Environmental Studies

Short notes for 1st year B.Tech (all branches) · BCA · GATE

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1. Introduction

- **Environment** = everything around us: air, water, land, plants, animals and humans, and how they interact.
- Environmental studies is **multidisciplinary**: it uses biology, chemistry, physics, geography, economics and law.
- Need: rising population, pollution, climate change, loss of forests and species.

➤ Parts of the environment

Part	Meaning
Atmosphere	Air layer around the earth
Hydrosphere	All water: oceans, rivers, ice, groundwater
Lithosphere	Rocks and soil (earth's crust)
Biosphere	Zone where life exists

- Atmosphere layers (bottom up): troposphere, stratosphere, mesosphere, thermosphere, exosphere.
- Ozone layer is in the **stratosphere** (about 15–35 km).
- Dry air: N_2 about 78%, O_2 about 21%, Ar about 0.93%, CO_2 about 0.04%.

2. Natural Resources

- **Renewable**: can be replaced naturally (solar, wind, water, forests if used wisely).
- **Non-renewable**: limited stock (coal, petroleum, minerals).

Resource	Main problems
Forest	Deforestation, mining, dams, timber, shifting cultivation
Water	Over-use of groundwater, floods, droughts, dam conflicts
Mineral	Land damage, pollution from mining
Food	Over-grazing, fertiliser and pesticide misuse, waterlogging, salinity
Energy	Fossil fuel use, air pollution, limited stock
Land	Soil erosion, landslides, desertification

- **Alternative energy**: solar, wind, hydro, tidal, geothermal, biomass, hydrogen, nuclear.
- **Sustainable development**: meeting today's needs without harming the ability of future generations to meet theirs (Brundtland report, 1987).

TIP Write one Indian example for every resource issue: Sardar Sarovar (dams), Chipko movement (forests), Rajasthan desertification.

3. Ecosystems

- **Ecosystem** = living things (biotic) + non-living surroundings (abiotic) working as one unit.
- **Biotic**: producers (plants), consumers (herbivores, carnivores), decomposers (bacteria, fungi).
- **Abiotic**: sunlight, water, temperature, soil, minerals.

➤ Energy flow

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Sun -> Producers -> Herbivores -> Carnivores -> Top carnivores
        (100%)       (10%)          (1%)          (0.1%)
           \            \              \             /
            +----------> Decomposers <-------------+
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- **Food chain**: one path of feeding. **Food web**: many connected food chains.
- **10% law** (Lindeman): only about 10% of energy passes to the next level; the rest is lost as heat.
- Energy flow is **one way**; nutrients **cycle** (carbon, nitrogen, water, phosphorus cycles).

➤ Ecological pyramids

Pyramid	Shape
Energy	Always upright
Numbers	Upright (grassland), inverted (tree with insects)
Biomass	Upright on land, inverted in ponds/oceans

- Types of ecosystems: forest, grassland, desert, aquatic (pond, lake, river, ocean, estuary).
- **Ecological succession**: slow change of a community until a stable **climax** community forms.

4. Biodiversity and Conservation

- **Biodiversity** = variety of life. Three levels: **genetic**, **species**, **ecosystem** diversity.
- India is a **mega-diversity** nation (about 7–8% of the world's recorded species).
- **Hotspots**: regions with very high endemic species under threat. In India: Himalaya, Western Ghats and Sri Lanka, Indo-Burma, Sundaland (Nicobar Islands).
- Threats: habitat loss, poaching, invasive species, pollution, climate change, man–wildlife conflict.

Conservation	Meaning	Examples
In-situ	In the natural home	National parks, sanctuaries, biosphere reserves
Ex-situ	Outside the natural home	Zoos, seed banks, botanical gardens

EXAM POINT IUCN Red List categories include Extinct, Critically Endangered, Endangered, Vulnerable. Example: Bengal tiger is Endangered.

5. Environmental Pollution

➤ Air pollution

- **Primary pollutants**: emitted directly (CO, SO2, NOx, particulate matter).
- **Secondary pollutants**: formed in air (ozone at ground level, PAN, smog).
- PM2.5 = particles smaller than 2.5 μm; they reach deep into the lungs.
- Control: electrostatic precipitator, cyclone separator, scrubbers, bag filters, catalytic converters.

Water pollution

- Sources: sewage, industrial waste, farm runoff (fertilisers), oil spills.
- **BOD** (Biochemical Oxygen Demand) = oxygen used by microbes to break down organic matter. High BOD = more pollution.
- **COD** (Chemical Oxygen Demand) is always >= BOD.
- **Eutrophication**: excess nitrates and phosphates → algal bloom → oxygen falls → fish die.
- **Biomagnification**: toxins like DDT and mercury increase up the food chain. Minamata disease = mercury poisoning.

Other pollution

Type	Source	Effect / note
Soil	Pesticides, industrial waste, plastics	Low fertility, toxins in food
Noise	Traffic, industry, loudspeakers	Measured in dB; above ~85 dB harms hearing
Thermal	Hot water from power plants	Less dissolved O2 in water
Nuclear	Reactor accidents, waste	Radiation sickness, cancer (Chernobyl 1986)

Solid waste management

- Steps: **reduce, reuse, recycle** (3 R). Methods: sanitary landfill, composting, incineration, vermicomposting.
- E-waste and biomedical waste need separate handling rules.

6. Global Environmental Issues

- **Greenhouse effect**: gases trap heat. Main greenhouse gases: CO2, CH4, N2O, CFCs, water vapour.
- **Global warming** results: rising sea level, melting glaciers, extreme weather.
- **Ozone depletion**: CFCs release chlorine which breaks O3. Ozone hole is largest over Antarctica.
- **Acid rain**: SO2 and NOx form H2SO4 and HNO3; rain pH below 5.6. Damages buildings (Taj Mahal yellowing), lakes, soil.

Agreement	Year	About
Stockholm Conference	1972	First UN meet on human environment (5 June = World Environment Day)
Montreal Protocol	1987	Phase out ozone-depleting substances
Earth Summit, Rio	1992	Agenda 21, sustainable development
Kyoto Protocol	1997	Binding cuts in greenhouse gas emissions
Paris Agreement	2015	Keep warming well below 2 °C

7. Disaster Management

- **Disaster** = a serious event that causes big loss of life and property beyond local coping capacity.
- Natural: floods, cyclones, earthquakes, tsunamis, landslides, droughts. Man-made: industrial accidents (Bhopal gas tragedy 1984, methyl isocyanate leak).
- **Disaster cycle**: mitigation → preparedness → response → recovery.
- India: **NDMA** (National Disaster Management Authority) under the Disaster Management Act, 2005.

TIP For earthquakes, remember "Drop, Cover, Hold On". The Richter scale is logarithmic: each step is about 10 times more ground motion.

8. Environmental Laws and Society

Act	Year
Wildlife (Protection) Act	1972
Water (Prevention and Control of Pollution) Act	1974
Forest (Conservation) Act	1980
Air (Prevention and Control of Pollution) Act	1981
Environment (Protection) Act	1986
Biological Diversity Act	2002

- **CPCB** (Central Pollution Control Board) and state boards enforce pollution laws.
- **EIA** (Environmental Impact Assessment): study of the effects of a project before approval.

- Movements: **Chipko** (1973, Uttarakhand), **Narmada Bachao Andolan**, **Silent Valley** (Kerala), Appiko (Karnataka).
- Population growth affects resources; family welfare, women's education and health help control it.
- **Rainwater harvesting**, watershed management and green buildings are good local practices.
- Article 48A (state) and Article 51A(g) (citizens) of the Constitution deal with protecting the environment.

9. Most Asked Questions (practice)

1. Define environmental studies. Why is it multidisciplinary?
2. Explain the structure and function of an ecosystem with a food chain.
3. What is the 10% law? Draw the ecological pyramids.
4. What are biodiversity hotspots? Name the hotspots in India.
5. Explain in-situ and ex-situ conservation with examples.
6. What is BOD? Explain eutrophication and biomagnification.
7. Write the causes, effects and control of air pollution.
8. Explain global warming, ozone depletion and acid rain.
9. Write a short note on the Environment (Protection) Act, 1986.
10. What is sustainable development? Give ways to achieve it.

TIP Answers score well with a diagram (food chain, pyramid, energy flow) and one Indian case study. Learn the years of the main Acts and international agreements.