Some species of bacteria are also found to inhabit some of the most unfavourable conditions on Earth, such as hot water springs, geothermal vents, acidic lakes, etc.

Size
Bacteria are the smallest living organisms, ranging from size 0.2 - 2.0 µm.

Shape
Bacteria are found in diverse shapes. On the basis of shape, they can be broadly classified as cocci (spherical bacteria), bacilli (rod-shaped bacteria), spirilla (spiral bacteria), and vibrio (comma-shaped bacteria).

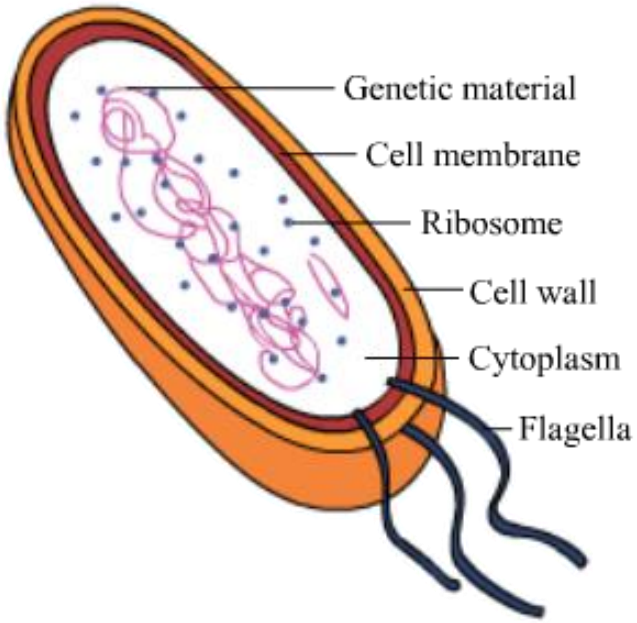




Spirilli Vibrio

Structure

- Bacterium is unicellular in nature, consisting of a cell wall made up of peptidoglycan, cell membrane and protoplast.
- The cytoplasm lacks any cell organelle, except vacuoles and ribosomes.
- DNA lies freely in the central region of the cytoplasm.
- In some cases, the cell wall is further surrounded by a slimy protective layer, called capsule.
- Some bacteria also contain whip-like flagella that help them in their movement.



A Bacterial Cell

Nutrition

Most bacteria are heterotrophic in nature. Some of them are saprophytes and derive nutrition from dead, decaying organisms. Others are parasitic on other living organisms and derive nutrition from them.

Reproduction

- Almost all bacteria reproduce asexually by means of binary fission.

- Very few bacteria are also found to reproduce sexually through **conjugation**. It is an extremely simple mode of sexual reproduction in which two bacteria of different strains (but same species) come together and transfer of plasmid (an extra-chromosomal small circular DNA) occurs between them.

  Under unfavourable conditions, the bacterial cell can transform into a spore. A spore is a spherical mass of bacterial cell surrounded by a thick, hard protective wall. Due to presence of this wall, a spore can tolerate extreme weather conditions as well as exposure to harmful chemicals. On the return of favourable conditions, it germinates into a new bacterium.

  Bacteria have wide scale applications in various industries and day to day life. They play important role in many biological and ecological processes.

  Importance of bacteria:

- They are used in the food industry for various purposes, such as fermenting fruit juices into vinegar, making curd from milk (which is done by bacteria *Lactobacillus),* making cheese, etc.

- They are used in tanning of leather, where animal hides are cured using bacteria.

- They are used in the synthesis of antibiotics (medicines which can destroy disease causing germs). Streptomycin is one such antibiotic obtained from bacteria.

- *E. coli* is a bacteria which lives in the large intestine of humans and produces vitamin B and K which is required by the body.

- Compost and manures are produced due to decomposition of cow dung, horse dung and animal waste by bacteria.

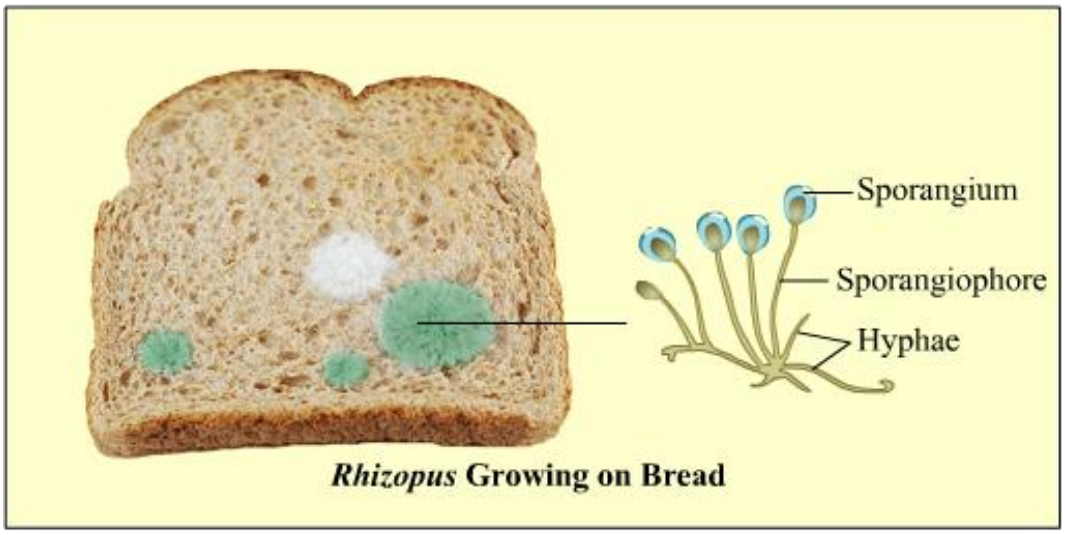
  From the above examples we can understand how important bacteria are.
  However, bacteria are also capable of causing various kinds of harmful effects. Some examples of them are as follows:

- Spoilage of food, such as milk, fish, meat, etc, is the result of bacterial action. They are responsible for spoilage of tinned foods as well.

- They are responsible for causing a number of diseases in humans as well as animals. For example: cholera is caused by *Vibrio cholerae* and tuberculosis is caused by *Mycobacterium tuberculosis*.

A General Study of Fungi

Fungi is a group of eukaryotic, unicellular as well as multicellular, non-photosynthetic organisms that includes mushrooms, moulds and yeasts. These organisms have a rigid cell wall made up of chitin and are found in diverse shapes and sizes. Most common fungi to be found in nature are moulds, which grow on various food materials, wood and even leather. One such mould is *Rhizopus* which is the common bread mould.



***Rhizopus* Growing on Bread**

Structure of *Rhizopus*

- *Rhizopus* consists of a network of transparent, fine thread-like structure, called hypha.
- The collective mass of hyphae is referred as mycelium.
- Some hyphae, called sporangiophore, are specialised to form spores.
- The sporangiophore consists of a swollen tip which is covered with a sac-like structure. This enclosed structure is known as sporangium.
- Inside the sporangia, spores are formed, which are the means of asexual reproduction in fungi.
- Once the spores get mature, the sporangium burst opens, liberating the spores in the atmosphere.
- On finding suitable substratum, these spores germinate and form a new mycelium.

Nutrition

Most of the fungal species are saprophytic in nature. Some of them are parasitic on various plants and animals as well.

Reproduction in Fungi

- Most fungi reproduce asexually, though sexual reproduction may also take place in few cases.
- Asexual reproduction may occur in the form of spore formation (as in *Rhizopus)* or as budding (as in yeast).

Just as bacteria, fungi too can have both useful as well as harmful impacts.

Useful Fungi:

- Some fungi, like mushrooms, are an important source of food.
- Yeast is a fungi which is commonly used in baking processes.
- Vitamin B is also produced by some kinds of fungi.
- Some species of fungi are also used in cheese making. For example, species of *Mucor* and *Rhizopus.*
- Antibiotic penicillin is obtained from a fungus called *Penicillium notatum.*

Harmful fungi:

- Molds are responsible for the spoilage of food, leather goods and textiles.
- Some fungi can attack crops and lead to huge losses to farmers.
- They can cause various kinds of skin and lung infections. For example, Athlete's foot and ringworm.

Use of Microbes in Increasing Soil Fertility

Which element is the major element of the air? 'Nitrogen' is the most abundant element present in the air.

Information about nitrogen

Symbol	**N**
Atomic number	7
Atomic mass	14
Electronic configuration	$Is^2\ 2s^2\ 2p^3$
Valency	+3, +5
Physical state	Gaseous

Colour	Colorless

Nitrogen is the major element which is inevitable for the growth and sustenance of living organisms as it is the essential constituent of proteins.

So animals get nitrogen in the form of protein but what about plants? **From where plants get nitrogen?**

Do you know that some bacteria help in increasing soil fertility?

There are some bacteria which help in the conversion of ammonia into nitrites and nitrates by the process of nitrification.

Plants take up these nitrites and nitrates from the soil.
E.g. *Nitrosomonas* and *Nitrobacter*. In this way, they help in increasing the fertility of soil.

Certain bacteria and blue-green algae fix the atmospheric nitrogen into soil and thereby, increase the fertility of soil. They are known as biological nitrogen fixers. This process of conversion of nitrogen into nitrogenous compounds is known as nitrogen fixation.

These nitrogen-fixing bacteria can be both free-living (E.g. *Azotobacter*) and can have symbiotic relationships (E.g. *Rhizobium*) with the roots of leguminous plants like pulses.

It lives in symbiotic association with plants and fixes the atmospheric nitrogen in leguminous plants.

Micro-organisms not only increase soil fertility, but also help in recycling matter within the ecosystem, and thus help in cleaning the environment.

Let us understand how micro-organisms take part in recycling matter by taking a look at the nitrogen cycle.

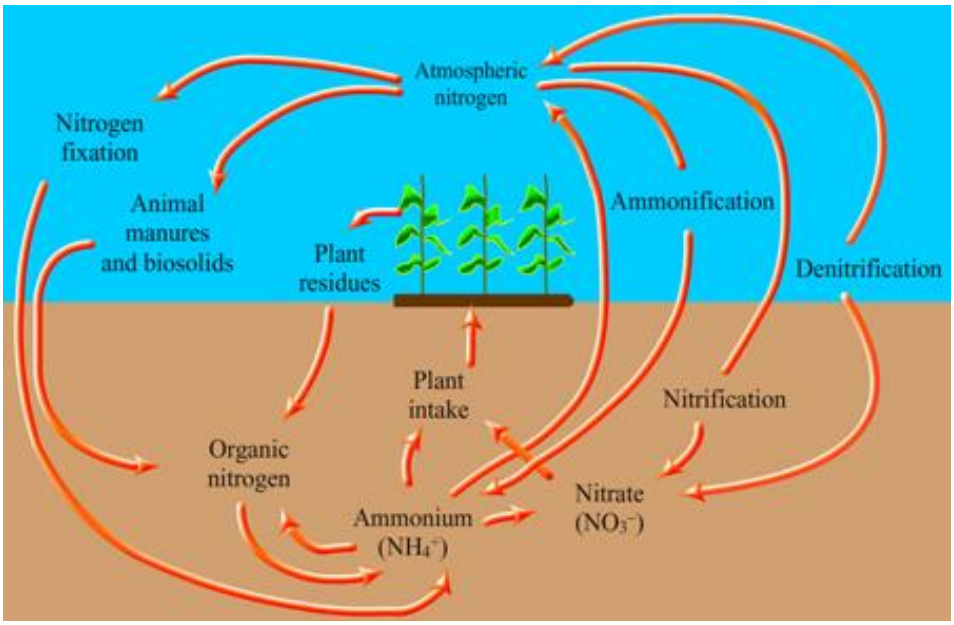
Nitrogen cycle

You know that our atmosphere contains 78% of nitrogen. But all this nitrogen cannot be taken up directly by plants and animals. As studied earlier, certain bacteria and blue-green algae fix the atmospheric nitrogen into soil and convert it into compounds of nitrogen. *Rhizobium* is one such bacterium which does this.

It converts the atmospheric nitrogen into usable form, which is then taken up by plants through their roots. This nitrogen is then utilized by plants to synthesize proteins and other such compounds. Nitrogen is then transferred to animals in the form of proteins when they feed on plants.

But how does this nitrogen reach back into the atmosphere? When plants and animals die, micro-organisms like bacteria and fungi present in soil convert nitrogen present in dead organisms into nitrogenous compounds by the process of **decomposition**, which can be used by plants again.

Some micro-organisms convert these compounds into nitrogen gas, which goes back into the atmosphere. Therefore, micro-organisms help the nitrogen cycle to continue and maintain the percentage of nitrogen present in the atmosphere.



- Fungi are decomposers and reduce organic matter and release valuable nutrients into the soil and hence help in the recycling of nutrients.

- Some fungi form symbiotic associations with the roots of plants (Mycorrhiza), which help the roots to effectively absorb nutrients from the soil.

Use of Microbes in Food Industry

Do you know that micro-organisms are used to prepare a number of food items we consume?

Let us explore the use of micro-organisms in the preparation of food.

i. Use of bacteria in preparing curd and yoghurt

You must have seen your mother preparing curd by adding a small amount of curd to warm milk and keeping it to set the whole night.

What do you think the small amount of curd contains, which helps in the preparation of curd from milk?

Curd contains several micro-organisms like the bacterium ***Lactobacillus*****,** which promotes the formation of curd. It multiplies in milk and converts it to curd.

Bacteria are also used in the preparation of cheese, pickles, and many other food items.

You must have heard about 'Yakult', seen its advertisement or tried it yourself. But why are we talking about 'Yakult' here?
It is because 'Yakult' is a probiotic drink. Now you may think what a probiotic is.

Probiotics are such edible preparations which contain useful active bacteria, like *Lactobacillus, Acidophilus, Lactobacillus casei, Bifidobacterium bifidum,* etc. These bacteria are beneficial for the intestine as they help in the process of metabolism.

They are usually given when a person is suffering from diarrhoea or is under antibiotic treatment. Antibiotics kill both beneficial and harmful bacteria present in our body, thus affecting the metabolic process. These probiotics form the colonies of useful microbes in alimentary canal and thus aid in the digestion process.

ii. Use of yeast in preparing bread and cake

But how are micro-organisms useful in the preparation of bread?

Let us find out by performing this simple activity.

Take ½ kg of *maida* and add some sugar to it. Mix it with warm water and add a small amount of yeast powder to the mixture. Knead the *maida* to make soft dough. Keep the *maida* aside and record your observation after two hours. You will notice that *maida* has risen and has become fluffy. **Do you know the reason behind the fluffiness of *Maida*?**

This happens because yeast added to *maida* reproduces rapidly, and produces carbon dioxide gas while respiring. This gas fills the dough and increases its volume making it to rise.

Maida with Yeast Powder Raised maida

Based on this principle, yeast (which is a micro-organism) is used in the preparation of breads and cakes. It helps in making them spongy.

iii. Use of yeast in preparing alcohol and wine

Micro-organisms are used commercially to prepare alcohol, wine, and vinegar. Yeast is the most common micro-organism, which is used to prepare alcohol and wine. Let us find out how yeast takes part in the production of alcohol.

During the preparation of alcohol, yeast is grown on natural sugars present in grains like rice, wheat, barley, or crushed fruit juices. Yeast breakdowns the sugar present in these grains into alcohol, leading to the large-scale production of alcohol. This process of conversion of sugar into alcohol is known as **fermentation**.

iv. Use of bacteria in other food industries

- In the production of vinegar - Sugar solution is converted into acetic acid (vinegar) by the action of the bacteria called *Acetobacter*.

- In the curing of tea - Bacteria act upon the tea leaves and give tea its characteristic flavors.

- In the production of **cheese:** Cheese is a valuable food having high quantities of proteins, some fats, calcium, phosphorous, vitamin A and some quantities of vitamin B. It is prepared from milk with the help of *Lactobacillus* bacteria. Its preparation involves following steps:

- **Curdling of milk:** Done by adding *Lactobacillus*; curd thus produced is separated from whey.

- **Processing of curd:** Extra moisture is removed to form cottage cheese.

- **Salting:** To further remove moisture and prevent growth of undesirable microbes
- **Ripening:** To give cheese its characteristic flavour; done at suitable temperature and humidity

Did you Know?

- The bacterium *Propionibacterium sharmanii* is used in ‘Swiss cheese’ to give it its characteristic holes by producing large amount of carbon dioxide.

- ‘Roquefort cheese’ is ripened by growing certain fungi on them to give them their specific flavour.

v. Use of mushroom and *Penicillium* in food industries

- Some varieties of mushrooms such as *Agaricus* are edible and good sources of proteins and vitamins, but some wild mushrooms such as *Amanita* species are poisonous.
- *Penicillium spp.* is used in the flavouring of cheese.

Microbes - Household and Industrial applications

Household Applications

- **Lactic acid bacteria (LAB)**
- Milk $\xrightarrow{LAB}$ Curd
- LAB produces acids that coagulate and partially digest milk proteins.
- Small amount of curd that is added to the milk for curdling acts as an inoculum containing thousands of LABS, which further multiply.
- LAB enhances the nutritional value of milk by increasing Vitamin B_{12}.
- LAB present in stomach prevents infections.
- **Fermentation**
- Dosa and idli dough is fermented by bacteria, which produces CO_2 gas and gives it a puffed-up appearance.
- Dough used for making breads is fermented by baker's yeast (*Saccharomyces cerevisiae*).
- 'Toddy', a traditional drink from South India is made by fermenting sap from palm trees.
- The xanthan gum, which is used in thickening of ice creams, puddings, chocolates etc. is obtained by fermentation of starch and molasses. The fermentation is carried out with the help of *Xanthomonas* sp.

  Xanthum gum is also used in the production of pigments, fertilizers, weedicides, textile pigments, tooth pastes, high quality paper, etc.

Industrial applications

- For industrial purposes, microbes are grown in large vessels called fermentors.

- On industrial scale, fermented beverages, antibiotics, enzymes, and other bioactive molecules are prepared using microbes.

- **Fermented beverages**
  Saccharomyces cerevisiae, also called brewer's yeast, is used to prepare wine, beer, whisky, brandy, rum, etc. depending upon the type of raw material and processing.

- If fermented broth is distilled, then brandy and rum are produced while wine and beer are produced without distillation.

- **Antibiotics**

- Certain microorganisms inhibit the growth of other microorganisms wherever they grow.

- Antibiotics are chemical substances produced by certain microbes that kill or retard the growth of other microbes (disease-causing microbes).

- Penicillin discovered by Alexander Fleming was the first antibiotic to be discovered.

- Fleming discovered it by chance when he was working on the bacterium *Staphylococcus*. He discovered that growth of *Staphylococcus* ceases in the culture plates where *Penicillium notatum* was grown.

- Later on, its use as an effective antibiotic was established by Chain and Florey.

- **Chemicals, enzymes, and bioactive agents**

Microorganism	Substance produced
Fungus Aspergillus niger	Citric acid

Bacterium Acetobacter aceti	Acetic acid
Bacterium Clostridium butylicum	Butyric acid
Bacterium Lactobacillus	Lactic acid
Yeast S.cerevisiae	Ethanol
Bacterium Streptococcus	Streptokinase (used as a clot buster for removing clots from blood vessels of patients with myocardial infarction)
Fungus Trichoderma polysporum	Cyclosporin A (used as immune-suppressive agent in organ transplantation)
Yeast Monascus purpureus	Statins (lower blood cholesterol levels)

- **Leather industry**

  Bacteria are also used in leather industries during tanning of leather. The soft, perishable parts of the skin (**hide**) are degraded with the help of certain bacteria.

Use of Microbes in Medicines

You know that micro-organisms cause diseases, but do you know that some micro-organisms are also used to prevent diseases? Let us explore.

You must have consumed antibiotics when you were ill. What do you think are antibiotics? Antibiotics are medicines which are obtained from certain micro-organisms. They kill or stop the growth of other disease-causing micro-organisms. Thus, they are useful for humans.

Sometimes, the symptoms of a disease are visible but the pathogens cannot be identified. In this case, broad-spectrum antibiotics are used that are active against a wide variety of bacteria. Example, phenicols, cephalosporins etc.

On the other hand, narrow-spectrum antibiotics are used when the pathogens are identified. Example, azithromycin, penicillin etc.

Fungi such as *Penicillium spp.* and *Aspergillus spp.* are used to produce antibiotics, which are used to cure deadly diseases such as pneumonia.

Bacteria are also used to produce antibiotics.

Subtilin, Bacitracin and Gramicidin are examples of antibiotics obtained from bacteria while penicillin, cyclosporin and cephalosporin are a few examples of the commonly used antibiotics obtained from fungi.

Apart from treating human diseases, antibiotics are also mixed with livestock and poultry food to check the spread of microbial infection among farm animals.

Some Interesting Facts:

- **Penicillin was the first antibiotic discovered. Scottish scientist, Alexander Fleming, discovered the drug in 1928.**

- **Do you know that proper use of antibiotics can stop the infection and save lives, while improper use of it can be more harmful than helpful? Therefore, knowing when to take antibiotics is very important.**

You must have been given injections to protect yourself against several diseases when you were young. These injections are called **vaccines. But what do you think these vaccines contain?** Vaccines are the dead or weakened micro-organisms, which help the body fight against diseases. Let us find out how.

Our body reacts to infection by micro-organisms by producing certain substances called **antibodies**. These antibodies kill the invading micro-organisms freeing the body from diseases. So, in order to protect the body from diseases caused by micro-organisms, some dead or weakened microbes are introduced into the body, which causes the production of antibodies.

These antibodies then remain in the body for a long period of time protecting the body from diseases. This whole process of introducing vaccines into the body is known as **vaccination.**

Vaccines are available for a large number of diseases like cholera, tuberculosis, smallpox, hepatitis, chicken pox, polio etc. Therefore, vaccines are another medium through which micro-organisms are used to prevent diseases in humans and other animals.

A number of bacteria have been used in the production of vaccines against some deadly diseases such as tuberculosis, whooping cough, diphtheria, etc.

Genetically engineered bacteria

Some genetically engineered bacteria are used in the production of insulin for the treatment of diabetes.

Some Interesting Facts:

- Polio vaccine is cultured on kidneys of monkeys and cells of aborted foetuses.

  Rubella, chickenpox, and hepatitis A vaccines are cultured on cells of aborted foetuses.

  Serums and Toxoids

  When a pathogenic bacterium enters our body, it releases some harmful proteins during its growth or after death. These harmful proteins are known as **toxins**. The immune system defends our body from these harmful toxins by releasing **antitoxins**, which can react with and neutralise the toxins. These antitoxins are found in the **serum**.

  Serum is a pale yellow coloured blood component which lacks any blood cell as well as clotting factors. It is basically the blood plasma from which all the clotting factors have been removed. Due to the presence of antitoxins/antibodies in serum, it can be used as a preventive measure against bacterial invasions. Let us see how this is done.

- A small dose of bacterial toxin or toxoid is introduced into the blood of a healthy animal. **(Toxoid: inactivated toxins of a particular bacterium)**

- The immune system of that animal will produce antitoxins against the injected toxin.

- After sometime, some amount of blood is taken out from the animal and allowed to clot.

- The serum thus obtained after clotting contains the antitoxins against that particular bacterial toxin or toxoid. It can now be used to provide protection against that bacterium.

  Few serum compounds have been produced by genetically modified bacteria as well, for example, blood clotting factor VIII (for treatment of Haemophilia A), Factor IX (for treatment of Haemophilia B), etc.

Mushroom Cultivation

You must have eaten some delicious dishes made of mushrooms at your home or hotels. You might also be aware that mushrooms that we eat are a type of fungus. However, are all mushrooms species growing in wild edible? The answer is, **no**. In fact, most of the them are highly poisonous! Let us study more about the edible mushrooms and how they are cultivated.

Edible Mushrooms

Edible mushrooms are fleshy, non-poisonous fruit bodies of mushrooms that have desirable taste and aroma. Some of the most widely cultivated kinds of mushrooms are:

- *Agaricus bisporous* (white button mushroom)
- *Volvariella* (paddy straw mushroom)
- *Pleurotus* (oyster mushroom)

Out of these, *Agaricus bisporous* is undoubtedly the most common edible mushroom eaten all over the world.

Can you find out some examples of non-edible mushrooms?

Apart from their rich flavour, mushrooms are also widely popular for their high nutritional values. They are the excellent source of vitamins and minerals. Some common vitamins found in mushrooms are niacin, pantothenic acid and biotin.

Nutritional Facts of Mushrooms

Nutrients	Amount
Water	85-95%
Proteins	3%
Carbohydrates	4%
Fat	0.3-0.4%
Minerals and Vitamins	1%

Cultivation of *Agaricus bisporous*

Cultivation of *Agaricus bisporous* or white button mushrooms is widely popular in India. It is usually done indoors, thus eliminates the requirement of large area of land. There are five major steps involved in the cultivation of mushrooms. Let us study each of them in a little detail.

- **Composting**: First of all, a nutrient-rich compost is prepared, comprising of wheat or paddy straw, chicken manure and some organic and inorganic fertilizers. This compost mixture is then kept at about 50ºC for almost a week.

- **Spawning**: Some amount of the mycelium of the required mushroom, or 'mushroom seed', is then introduced in the compost. It is then allowed to spread for few days.

- **Casing**: In this step, a thin layer of soil is spread over the compost. This step is highly important as the layer of soil gives support to the mycelium and provides humidity to it. It also helps in regulating the temperature and prevents quick drying of the compost.

- **Cropping and harvesting:** There are three principle stages of growth of mushrooms.

- The mycelium first grows all over the compost within 2-6 weeks.

- Once fully spread, tiny little pin heads start appearing at the surface.

- Next, the button stage arrives, in which the pin heads continue to expand and ultimately enlarged, button stage mushrooms are formed.

- Once fully grown, the mushrooms are then cultivated.
- **Preservation**: Since mushrooms are highly perishable in nature, they must be preserved to increase their shelf-life. The preservation process includes:
- Vacuum cooling
- Freeze drying in acidic solutions
- Irradiating with gamma rays and storing at 15ºC, etc

Harmful role of Bacteria and Fungi

Certain type of foods should not be consumed due to various reasons. Some of the foods which should not be consumed are

1. Spoiled food

Have you ever noticed food going bad when placed outside for two or more days? Have you wondered how this happens?

This is because of the action of bacteria and fungi on food, particularly in summer season. They decompose the food and produce toxins in the process. Fungi digests and absorbs important nutrients of the food. As a result, the food becomes stale and poisonous. Intake of such food may result in vomiting, diarrhoea and abdominal pains.

2. Frozen foods

A lot of people love frozen foods like ice-cream, isn't it? Then, why should we not consume them?

On consuming frozen foods, the inner surface of the mouth becomes numb. This is because the salivary glands and taste buds shrink and do not function properly.

3. Very hot food

On consumption of very hot foods and liquids, the cells of the inner membrane of the mouth and oesophagus get destroyed. This leads them to lose the sense of perception. Further, on entering stomach, very hot food or liquid affects the inner lining of stomach and hinders digestion.

How do consumption of very hot food hinders digestion?

The digestive glands present in the stomach secrete digestive juices at an optimum temperature (neither very hot nor very cold).

On consumption of very hot or very cold food, the secretions of the digestive glands get affected and they do not secrete in right proportion. As a result, it hinders the process of digestion.

4. The food washed or cooked in contaminated water is also harmful to eat.

Bacteria are harmful to us in many ways.

Food Spoilage

- Bacteria spoil fresh and cooked food by growing on them and releasing harmful substances in the food and also by reducing the palatability of the food. They cause putrefaction of food.
- Certain bacteria such as *Clostridium botulinum* and *Salmonella typhimurium* cause some serious food poisoning such as botulism and diarrhoea.
- Some bacteria spoil canned foods and reduce its shelf life.

Cause Diseases

- Bacteria cause a number of diseases in plants, animals, and human beings.
- **Plant Diseases**

  In plants, diseases such as leaf spot disease of cotton is caused by a bacterium called *Xanthomonas malvacearum*; bacterial wilt of potato is caused by *Xanthomonas solanacearum*; and the crown gall disease is caused by *Agrobacterium tumefaciens.*

- **Animal Diseases**

  In animals, diseases such as anthrax of cattle, foot and mouth disease, pneumonia in horses, sheep, and goats is caused by bacteria.

- **Human Diseases**

  Many diseases in humans are caused by bacteria. Some of them are:

Disease	**Causative bacterium**
Cholera	*Vibrio cholerae*

Diphtheria	*Corynebacterium diphtheriae*
Diarrhoea	*Escherichia coli*
Leprosy	*Mycobacterium leprae*
Tuberculosis	*Mycobacterium tuberculosis*
Plague	*Yersinia pestis*
Tetanus	*Clostridium tetani*
Pneumonia	*Streptococcus pneumoniae*
Typhoid	*Salmonella typhii*

Bioweapons

Bioweapons are biological devices such as disease-causing microorganisms or their toxins, which are used against crops, animals, or humans. The usage of bioweapons is called biological warfare. Some of the organisms used in biological war are:

- *Vibrio cholerae*
- *Clostridium botulinum*
- *Bacillus anthracis*
- *Yersinia pestis*

Harmful Role of Fungi

Fungi cause many diseases in plants, animals, and human beings.

- In human beings, fungi cause several allergies and food poisoning.
- In plants, the white rust of crucifers, the blight of potatoes, rust of wheat, mildew, and smuts are caused by fungi.
- Fungi such as *Rhizopus* and *Mucor* cause food spoilage.
- Fungi also grow on neglected pieces of furniture and disintegrate them. This is known as **biodeterioration.**

Preservation of Food

Our food gets spoilt due to the growth of bacteria and fungi on them. We can protect stuff from spoilage by preserving it. Some of the methods used for preserving food are:

- **High temperature**

Food stuff can be heated at a temperature of 120° − 126°C at 15 lbs of pressure for 12 − 90 minutes. During this process, bacterial and fungal cells along with their spores are destroyed. This method is known as sterilisation and it is followed for canned food.

- **Pasteurisation**

  This method was devised by Louis Pasteur in 1866. It is usually done for preventing milk from getting spoilt. There are two procedures involved.

- Milk is heated to 145° F (62.8°C) for 30 minutes; this process is called low temperature method.

- Milk is heated to 161°F (71.7°C) for 15 seconds; this process is called high temperature method.

  The finished product is then cooled and stored at low temperature.

- **Low temperature storage**

  In this process, food stuff is stored at a low temperature of −10°C to −18°C where growth of microorganisms is completely inhibited.

- **Dehydration**

  In this process, the food stuffs are preserved by reducing their overall water content.

- **Use of preservatives**

  Jams, pickles, and jellies are preserved by adding salt, sugar, or chemical preservatives.