

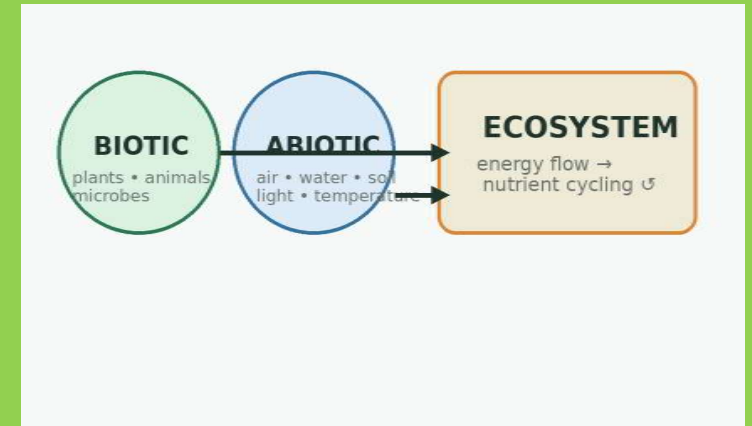
Environmental Studies

Introduction · Air Pollution & Noise Pollution · Water Pollution · Soil Pollution · Impact of energy usage on environment · Disaster Management

Prepared By : Ramesh Kumar



ENVIRONMENTAL STUDIES



Exam Masterclass

Chapter-wise e-content • Definitions • Processes • Comparisons • Exam tips

How to use

Learn the definition → draw the flowchart → memorize key effects → practice the answer framework.

Syllabus Roadmap

Chapter 1

Ecology • ecosystem • sustainability • renewable energy • rainwater harvesting • deforestation

Chapter 2

Air pollution • pollutant classification • effects • noise pollution

Chapter 3

Water pollution • DO/BOD/COD • treatment • sewage

Chapter 4

Soil pollution • solid waste disposal • e-waste management

Chapter 5

Global warming • greenhouse effect • ozone • acid rain • recycling • green buildings • carbon

Chapter 6

Disasters • earthquake • cyclone • flood • tsunami • volcano • trauma & stress

EXAM TIP: For 5–10 marks: definition + causes/process + effects + prevention + labelled diagram.

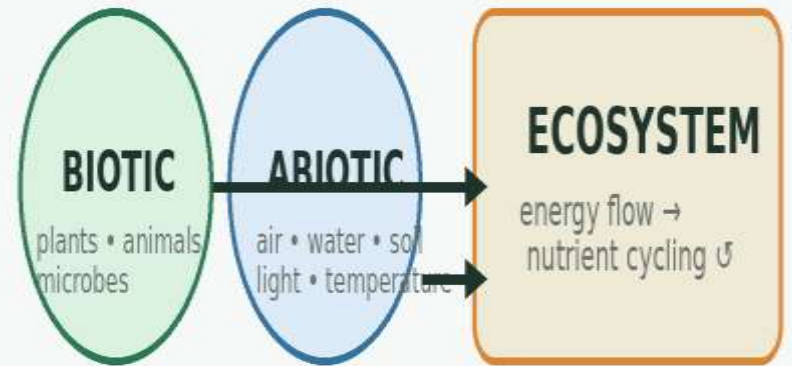
Chapter 1 • Introduction

Ecology = scientific study of relationships between organisms and their environment.

Ecosystem = functional unit in which biotic and abiotic components interact.

Key idea: energy flows one-way; nutrients cycle.

Exam keywords: interaction, interdependence, energy flow, nutrient cycling.



EXAM TIP: Write ecology as a relationship study; define ecosystem as a functional unit.

Sustainable Development

Definition: development that meets present needs without compromising future generations' ability to meet their needs.

Three pillars: environmental protection + economic viability + social equity.

Steps: assess impacts → set sustainable goals → use resources efficiently → prevent pollution → monitor → improve.

Examples: renewable energy, water conservation, efficient buildings, sustainable transport.

1 • Assess

Identify environmental and social impacts.

2 • Plan

Set measurable targets and choose cleaner options.

3 • Improve

Monitor indicators and correct gaps.

EXAM TIP: Remember the 3 pillars: People + Planet + Prosperity.

Renewable Sources of Energy

Renewable energy comes from sources replenished naturally on a human time scale.

Solar: sunlight → electricity/heat. Wind: moving air → turbine power.

Hydropower: flowing/falling water. Biomass: organic matter → heat/fuels.

Geothermal: Earth's internal heat. Ocean energy: tides/waves (where feasible).

Advantages

- + Lower operational emissions
- + Inexhaustible resource base
- + Energy diversification

Limitations

- Intermittency for solar/wind
- High initial investment
- Land/ecological impacts

EXAM TIP: In answers, balance 3 advantages with 2–3 limitations and give examples.

Rainwater Harvesting

Definition: collection and storage of rainwater for direct use or groundwater recharge.

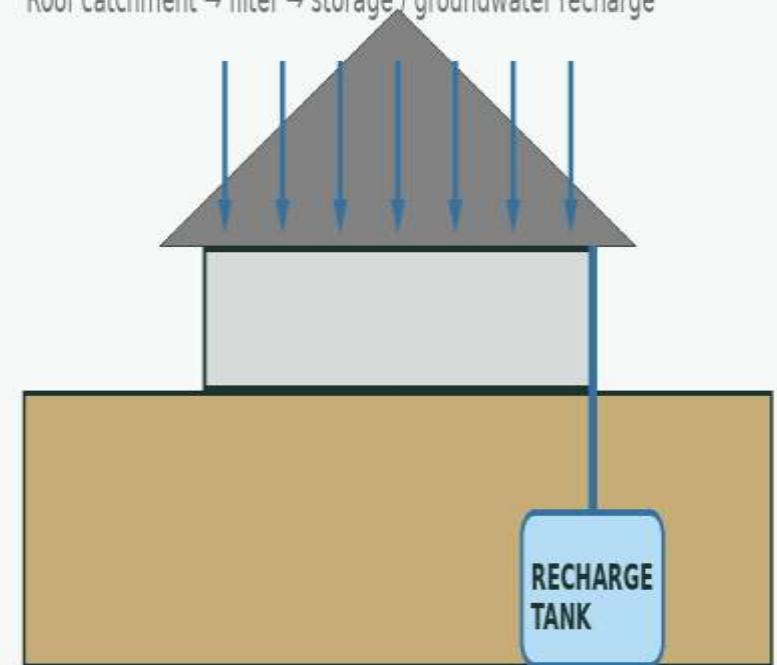
Purposes: water security, recharge aquifers, reduce runoff/flooding, lower dependence on municipal supply.

Methods: rooftop collection; surface runoff harvesting; recharge pits/wells; storage tanks.

Basic sequence: catchment → conveyance → first-flush diversion → filtration → storage/recharge.

Rainwater Harvesting

Roof catchment → filter → storage / groundwater recharge



EXAM TIP: Draw the rooftop flow diagram and label first flush, filter and storage/recharge.

Deforestation

Definition: permanent or long-term removal of forest cover and conversion to another land use.

Causes: agriculture expansion, logging, mining, roads/urbanization, fires, infrastructure.

Effects: biodiversity loss, soil erosion, disrupted water cycle, carbon emissions, habitat fragmentation.

Prevention: afforestation/reforestation, sustainable forestry, protected areas, community participation, better land-use planning.

CAUSE

Land-use change + extraction + infrastructure

EFFECT

Habitat loss + erosion + warming + water-cycle disruption

CONTROL

Protect + restore + regulate + involve communities

EXAM TIP: Use the chain: cause → environmental effect → human consequence → preventive measure.

Chapter 2 • Air Pollution

Air pollution = presence of solid, liquid or gaseous contaminants in air at concentrations harmful to life, materials or ecosystems.

Sources: vehicles, industries, power plants, construction dust, waste burning, household fuels, agriculture.

Primary pollutants are emitted directly; secondary pollutants form in the atmosphere.

Major pollutants: particulate matter, SO_2 , NO_x , CO, VOCs, ozone (secondary), smoke and certain toxic metals.

Air Pollution: emission to impact



PM • SO_2 • NO_x • CO

sources → exposure → effects

EXAM TIP: Always separate source, pollutant and effect; they are different parts of the answer.

Classification of Air Pollutants

Primary

Emitted directly.

Examples: CO, SO₂, NO, dust, smoke.

Secondary

Formed by atmospheric reactions.

Examples: ozone, PAN, many acids.

Particulate

Suspended solids/liquids.

PM₁₀, PM_{2.5}, fumes, mist, dust.

Natural

Volcanoes, dust storms, wildfires, pollen.

Anthropogenic

Transport, industry, power, construction, burning.

By state

Gaseous pollutants vs particulate pollutants.

EXAM TIP: Best scoring classification: primary/secondary + particulate/gaseous + natural/man-made.

Harmful Effects of Air Pollution

Humans: irritation, asthma/COPD aggravation, cardiovascular stress, reduced lung function and premature mortality risk.

Plants: reduced photosynthesis, leaf injury, growth/yield reduction.

Animals: respiratory stress, food-chain exposure and habitat degradation.

Materials: corrosion, soiling, fading and deterioration of buildings/monuments.

Economy & aesthetics: healthcare costs, productivity loss, crop damage, visibility reduction and smog.

EXAM TIP: Mention at least one effect on humans, plants, animals, materials, economy and aesthetics.

Noise Pollution

Definition: unwanted or excessive sound that adversely affects health, comfort, communication or the environment.

Causes: road traffic, railways, aircraft, construction, industry, loudspeakers, generators and household equipment.

Effects: hearing impairment, sleep disturbance, stress, hypertension risk, reduced concentration and communication interference.

Control: source reduction → path control → receiver protection; zoning and time restrictions also help.

Source

Quieter machines • maintenance • speed control

Path

Barriers • distance • acoustic design

Receiver

Ear protection • building insulation

EXAM TIP: The control hierarchy—source, path, receiver—is a compact scoring framework.

Chapter 3 • Water Pollution

Water pollution = degradation of water quality that makes it harmful or less suitable for intended uses.

Sources: domestic sewage, industrial effluents, agricultural runoff, oil, mining, landfill leachate and urban stormwater.

Pollutants: organic matter, nutrients, pathogens, toxic chemicals, sediments, oil and heat.

Major consequences: oxygen depletion, disease transmission, eutrophication, toxicity and loss of aquatic biodiversity.

Water quality: organic load and oxygen c

DO ↓ BOD ↑ COD ↑

EXAM TIP: Start every water-pollution answer with definition + sources, then move to DO/BOD/COD and effects.

DO, BOD and COD — Must Know

DO — Dissolved Oxygen

Oxygen available in water for aquatic organisms.

Healthy systems generally need adequate DO.

BOD — Biochemical Oxygen Demand

Oxygen used by microorganisms to biodegrade organic matter.

Higher BOD → greater organic pollution.

COD — Chemical Oxygen Demand

Oxygen equivalent needed to chemically oxidize oxidizable substances.

Usually higher than BOD for the same sample.

Exam relationship: high organic load → BOD rises → DO tends to fall → aquatic stress increases.

BOD is biologically based; COD is chemically based and can be measured more rapidly.

EXAM TIP: Memorize: BOD ↑ usually signals organic pollution; DO ↓ signals oxygen stress.

Objectives of Water & Sewage Treatment

- Remove solids and suspended matter.
- Reduce biodegradable organic load and oxygen demand.
- Remove pathogens and harmful contaminants.
- Reduce nutrients when required to prevent eutrophication.
- Produce an effluent safe enough for discharge or further reuse, subject to standards.
- Stabilize and safely manage sludge.

Treatment goal

Protect public health + ecosystems

Process goal

Separate + biodegrade + disinfect

Sludge goal

Stabilize + dewater + safely use/dispose

EXAM TIP: Write objectives as verbs: remove, reduce, destroy, stabilize, protect.

Primary & Secondary Sewage Treatment

PRIMARY

Screening

- grit removal
- primary sedimentation

Mainly physical separation of settleable solids and floatables.

SECONDARY

Biological treatment

- aeration / biofilm
- secondary settling

Microorganisms degrade biodegradable organic matter.

SLUDGE

Primary + secondary sludge

- thickening / stabilization
- dewatering
- safe management

EXAM TIP: For comparison questions, make a 3-column table: principle, process, what is removed.

Chapter 4 • Soil Pollution

Soil pollution = undesirable change in soil's physical, chemical or biological quality caused by contaminants.

Causes: excessive fertilizers/pesticides, industrial waste, mining, sewage/sludge, oil spills, landfill leachate and improper dumping.

Effects: reduced fertility, altered soil organisms, food-chain contamination, groundwater contamination and ecosystem damage.

Control: source reduction, safer chemicals, proper waste treatment, soil remediation and monitoring.

Pathway

Soil → crop → animal/human food chain

Risk

Persistent chemicals may accumulate or biomagnify

Control

Prevent → contain → remediate → monitor

EXAM TIP: Include one biological effect, one human-food-chain effect and one control measure.

Solid Waste Disposal Methods

Open dumping: low-cost but unsafe; causes odor, pests, fires and leachate.

Sanitary landfill: engineered containment, liners, leachate collection and gas management.

Incineration / waste-to-energy: volume reduction and energy recovery; requires emission control.

Composting: biological decomposition of biodegradable organic waste into a soil amendment.

Anaerobic digestion: oxygen-free biological treatment producing biogas and digestate.

Best practice: prioritize reduction, reuse, recycling and recovery before final disposal.

Solid Waste Management Hierarchy

REFUSE / REDUCE

REUSE

RECYCLE

RECOVER

DISPOSE

EXAM TIP: Draw the waste hierarchy and state why open dumping is inferior to engineered disposal.

E-Waste & E-Waste Management

E-waste = discarded electrical and electronic equipment and components.

Examples: phones, computers, televisions, appliances, circuit boards and batteries.

Risks: toxic metals/chemicals, informal burning, unsafe dismantling and resource loss.

Management chain: collection → segregation → authorized dismantling/recycling → material recovery → safe treatment of residues.

Circular-economy principle: repair/reuse/refurbish first, recover valuable materials next.

3R + Repair

Reduce • Reuse • Recycle + Repair/Refurbish

Safe chain

Segregate → authorized processor → recover materials

Exam point

Informal burning/dismantling increases exposure risks

EXAM TIP: Define e-waste, give 4 examples, 3 hazards and the management chain.

Chapter 5 • Impact of Energy Usage on Environment

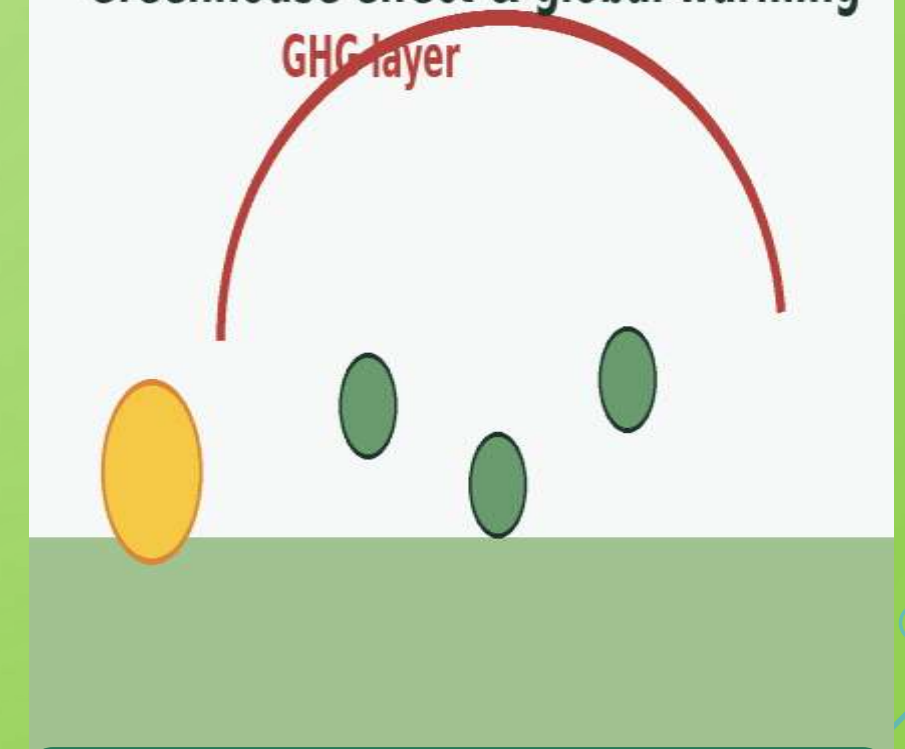
Energy production and use can affect air quality, climate, land, water and ecosystems.

Fossil fuels release greenhouse gases and air pollutants; extraction can disturb land and water.

Renewables reduce many operational emissions but can still have land, material, wildlife or waste impacts.

Sustainable energy strategy: efficiency + demand management + cleaner generation + storage + resilient systems.

Greenhouse effect & global warming



EXAM TIP: Avoid saying 'renewable = zero impact'; discuss lifecycle and site-specific impacts.

Greenhouse Effect vs Global Warming

Greenhouse Effect

Natural atmospheric process in which greenhouse gases absorb and re-emit infrared radiation, keeping Earth warmer than it would otherwise be.

Enhanced Greenhouse Effect

Human activities increase greenhouse-gas concentrations, strengthening heat retention.

Global Warming

Long-term increase in Earth's average surface temperature, driven largely by the enhanced greenhouse effect.

Climate Change

Broader long-term shifts in temperature, rainfall, extremes, oceans, ice and ecosystems.

EXAM TIP: Write: greenhouse effect = process; global warming = temperature trend; climate change = broader system change.

Ozone Layer Depletion

Ozone layer: region of the stratosphere containing relatively high ozone concentrations that absorbs harmful ultraviolet radiation.

Certain ozone-depleting substances release reactive halogens that catalytically destroy ozone.

Effects: greater UV-B exposure → skin cancer risk, cataracts, immune effects; damage to crops, phytoplankton and materials.

Prevention: phase out ozone-depleting substances, maintain compliance with international controls, prevent leakage and use safer alternatives.



EXAM TIP: Key phrase: catalytic destruction means one reactive atom can participate in many ozone-destroying reactions.

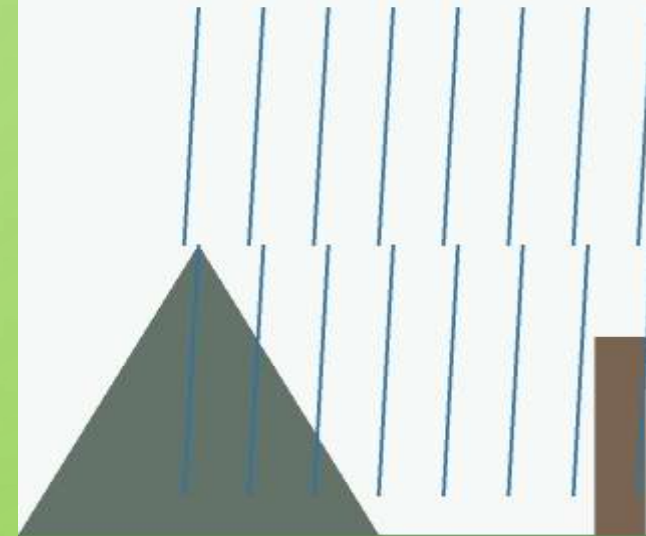
Acid Rain — Definition, Causes, Effects, Control

Definition: acidic precipitation/deposition formed when atmospheric pollutants—especially sulfur and nitrogen oxides—produce acids.

Causes: SO_2 from fossil-fuel combustion; NO_x from combustion and high-temperature processes.

Effects: acidification of lakes/soils, forest stress, nutrient loss, corrosion and damage to buildings/monuments.

Prevention: low-sulfur fuels, renewables, energy efficiency, flue-gas desulfurization, catalytic controls and NO_x reduction.



EXAM TIP: Flow to memorize: $\text{SO}_2/\text{NO}_x \rightarrow$ atmospheric oxidation $\rightarrow$ acids $\rightarrow$ wet/dry deposition $\rightarrow$ ecosystem/material damage.

Recycling

Definition: processing discarded materials into usable materials/products, reducing the need for virgin resources.

Advantages: resource conservation, lower landfill demand, potential energy savings, jobs and reduced extraction pressure.

Disadvantages: collection/sorting cost, contamination, energy use, market volatility and some materials can only be recycled a limited number of times.

Good practice: design for recycling + segregation at source + clean material streams + reliable end markets.

EXAM TIP: Do not confuse recycling with reuse: reuse keeps the product in service; recycling reprocesses material.

Green Building

Definition: building designed, constructed and operated to reduce environmental impacts while improving occupant performance and comfort.

Features: passive design, daylighting, efficient lighting/HVAC, water efficiency, low-impact materials, renewable energy and waste reduction.

Benefits: lower energy/water use, lower operating costs, improved indoor environmental quality and reduced emissions.

Life-cycle approach: site → design → construction → operation → maintenance → end-of-life.

Energy

Passive design + efficiency + renewables

Water

Low-flow fixtures + rainwater + reuse

Materials

Durable, low-impact, locally appropriate

EXAM TIP: Use 'life-cycle thinking' to make a green-building answer stronger.

Carbon Footprint & Carbon Credit

Carbon Footprint

Total greenhouse-gas emissions associated with a person, product, organization, event or activity, expressed in CO₂-equivalent (CO₂e).

Carbon Credit

A tradable unit representing a defined amount of greenhouse-gas reduction/removal under a particular carbon-market system.

Reduce the footprint

Measure → avoid/reduce → improve efficiency → switch energy
→ address residual emissions.

Exam caution

Credits are not a substitute for direct emissions reduction; quality, additionality and accounting matter.

EXAM TIP: Define both separately, then explain the relationship: footprint is an emissions measure; credit is a market/accounting unit.

Chapter 6 • Disasters

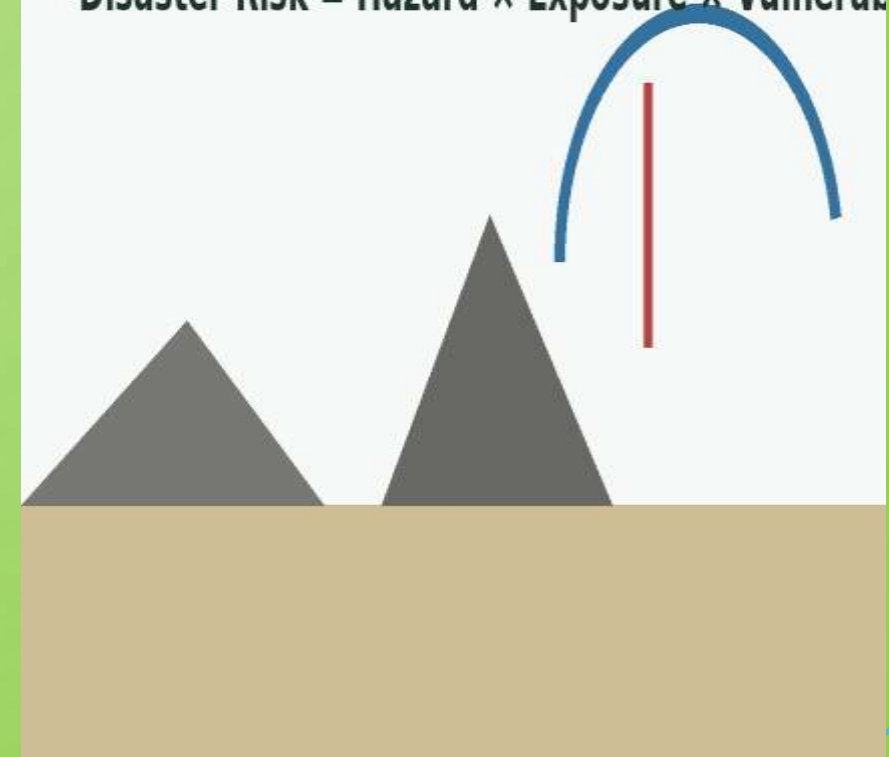
Disaster: serious disruption causing human, material, economic or environmental losses that exceed the affected community's capacity to cope using its own resources.

Types: natural hazards (earthquake, cyclone, flood, tsunami, volcanic eruption) and human-induced/technological hazards.

Risk is shaped by hazard, exposure, vulnerability and capacity—not hazard alone.

Disaster management cycle: prevention/mitigation → preparedness → response → recovery.

$$\text{Disaster Risk} = \text{Hazard} \times \text{Exposure} \times \text{Vulnerability}$$



EXAM TIP: High-scoring line: a hazard becomes a disaster when it causes severe disruption beyond coping capacity.

Earthquake

Sudden release of energy in Earth's crust, producing seismic waves and ground shaking.

Causes: movement along faults, tectonic plate processes; volcanic activity can also produce earthquakes.

Effects: building collapse, landslides, liquefaction, fires, infrastructure failure and casualties; undersea quakes can generate tsunamis.

Preparedness: earthquake-resistant design, retrofitting, securing heavy objects, drills, emergency kits and rapid response planning.

Before

Retrofit • secure • drill • plan

During

Drop • cover • hold on; avoid windows

After

Check injuries • utilities • aftershocks • official instructions

EXAM TIP: Explain cause + secondary hazards + preparedness; do not stop at 'ground shaking'.

Cyclone

A large rotating storm system with strong winds; tropical cyclones form over warm ocean waters under suitable atmospheric conditions.

Hazards: extreme winds, heavy rain, storm surge, flooding and landslides.

Effects: damage to homes/infrastructure, crop loss, power disruption, coastal inundation and casualties.

Preparedness: early warning, evacuation plans, cyclone shelters, resilient construction, coastal planning and emergency supplies.

EXAM TIP: Remember storm surge: abnormal rise of sea level driven mainly by cyclone winds and pressure.

Flood

Flood: overflow or accumulation of water on land that is normally not covered by water.

Types: riverine, flash, urban/pluvial and coastal flooding.

Causes: intense rainfall, river overflow, drainage failure, land-use change, storm surge and blocked channels.

Management: floodplain zoning, wetlands/water storage, drainage maintenance, embankments where appropriate, early warning and evacuation.

EXAM TIP: Best prevention answer: combine structural measures with land-use planning and early warning.

Tsunami

Series of long-wavelength sea waves caused by sudden displacement of a large volume of water.

Common trigger: undersea earthquake; also landslides and volcanic activity can trigger tsunamis.

Warning signs: strong/long earthquake near coast, unusual rapid sea withdrawal or rise, official alerts.

Safety: move quickly to higher ground/inland, follow evacuation routes, do not return until authorities give the all-clear.

EXAM TIP: Key distinction: tsunami is a water-displacement hazard, not simply a 'big tide'.

Volcanic Eruption

Release of magma, ash and volcanic gases from a volcano.

Hazards: lava flows, ash fall, pyroclastic flows, lahars, toxic gases and secondary effects.

Impacts: casualties, respiratory irritation, crop/livestock losses, transport disruption and infrastructure damage.

Preparedness: monitoring, hazard maps, exclusion zones, evacuation routes, respiratory protection for ash and public warning systems.

EXAM TIP: List at least four hazards: lava, ash, pyroclastic flow, lahar, gases.

Trauma & Stress in Disasters

Trauma: psychological or physical response to an overwhelming event that exceeds a person's coping capacity.

Stress responses may include fear, anxiety, sleep disturbance, irritability, poor concentration and physical symptoms.

Immediate support: safety, calm communication, basic needs, social connection, accurate information and practical assistance.

Seek professional mental-health support when symptoms are severe, persistent, disabling or associated with risk of self-harm.

SAFE

Safety • shelter • food • water • medical care

CONNECT

Family/community/social support

REFER

Professional help for persistent/severe distress

EXAM TIP: For short notes: define trauma/stress, list symptoms, then write immediate support measures.

One-Page Revision Map

Air

Sources → pollutants → effects
→ control

Water

Sources → DO/BOD/COD →
treatment → sewage

Soil/Waste

Causes → effects → disposal
→ e-waste

Climate

GHG → warming → ozone
→ acid rain → carbon

Disasters

Hazard → exposure →
vulnerability → response

Sustainability

People + Planet + Prosperity

Water Harvesting

Catch → filter →
store/recharge

Deforestation

Cause → loss → prevention

**EXAM TIP: If you can reproduce these chains without notes,
you are exam-ready.**

Most-Likely Exam Questions

1. Define ecology and ecosystem. Explain their components and interactions.
2. Explain sustainable development and steps to achieve it.
3. Discuss advantages and disadvantages of renewable energy.
4. Explain rainwater harvesting methods and purposes.
5. Define air pollution; classify pollutants and discuss effects.
6. Explain noise pollution: causes, effects and control.
7. Explain DO, BOD and COD and their relationship to water quality.
8. Describe primary and secondary sewage treatment.
9. Explain soil pollution and solid-waste disposal methods.
10. Write a note on e-waste management.
11. Explain greenhouse effect, global warming, ozone depletion and acid rain.
12. Define recycling, green building, carbon footprint and carbon credit.
13. Define disaster and explain earthquake/cyclone/flood/tsunami/volcano.
14. Explain trauma and stress after disasters and immediate support.

EXAM TIP: Practice each answer in: definition → 4–6 points
→ labelled diagram/flowchart → conclusion.

Answer-Writing Formula for Top Scores

1. Definition

Start with a precise textbook-style definition.

2. Classification

Give types/categories where relevant.

3. Core points

Causes / process / effects / examples.

4. Diagram

Use a simple labelled flowchart.

5. Control

Prevention, treatment or management.

6. Keywords

Underline technical terms.

7. Conclusion

End with one synthesis sentence.

Golden rule: don't write everything you know—write what the question asks, in a structured sequence.

Use headings, bullets, arrows, comparison tables and labelled diagrams.

For numerical/environmental quality terms, always state what the indicator measures and what high/low values imply.

Quick Self-Test

- Can you distinguish ecology from ecosystem in two lines?
- Can you list the 3 pillars of sustainable development?
- Can you classify pollutants as primary vs secondary?
- Can you explain why high BOD can mean low DO?
- Can you place primary and secondary sewage treatment in order?
- Can you draw the rainwater harvesting chain from roof to recharge?
- Can you explain greenhouse effect vs global warming?
- Can you give 4 causes and 4 effects of deforestation?
- Can you state the disaster-management cycle?
- Can you answer any 10-mark question using headings without notes?

EXAM TIP: Target: 8/10 correct from memory, then revise only the weak areas.

Study & Reference Note

Core concepts in this deck are aligned to the syllabus supplied in the prompt.

For formal exam preparation, cross-check definitions and numerical standards with your prescribed university textbook/notes and applicable national standards.

Suggested authoritative references: standard Environmental Studies textbooks; WHO/UNEP materials; national pollution-control and disaster-management agencies; IPCC assessment reports for climate topics.

Visuals in this deck are original schematic educational diagrams created for teaching use.

EXAM TIP: Use your prescribed textbook wording for definitions if your university expects a specific phrasing.

Thank You

Questions & Discussion

