Introduction to Environmental SCIENCE
Environmental science in America is defined with 3 Major Events

✓ **Discovery of CO$_2$ accumulation in the atmosphere** (1957) - Roger Revelle and Charles Keeling of Scripps Institution of Oceanography began documenting rise of CO$_2$ from 315 parts per million (ppm) base in 1957

✓ **Publication of *Silent Spring*** by Rachel Carson, Sept. 27, 1962 - The book that catalyzed the worldwide environmental movement, *Silent Spring* called for an end to indiscriminate pesticide use and, on a broader level, a change in the way we view nature.

✓ **Discovery of atmospheric ozone depleting chemicals** (1974) - F. Sherwood Rowland and Mario J. Molina describe the way refrigerants (CFCs or chlorofluorocarbons) break up ozone in a catalytic cycle in the June issue of Nature.

http://www.radford.edu/~wkovarik/envhist/majorEvents.html
Environmental Science

Typically a Science degree (Quantitative data driven)

Focus involves core sciences (biology, chemistry, physics) and uses these subjects to help solve political, social, and economic issues.

Environmental Studies

Typically a Liberal Arts degree (Qualitative data driven)

Core focus is on history, politics, and economics from a social aspect. Does not use advanced core science concepts.
ENVIRONMENTAL SCIENCE IS AN INTERDISCIPLINARY STUDY
# MAJOR FIELDS OF STUDY RELATED TO ENVIRONMENTAL SCIENCE

## Table 1-1

<table>
<thead>
<tr>
<th>Major Fields</th>
<th>Subfields</th>
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</thead>
<tbody>
<tr>
<td>Biology: study of living things (organisms)</td>
<td>Ecology: study of how organisms interact with one another and with their nonliving environment</td>
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<tr>
<td></td>
<td>Botany: study of plants</td>
</tr>
<tr>
<td></td>
<td>Zoology: study of animals</td>
</tr>
<tr>
<td>Chemistry: study of chemicals and their interactions</td>
<td>Biochemistry: study of the chemistry of living things</td>
</tr>
<tr>
<td>Earth science: study of the planet as a whole and its nonliving systems</td>
<td>Climatology: study of the earth’s atmosphere and climate</td>
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<tr>
<td></td>
<td>Geology: study of the earth’s origin, history, surface, and interior processes</td>
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<tr>
<td></td>
<td>Hydrology: study of the earth’s water resources</td>
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<tr>
<td>Social sciences: studies of human society</td>
<td>Paleontology: study of fossils and ancient life</td>
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<td></td>
<td>Anthropology: study of human cultures</td>
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<td></td>
<td>Demography: study of the characteristics of human populations</td>
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<tr>
<td></td>
<td>Geography: study of the relationships between human populations and the earth’s surface features</td>
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<tr>
<td></td>
<td>Economics: study of the production, distribution, and consumption of goods and services</td>
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<tr>
<td></td>
<td>Political Science: study of the principles, processes, and structure of government and political institutions</td>
</tr>
<tr>
<td>Humanities: study of the aspects of the human condition not covered by the physical and social sciences</td>
<td>History: study of information and ideas about humanity’s past</td>
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<td></td>
<td>Ethics: study of moral values and concepts concerning right and wrong human behavior and responsibilities</td>
</tr>
<tr>
<td></td>
<td>Philosophy: study of knowledge and wisdom about the nature of reality, values, and human conduct</td>
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</tbody>
</table>
Environmental Science Is a Study of Connections in Nature

- How nature works
- How the environment affects us
- How we affect the environment
- How to deal with environmental problems
- How to live more sustainably
Sustainability Is the Central Theme

• Natural capital: supported by solar capital
  ▪ Natural resources
  ▪ Natural services
    ○ E.g., nutrient cycling

• Degradation of natural capital through human activities

• Scientific solutions (science vs. politics)
Natural Capital = Natural Resources + Natural Services

- **Air**
  - Air purification
  - Climate control
  - UV protection (ozone layer)

- **Water**
  - Water purification
  - Waste treatment

- **Nonrenewable minerals (iron, sand)**

- **Soil**
  - Soil renewal

- **Nonrenewable energy (fossil fuels)**

- **Renewable energy** (sun, wind, water flows)

- **Solar capital**

- **Natural gas**
  - Oil

- **Land**
  - Food production
  - Nutrient recycling

- **Life (biodiversity)**
  - Population control
  - Pest control

- **Coal seam**

**NATURAL CAPITAL**

- **Natural resources**
  - Nonrenewable energy (sun, wind, water flows)
  - UV protection (ozone layer)

- **Natural services**

**Fig. 1-3, p. 8**
Environmentally Sustainable Societies
Protect Natural Capital and Live off Its Income

- Live off natural income
  - The renewable resources provided by natural capital

- Human activity and its affect on the earth’s natural capital
  - Currently human trends lead to degradation of natural capital
There Is a Wide Economic Gap between Rich and Poor Countries

- Country’s economic growth: measured by **gross domestic product (GDP)** (annual value of goods and services in a country)
- Changes in economic growth: measured by **per capita GDP** (GDP/total pop. at midyear)
- Purchasing power parity (PPP) plus GDP are combined for **per capita GDP PPP**
- Developed vs. Developing countries
Comparison of Developed and Developing Countries, 2008

Percentage of World’s:

- Population: 18% (Developed) vs. 82% (Developing)
- Population growth: 0.12% (Developed) vs. 1.46% (Developing)
- Life expectancy: 77 years (Developed) vs. 67 years (Developing)
- Wealth and income: 85% (Developed) vs. 15% (Developing)
- Resource use: 88% (Developed) vs. 12% (Developing)
- Pollution and waste: 75% (Developed) vs. 25% (Developing)
Experts Have Identified Five Basic Causes of Environmental Problems

Population growth

Unsustainable resource use

Poverty

Excluding environmental costs from market prices

Trying to manage nature without knowing enough about it

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Poverty Has Harmful Environmental and Health Effects

- Population growth affected
- Malnutrition
- Premature death
- Limited access to adequate sanitation facilities and clean water
SOME HARMFUL RESULTS OF POVERTY

<table>
<thead>
<tr>
<th>Lack of access to</th>
<th>Number of people (% of world’s population)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adequate sanitation facilities</td>
<td>2.6 billion (38%)</td>
</tr>
<tr>
<td>Enough fuel for heating and cooking</td>
<td>2 billion (29%)</td>
</tr>
<tr>
<td>Electricity</td>
<td>2 billion (29%)</td>
</tr>
<tr>
<td>Clean drinking water</td>
<td>1.1 billion (16%)</td>
</tr>
<tr>
<td>Adequate health care</td>
<td>1.1 billion (16%)</td>
</tr>
<tr>
<td>Adequate housing</td>
<td>1 billion (15%)</td>
</tr>
<tr>
<td>Enough food for good health</td>
<td>0.86 billion (13%)</td>
</tr>
</tbody>
</table>
Affluence Has Harmful and Beneficial Environmental Effects

- Harmful environmental impact due to
  - High levels of consumption
  - Unnecessary waste of resources

- Affluence can provide funding for
  - Developing technologies to reduce
    - Pollution
    - Environmental degradation
    - Resource waste
Prices Do Not Include the Value of Natural Capital

✓ Companies do not pay the environmental cost of resource use
✓ Goods and services do not include the harmful environmental costs
✓ Companies receive tax breaks and subsidies
✓ Economy may be stimulated but there may be a degradation of natural capital

❖ Need FULL cost pricing of goods
Different Views about Environmental Problems and Their Solutions

- Environmental Worldview including environmental ethics
  - Planetary management worldview (humans are separate from nature, nature serves us)
  - Stewardship worldview (humans can manage earth, but do so responsibly)
  - Environmental wisdom worldview (how does earth sustain itself? → humans are dependent on nature and so are other species)
We Can LEARN to Make Informed Environmental Decisions

- Scientific research
- Identify problem and multiple solutions
- Consider human values
We Can Work Together to Solve Environmental Problems

• Social capital
  – Encourages
    • Openness and communication
    • Cooperation
    • Hope
  – Discourages
    • Close-mindedness
    • Polarization
    • Confrontation and fear
Identify an environmental problem

Gather scientific information

Propose one or more solutions

Project the short- and long-term environmental and economic advantages and disadvantages of each solution

Decide on and implement a solution

Evaluate the consequences

Revise decision as needed

Steps Involved in Making an Environmental Decision
Exponential Growth

- Hunting and gathering
- Agricultural revolution
- Industrial revolution
- Black Death—the Plague
- Industrial revolution
FOUR SCIENTIFIC PRINCIPLES OF SUSTAINABILITY

Reliance on Solar Energy

Biodiversity

Nutrient Cycling

Population Control
<table>
<thead>
<tr>
<th>Current Emphasis</th>
<th>Sustainability Emphasis</th>
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<tbody>
<tr>
<td>Pollution cleanup</td>
<td>Pollution prevention</td>
</tr>
<tr>
<td>Waste disposal (bury or burn)</td>
<td>Waste prevention</td>
</tr>
<tr>
<td>Protecting species</td>
<td>Protecting habitat</td>
</tr>
<tr>
<td>Environmental degradation</td>
<td>Environmental restoration</td>
</tr>
<tr>
<td>Increasing resource use</td>
<td>Less resource waste</td>
</tr>
<tr>
<td>Population growth</td>
<td>Population stabilization</td>
</tr>
<tr>
<td>Depleting and degrading natural capital</td>
<td>Protecting natural capital</td>
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</tbody>
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Solutions for Environmental or Sustainability Revolution