Economic Importance of Bacteria and Fungi

Bacteria

- Most primitive, unicellular, prokaryotic organisms
- Are found in almost every nook and corner of the Earth
- On the basis of shape, bacteria are of four types:
    - Cocci
    - Bacilli
    - Spirilla
    - Vibrio
- Their cell wall is made up of peptidoglycan, which may or may not be covered by a slimy protective layer, called capsule.
- They lack most of the cell organelles, except ribosomes and vacuoles.
- Some bacteria contain whip-like flagella that help in movement.
- Most of the bacteria are heterotrophic in nature, and derive their nutrition either from dead and decaying organic matter (saprophytes), or from living organisms (parasites).
- They reproduce asexually through binary fission.
- They have wide scale applications ranging from day to day life to various industries. For example in production of cheese, curd and antibiotics.
- Bacteria are potentially harmful too, as they cause spoilage of food and various kinds of diseases in humans.

Fungi

- Eukaryotic, unicellular or multicellular, non-photosynthetic organisms
- They are found in diverse shapes and sizes.
- Their cell wall is made up of chitin.
- A fungal body is made up of thin transparent thread-like structures, called hypha.
- An entire mass of hypha is known as mycelium.
- Sporangiophores are special hyphae that bear sporangium on the top.
- Sporangia are sac-like enclosed structures that contain spores within them. Once the spores get mature, sporangia burst to release them in the environment.

- Spores, on getting suitable substratum, germinate and give rise to new mycelium.
- Most of the fungi are saprophytic in nature, while some are parasitic on other plants and animals.
- Fungi reproduce asexually through budding and spore formation.
- Fungi are used in the production of antibiotics, in food industry, etc.
- They are responsible for spoilage of food and cause skin infections, like Athlete's foot and ringworm.

- **In increasing soil fertility**
    - Blue green algae and *Rhizobium* bacteria are called biological nitrogen fixers.
    - They fix free atmospheric nitrogen to enhance soil fertility.

- **In cleaning the environment**
    - Microorganisms (decomposers) help in converting dead waste of plants and animals into simpler substances by the process of **decomposition**.

- **Nitrogen cycle**: It involves circulation of nitrogen through living and non-living components of nature.
    - Nitrogen gas comprises 78% of the atmosphere.
    - First process of nitrogen cycle is **fixation of nitrogen** gas into nitrogenous compounds caused by bacterium *Rhizobium* and lightning.
    - Nitrogen compounds in soil are taken up by the plants through roots and used up in synthesis of plant proteins. Animals obtain nitrogen by feeding on plants.
    - Waste of plants and animals are converted to nitrogenous compounds by the action of bacteria and fungi in the soil.
    - Some bacteria convert nitrogenous compounds back to nitrogen to maintain atmospheric levels of nitrogen.

- **Importance of microorganisms**
- **In food industry**
    - *Lactobacillus* bacteria promote the conversion of milk into curd.
    - Yeast is used in preparation of breads, pastries and cakes.
- **In beverage industry**
    - Yeast is used for commercial production of alcohol, wine and vinegar (acetic acid).
    - Yeast acts on sugar and converts it into alcohol by the process of fermentation. Louis Pasteur discovered fermentation.

- **Microorganisms** make up the largest number of living organisms on the planet. They play

  an important role in the welfare of human society.

- **Advantages of microbes in household and industrial products –**

- **In household products:**

o Lactic acid bacteria (LAB) or *Lactobacillus* help in the conversion of milk into curd.

o *Saccharomyces cerevisiae* is also known as brewer's yeast. It is used for making bread.

o *Propionibacterium sharmanii* produces large amount of CO_2, which causes large holes

in Swiss cheese.

- **In industrial products:**

o *Saccharomyces cerevisiae* is used for commercial production of alcohol and wine.

o **Antibiotics:** Antibiotics are medicines produced by certain microorganisms, to kill

other disease-causing microorganisms. For example, *Penicillium notatum* produces

the chemical penicillin, which checks the growth of *Staphylococci* bacteria.

o A fungus called *Aspergillus niger* is used for the production of citric acid.

o The bacterium called *Acetobacter aceti* is used for the production of acetic acid.

o Similarly, *Clostridium butylicum* and *Lactobacillus* are used for the production of

butyric acid and lactic acid respectively.

o The bacterium called *Streptococcus* is used for the production of streptokinase, which

is used as clot buster for removing clots from the blood vessels of patients.

o The fungus called *Trichoderma polysporum* is used for the production of Cyclosporin

A. Cyclosporin A is used as an immunosuppressive agent.

o The yeast called *Monascus purpureus* produces statins, which are used as blood-cholesterol-lowering agents.

- **In medicine production**
  - Medicines produced by certain microorganisms to kill or stop the growth of other disease-causing microorganisms are called **antibiotics**.
  - Antibiotics are obtained from bacteria and fungi.
  - They are classified as narrow-spectrum and broad-spectrum antibiotics.
  - Commonly used antibiotics are streptomycin, tetracycline, and erythromycin.
  - First antibiotic penicillin was prepared by Alexander Fleming
- **In vaccine production**
  - Protection of the body from the attack of various disease-causing microorganisms through vaccines is known as **vaccination.**
  - Vaccine includes dead or weakened microbes that trigger the production of antibodies in the body.
  - These antibodies help in preventing the attack from disease-causing microorganisms.
  - Vaccination helps in controlling diseases such as cholera, polio, small pox, hepatitis etc.
  - Vaccine for small pox was discovered by Edward Jenner.
- **Serum**
  - Serum is a pale yellow coloured blood component which lacks any blood cell as well as clotting factors.
  - Due to presence of antitoxins/antibodies in serum, it can be used as a preventive measure against bacterial invasions.

    - 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).

- Edible mushrooms are fleshy, non-poisonous fruit bodies of mushrooms that have desirable taste and aroma.
- Commonly cultivated species of mushrooms:
    - *Agaricus bisporous* (white button mushroom)
    - *Volvariella* (paddy straw mushroom)
    - *Pleurotus* (oyster mushroom)
- They are the excellent source of minerals and vitamins, such as niacin, pantathonic acid and biotin.
- Steps involved in mushroom cultivation:
    - Composting
    - Spawning
    - Casing
    - Cropping and harvesting
    - Preservation

Harmful role of bacteria

1. Bacteria cause a number of diseases in plants, animals and in humans. Some of the diseases caused by bacteria are

Disease	Causative bacterium
Cholera	*Vibrio cholerae*
Diphtheria	*Corynebacterium diphtheria*
Diarrhoea	*Escherichia coli*
Leprosy	*Mycobacterium leprae*
Tuberculosis	*Mycobacterium tuberculosis*
Plague	*Yersinia pestis*
Tetanus	*Clostridium tetani*
Pneumonia	*Streptococcus pneumonia*
Typhoid	*Salnonella typhi*

Harmful role of fungi

Fungi cause a number of disease in plants, animals and in humans

1. Ringworms: Caused by fungi which belong to genera Microsporum, Trichophyton and Epidermophyton

2. In plants, diseases like white rust of crucifers and wheat, blight of potato and smuts of maize are caused by fungi.

3. Fungi like Mucor and Rhizopus cause food spoilage.