



Chapter 3: Coal and Petroleum

1. Natural Resources

- **Definition:** Materials provided by nature that humans use.
- **Examples:** Air, water, soil, minerals, forests, fossil fuels.

(i) Inexhaustible Resources

- Unlimited in supply → will not run out.
- Example: Sunlight, air, water (to some extent).

(ii) Exhaustible Resources

- Limited in nature → can be used up.
- Example: Coal, petroleum, natural gas, minerals, forests.

(iii) Renewable Resources

- Can be replenished in a short time.
- Example: Solar, wind, water, plants.

(iv) Non-renewable Resources

- Cannot be replaced quickly → take millions of years.
 - Example: Coal, petroleum, natural gas.
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2. Coal

Formation of Coal

- Formed from ancient plants buried under earth → pressure + heat over millions of years → carbon-rich fuel.

Types of Coal (with % Carbon)

1. **Anthracite** → Hardest, highest carbon (~90%).
2. **Bituminous** → Most used, ~60–80% carbon.
3. **Lignite** → Brown, ~40% carbon.
4. **Peat** → Lowest quality, ~10–20% carbon.

Uses of Coal

- Fuel for cooking (earlier), trains, industries, thermal power plants.
 - Source of coal products.
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Destructive Distillation of Coal

- Heating coal in absence of air → produces many products.

Main Products:

1. Coke

- Almost pure carbon.
- Uses: Fuel in steel industry, extraction of metals.

2. Coal Tar

- Thick, black liquid with 200+ chemicals.
- Uses: Paints, perfumes, plastics, explosives, dyes, naphthalene balls.

3. Coal Gas

- Used as fuel for lighting and cooking (earlier).
- Now replaced by natural/petroleum gas.

4. Ammonium Compounds

- From coal → used in fertilisers.
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3. Petroleum

Formation of Petroleum

- Remains of tiny marine plants & animals buried under sea millions of years ago → heat + pressure → petroleum + natural gas.
 - Found trapped between rock layers.
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Obtaining Petroleum

- Drilled from oil wells.

- India: Assam, Gujarat, Mumbai High, Digboi.
 - Globally: Middle East (Saudi Arabia, Iraq, Iran, Kuwait), Russia, USA.
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Refining of Petroleum

- Crude oil has many components.
 - At refineries (India: Barauni, Jamnagar, Digboi, Panipat).
 - Method: **Fractional Distillation** → separates petroleum into useful fractions based on boiling points.
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Table: Constituents of Petroleum & Uses

Fraction	Boiling Range	Carbon Atoms	Uses
Petroleum Gas	<40°C	C1–C4	LPG for cooking, fuel
Petrol (Gasoline)	40–200°C	C5–C12	Cars, scooters
Kerosene	200–250°C	C12–C15	Stoves, lamps, jet fuel
Diesel	250–350°C	C15–C18	Trucks, buses
Lubricating Oil	350–400°C	C18–C25	Lubricants, ointments
Paraffin Wax	>400°C	Solid hydrocarbons	Candles, polish
Bitumen	Residue	Very high C	Roads, waterproofing

Petrochemicals

- Chemicals from petroleum: plastics, detergents, synthetic fibres, rubber, medicines.
 - Backbone of modern industry.
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🔥 4. Natural Gas

- Found with petroleum deposits.
- Mainly methane (CH_4).

- India: Tripura, Assam, offshore Mumbai, Krishna-Godavari basin.
 - Uses:
 - Domestic fuel (PNG).
 - CNG in vehicles.
 - Fertilisers, chemicals.
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5. Limitations of Fossil Fuels

- **Limited availability** → formed over millions of years, not renewable quickly.
 - **Air pollution** → burning releases CO₂, SO₂, causes acid rain & global warming.
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6. Conservation of Fossil Fuels

- Use public transport.
 - Energy-efficient appliances.
 - Switch to renewable energy (solar, wind).
 - Car-pooling.
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7. Technologia, Energy Crisis & Future

- Fossil fuels are depleting fast → causes **energy crisis**.
 - Technologia (“ester egg” 😊) like solar panels, electric vehicles, biofuels = future alternatives.
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Example Questions with Explanations

Q1. Why is fractional distillation necessary?

👉 Crude petroleum is a mixture of many components. Each has different boiling point & use. Fractional distillation separates them into useful fuels/products.

Q2. Difference in formation of coal & petroleum.

- **Coal:** Formed from ancient plants (forests) buried underground.
- **Petroleum:** Formed from marine animals + plants buried under seabed.

Q3. Why is coal gas replaced by petroleum gas in cooking?

👉 Petroleum gas (LPG) is safer, easier to transport, cleaner burning than coal gas.

Q4. Why does petroleum float on water?

👉 Petroleum is less dense than water and insoluble, so it floats.

Q5. Advantages of petroleum over coal as fuel.

- Cleaner burning → less smoke.
- Higher calorific value.
- Easy to transport & use.

Q6. Uses of coal & petroleum beyond fuel (esp. in India).

- Coal: Steel industry (coke), tar for roads, dyes, perfumes.
- Petroleum: Plastics, fertilisers, detergents, medicines, synthetic fibres.

Q7. Impact of burning coal vs petroleum on environment.

- Coal → more smoke, SO₂ (acid rain), ash residue.
 - Petroleum → less smoke, but releases CO₂.
- 👉 Coal is more harmful.

Q8. Difference between exhaustible vs inexhaustible & renewable vs non-renewable.

- Exhaustible: Can run out (coal, oil).
- Inexhaustible: Unlimited (air, sunlight).
- Renewable: Replaced quickly (plants, wind).
- Non-renewable: Take millions of years (coal, petroleum).

Q9. Why is conservation of fossil fuels important today but not centuries ago?

👉 Earlier → population small, demand less, resources abundant. Today → massive industrialisation, vehicles, high demand, shortage → urgent need for conservation.

Q10. Is it possible to create fossil fuels in lab? Why not?

👉 No. Fossil fuels require millions of years of heat, pressure, and natural processes. Labs cannot replicate such conditions in short time.



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.
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(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.
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(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).
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(d) Protozoa (singular: protozoan)

- Animal-like, unicellular, move using pseudopodia/flagella/cilia.
 - Examples:
 - *Amoeba* (pseudopodia)
 - *Paramecium* (cilia)
 - *Plasmodium* (malaria parasite)
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(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.
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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.
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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).
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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 CO₂ → 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.