

Introduction to Environmental Science

Introduction to Environmental Science

Key concepts, scope, and foundational principles

1. What Is Environmental Science?

Aspect	Description
Definition	An interdisciplinary field that studies the interactions between the natural environment and human societies.
Goal	Understand, protect, and sustainably manage natural resources and ecosystems.
Disciplines Integrated	Biology, chemistry, geology, physics, ecology, geography, sociology, economics, and public policy.
Typical Questions	• How do pollutants affect ecosystems? • What are the causes and consequences of climate change? • How can societies transition to renewable energy?

2. Core Components of the Discipline

- 1. Physical & Chemical Foundations**
 - Atmospheric chemistry, water chemistry, soil science, and energy flows.
- 2. Biological & Ecological Systems**
 - Population dynamics, food webs, biodiversity, ecosystem services.
- 3. Human Dimensions**
 - Demography, cultural values, economic incentives, environmental law.
- 4. Systems Thinking**
 - Viewing the Earth as a set of interconnected subsystems (e.g., biosphere, hydrosphere).

3. The Earth's Major Environmental Systems

System	Main Elements	Key Processes
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Atmosphere	Gases (N ₂ , O ₂ , CO ₂ , CH ₄), aerosols	Weather, climate regulation, greenhouse effect
Hydrosphere	Oceans, rivers, lakes, groundwater	Water cycle, nutrient transport, ocean currents
Lithosphere	Rocks, soils, minerals	Weathering, erosion, carbon sequestration
Biosphere	All living organisms	Photosynthesis, respiration, decomposition, pollination
Anthroposphere	Human-built structures, infrastructure	Resource extraction, waste generation, energy use

4. Fundamental Concepts

Concept	Explanation	Example
Carrying Capacity	Maximum population size an environment can sustain indefinitely.	Overgrazing reduces grassland carrying capacity for cattle.
Ecological Footprint	Measure of human demand on Earth's ecosystems.	A person's footprint may exceed the resources of 2.5 Earths.
Biogeochemical Cycles	Continuous movement of elements (C, N, P, S) through living and non-living compartments.	Carbon moves from atmosphere → plants → soil → back to atmosphere.
Ecosystem Services	Benefits humans obtain from ecosystems (provisioning, regulating, cultural, supporting).	Wetlands filter pollutants (regulating service).
Sustainability	Meeting present needs without compromising future generations' ability to meet theirs.	Using renewable energy instead of fossil fuels.
Resilience	Ability of a system to absorb disturbance and reorganize while retaining function.	Coral reefs recovering after a bleaching event.

5. Major Environmental Issues (Overview)

Issue	Primary Drivers	Environmental Impact	Typical Mitigation Strategies
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Climate Change	Greenhouse gas emissions, land use change	Global temperature rise, sea level rise, extreme weather	Renewable energy, carbon pricing, reforestation
Biodiversity Loss	Habitat destruction, invasive species, overexploitation	Species extinctions, ecosystem instability	Protected areas, habitat restoration, sustainable harvesting
Water Scarcity & Pollution	Over withdrawal, agricultural runoff, industrial discharge	Freshwater depletion, eutrophication,	