📘 Chapter 2: Microorganisms – Friends and Foes

🔬 1. Microorganisms

- **Definition**: Organisms too small to be seen with naked eyes, visible only through a microscope.
- Found everywhere: in air, soil, water, inside our bodies, even in extreme conditions (hot springs, deep oceans, ice, desert).

👉 They can be **friends** (helpful) or **foes** (harmful).

🌍 2. Where Do Microorganisms Live?

- In soil, water, air, plants, animals, and humans.
- Extreme conditions:
  - Hot springs (high temperature)
  - Polar regions (extreme cold)
  - Salty water (e.g., Dead Sea)
  - Inside human/animal bodies (intestine → *E. coli*)

🧪 3. Activity – Presence of Microbes in Soil & Water

- Take moist soil in a beaker → cover with water → keep for some hours.
- Observe under microscope → you'll see tiny moving organisms (protozoa, bacteria, algae).
  👉 Proves microorganisms exist naturally in soil & water.

🦠 4. Major Groups of Microorganisms

(a) Bacteria (singular: bacterium)

- Smallest, simplest organisms → prokaryotic (no nucleus).

- Shapes:
    - **Cocci**: Round → e.g., *Streptococcus*
    - **Bacilli**: Rod-shaped → e.g., *Lactobacillus*
    - **Vibrio**: Comma-shaped → e.g., *Vibrio cholerae*
    - **Spirilla**: Spiral → e.g., *Spirillum*
- Roles: fix nitrogen, decompose waste, cause diseases.

(b) Algae (singular: alga)

- Simple plant-like organisms.
- Contain chlorophyll → make food by photosynthesis.
- Examples: *Chlamydomonas*, *Spirogyra*, *Ulva*.
- Uses: Agar (jelly-like substance), food in some countries, oxygen production.

(c) Fungi (singular: fungus)

- Non-green organisms → no chlorophyll, so they feed on dead/decaying matter.
- Appear as cottony growth (bread mould).
- Examples: *Yeast*, *Mushrooms*, *Aspergillus*.
- Some edible (mushrooms), some harmful (cause disease).

(d) Protozoa (singular: protozoan)

- Animal-like, unicellular, move using pseudopodia/flagella/cilia.
- Examples:
    - *Amoeba* (pseudopodia)
    - *Paramecium* (cilia)
    - *Plasmodium* (malaria parasite)

(e) Viruses (singular: virus)

- Borderline between living and non-living.

- Non-living outside host, living inside host (reproduce).
- Example: Polio virus, HIV, Influenza virus, Bacteriophage.
- Cause many diseases in humans, plants, animals.

👫 5. Microorganisms as Friends

(i) In Food Production

- **Lactobacillus**: Converts milk into curd, cheese, paneer.
- **Yeast**: Fermentation of dough → bread, idli, dosa fluffy.

👉 **Activity**: Put yeast + sugar in dough → gas bubbles (CO_2) produced → dough rises.

(ii) Other Uses

- **Bacteria**:
  - *Lactobacillus* → curd, cheese.
  - *Acetobacter* → vinegar.
- **Algae**: Agar-agar (used in ice cream, jellies), spirulina (protein-rich food).
- **Fungi**: Yeast → alcohol, bread.

(iii) In Medicine

- **Antibiotics** (from fungi & bacteria):
  - *Streptomycin*
  - *Tetracycline*
  - *Penicillin* (from fungus *Penicillium notatum*)
- **Precautions while using antibiotics**:
  - Only on doctor's advice.
  - Wrong/overuse kills good bacteria, causes resistance.

(iv) In Vaccines & Immunity

- **Immunity**: Body's defense power against infection.
- **Vaccine**: Weak/dead microbes injected → body produces antibodies.
- Examples: Polio, Hepatitis, TB, Smallpox vaccines.

😷 6. Microorganisms as Foes

(i) Diseases in Humans

- **Bacteria**: Tuberculosis, Typhoid, Cholera.
- **Virus**: Polio, Flu, Measles, COVID-19.
- **Fungi**: Skin infections (Ringworm).
- **Protozoa**: Malaria (Plasmodium), Dysentery (Entamoeba).

(ii) Diseases in Animals

- Anthrax (cattle, by bacteria).
- Foot-and-mouth disease (cattle, by virus).

(iii) Diseases in Plants

- Citrus canker (bacteria).
- Rust of wheat (fungus).
- Yellow vein mosaic of bhindi (virus).

🍋 7. Spoilage of Food

- Microbes grow on food → change taste, smell, texture.
- Spoiled food causes food poisoning.

Food Preservation Methods (9 main)

1. Sun drying
2. Salting
3. Sugaring (jams, jellies)
4. Oil & vinegar
5. Freezing
6. Refrigeration
7. Pasteurisation (Louis Pasteur, 1862)
8. Chemical preservatives (sodium benzoate, potassium metabisulphite)
9. Canning (airtight sealing)

Pasteurisation: Milk heated to 70°C for 15–30 sec → cooled suddenly → kills microbes, keeps nutrients.

🔄 8. Nitrogen Cycle

- **Fixation**: Nitrogen gas → usable nitrogen (by Rhizobium, lightning).
- **Assimilation**: Plants absorb nitrates → proteins.
- **Ammonification**: Dead organisms → ammonia.
- **Nitrification**: Ammonia → nitrites/nitrates (by bacteria).
- **Denitrification**: Nitrates → nitrogen gas (back to atmosphere).

👉 Maintains balance of nitrogen in atmosphere & soil fertility.

📝 Example Questions & Explanations

Q1. Define immunity.
👉 Ability of the body to resist infections by producing antibodies.

Q2. How is fermentation helpful in baking?
👉 Yeast ferments sugar → produces CO_2 → makes dough soft & fluffy (bread, cakes).

Q3. Why is sudden cooling done during pasteurisation?
👉 To prevent survival of remaining microbes after heating.

Q4. How do viruses differ from other microorganisms?
👉 Viruses are non-living outside host, cannot reproduce alone, but become active inside host.

Q5. How does soil fertility depend on nitrogen cycle?
👉 Nitrogen cycle adds nitrates to soil → plants use them for growth.

Q6. Why wash hands before/after handling food?
👉 Prevent spread of microbes that cause food poisoning.

Q7. Why are antibiotics useless against flu?
👉 Flu is caused by virus; antibiotics kill bacteria only, not viruses.

Q8. Why should water not be left open?
👉 Stagnant water → breeding ground for mosquitoes & microbes.

Q9. Plastic bags banned, paper bags promoted. Why?

👉 Plastic → non-biodegradable, blocks drains, kills animals. Paper → eco-friendly, biodegradable.

Q10. Advantages vs Disadvantages of Microorganisms

Advantages

- Used in food (curd, cheese, bread).
- Medicine (antibiotics, vaccines).
- Nitrogen fixation.
- Decomposition of waste.

Disadvantages

- Cause diseases.
- Spoil food.
- Destroy crops.

Q11. "Microbes help in jute bags" – Justify.

👉 Microbes (*Bacillus* species) help in *retting* process → separate jute fibres from stem → jute industry depends on them.