

Introduction to Environmental Science

UNIT 1
APES & ENSCI

Intro Terms:

- **Environment:** external living conditions that affect living organisms.
- **Ecology:** study of relationships between living organisms and their environment.
- **Environmental Science:** Interdisciplinary study that examines the role of humans on Earth. (Integrates Biology, Chemistry, Geography, Geology, Economics, Politics, Philosophy, & Ethics)
- **Environmentalism:** social movement dedicated to protecting life support systems for all species.

Sustainability

- The ability of a system to survive and function over time.
- *In EnSci terms:* the capacity of the Earth's natural systems and human cultural systems to survive, flourish, and adapt to changing environmental conditions into the very long-term future.

6 Major Causes of Environmental Problems

1. Population Growth
2. Wasteful Resource Use
3. Poverty
4. Bad Environmental Accounting
5. Ecological Ignorance
6. Inadequate Understanding of How the Earth Works

Principles of Sustainability:

Lessons from Nature

1. **Reliance on Solar Energy:** sun warms the planet, supports photosynthesis, powers wind and flowing water.
2. **Biodiversity:** variety of organisms, the system in which they interact, and the services to the environmental they provide shows ways of adaptation.
 - Renew topsoil, pest control, air/water purification
3. **Chemical/Nutrient Cycling:** circulation of chemicals from the environment to organism and back to the environment.
 - w/o this – no food, water, air, soil, life

Population & Economics



Economics

- **Economic Growth:** increase in the output of a country's goods & services.
 - Measured by % in change of a nation's GDP
- **Gross National Product (GDP):** annual market value of all goods & services produced by all foreign/domestic businesses in the nation.
- **Per Capita GDP:** changes in a nation's economic growth per person (GDP/Population)

Economic Development

- Effort to use economic growth to improve living standards
- More developed countries:
 - US, Canada, Japan, Australia, New Zealand, Most European countries
 - 19% of world's population, use 88% of all resources, produce 75% of pollution & waster
- Less developed countries:
 - 81% of world population
 - Middle income, moderately developed: China, India, Brazil, Turkey, Thailand, Mexico
 - Low income, least developed: Congo, Haiti, Nigeria, Nicaragua
 - Map on Pg S32 of textbook

Population Growth

- Continues to grow more rapidly than the Earth can support
- China – largest population, India -2nd
 - India's population growing faster than China
- Less developed countries are expected to represent 97% of future project population growth

Poverty

- Focus on survival at the expense of forest, soil, grasslands, wildlife
- Live in areas with a greater risk of natural disasters
- Generally work in unsafe/unhealthy conditions for low wages
- Life expectancy is reduced
- No government sponsored health/retirement plans
- People die from preventable diseases
 - Malnutrition, infectious diseases, lack of clean drinking water, respiratory problems.

Affluence & Environment

- Less Developed Countries:
 - Use of resource & environmental impact is LOW
 - Use all resources to survive
- Well developed countries:
 - Consume large amounts of resources far beyond their basic needs
 - Results in wastes & pollution
 - LARGE environmental impact
- **I=PAT**
- I= Impact
- P= Population
- A= Affluence
- T= Technology

Resources



Components of Sustainability

1. **Natural Capital** = natural resources + natural services

2. **Natural Resources**: materials & energy in nature, essential or useful for humans

- Renewable or non-renewable

3. **Natural Services**: natural processes that help support life and human economies

- Purification of air/water, renewal of topsoil

Natural Resources & Natural Services

Natural Resource	Natural Service
Air	Air purification, climate control, UV protection
Water	Water purification, waste treatment
Non-renewable minerals	(Examples: sand, ores ~ these are not services)
Non-renewable energy	(Examples: coal, oil, natural gas ~ these are not services)
Renewable energy	(Examples: sun, wind, water ~ these are not services)
Biodiversity	Population control, pest control
Land	Food production, nutrient recycling
Soil	Soil renewal

Resources

- **Perpetual:** supply is continuous.
 - The sun, expected to last at least 6 billion more years
- **Renewable:** takes anywhere from several days to hundreds of years to replenish
 - Water
 - **Sustainable Yield:** highest rate in which we can use a renewable resource without reducing its supply.
- **Non-renewable:** resources that exist in a fixed/finite quantity in relation to the human time scale
 - Coal/oil

Resource Rights (Resource Ownership)

- **Private Property:** individual or company own rights to the land, minerals, & other resources
- **Common Property:** rights to certain resources are held by a large group of individuals
- **Open-access Renewable Resources:** owned by no one, available for use by anyone at little to no charge
 - Atmosphere, ground water, open ocean & marine life

Tragedy of the Commons

- Common & Open-access resources are being/ have been degraded.
- Called Tragedy of the Commons by Garrett Hardin
- Idea of “if I don’t use it, someone else will” “if I just pollute a little it does not matter” “its okay to use, its renewable”
 - *Cumulative effect causes degradation of shared resources = no one benefits*

Tragedy of the Commons

Ways to Avoid Tragedy of the Commons:

1. Use less of the resource
2. Regulate use of the resource
3. Use less & regulate use of the resource
4. Convert open-access resources to private ownership
 - Not always practical

Humans & Resources

Humans degrade (destroy) natural capital by

1. Using normally renewable resources faster than they can be renewed.
2. Overloading natural systems with pollution & wastes.

Environmental Scientists look for scientific solutions, however, it is often left to governments to implement such solution. Many times solutions involve trade off, or compromises.

Pollution



Pollution

- Any addition to air, water, soil, or food that threatens the health, survival, or activities of humans or other living organisms.
- **Pollutants:** Polluting substances
 - Solid, liquid, gaseous by-products or waste
 - Point sources
 - Non-point sources

Pollution Sources

Point Sources

- Single, identifiable sources
 - Smokestack of a power plant
 - Drainpipe of a meat packaging plant
 - Exhaust pipe of an car

Non-Point Sources

- Dispersed & often difficult to identify
 - Runoff of fertilizers & pesticides
 - Storm drains

Unwanted Effects of Pollution

1. Disruption or degradation of life-support systems for humans and other species
2. Damage to wildlife, human health, & property
3. Creates nuisances, such as, noise, smell, tastes, & sights

Solutions: Output Pollution Control

- Cleaning up or diluting pollutants after we have produced them
- Temporary bandage, growing population & consumption levels not matched by improvements in pollution control technology.
- Removes pollutant from one area, only to cause pollution in another.
- Once release to harmful level, economic cost is too much to reduce to acceptable levels

Solutions: **Input Pollution Control**

- Reducing or eliminating the production of pollutants
- Often by switching to less harmful chemicals or processes

Ecological Footprint



Ecological Footprint

- Amount of biologically productive land and water needed to provide people in a country or area with an indefinite supply of renewable resources and to absorb and cycle the wastes and pollution produced by such wastes.
- **Per Capita Ecological Footprint**: ecological footprint per person
- **Ecological Deficit** = total ecological footprint > biological capacity
 - UNSUSTAINABLE

Environmental Degradation

- Air pollution
- Climate change
- Soil erosion
- Shrinking forests
- Decreased wildlife habitats
- Species extinction
- Aquifer depletion
- Declining ocean fisheries
- Water pollution
- Desert expansion

UN estimates that human activities have degraded 60% of Earth's natural capital, mostly in the last 50 years.

Guidelines for Working with Earth

1. Never leave Earth worse than you found it.
2. Take only what you need
3. Do no harm
4. Sustain diverse living organisms
5. Maintain Earth's capacity for self-repair/adaptation
6. Do not waste, do not pollute
7. Decrease population, reduce poverty

Change comes from dedicated, committed people: 5-10% of a population can bring major social change.

Sustainability

- Begins at personal & local levels
- **Refuse:** do not use
- **Reduce:** use less, only what is necessity
- **Reuse:** using a resource over and over in the same form.
- **Recycle:** collecting waste materials and making them into new materials.

Environmental Philosophies & Ethics



Earth-Wisdom Worldview

- Nature exists for all the Earth's species, not just for us.
- There is not always more
- Not all forms of economic growth is beneficial to the environment
- Our success depends on learning to cooperate with one another and with nature

Environmental Worldview

- How people think the world works
- What they think their role in the world should be
- What they see as right and wrong environmental behavior (ethics)

Planetary Management Worldview

- Increasingly common in the past 50 years
- We are the planets most important species
- We are in charge of the rest of nature