Introduction to Environmental Science
What is Environmental Science

• Study of the impact of humans on the environment

• Goal: To understand and solve environmental problems
RACHEL CARSON

Silent Spring

Biologist
Ecologist
Writer

First to bring light to the affects of human activities on the environment.
What is Ecology?

• The study of how living things interact with each other and the nonliving environment
Interrelated Nature Environmental Problems

- Environment is everything that affects an organism during its lifetime.
An Ecosystem Approach

• Ecology- the study of the relationships between living organisms and their environment.

• Ecosystem: Region in which the organisms and the physical environment form an interacting unit.

  – The task of an Environmental Scientist is to recognize and understand natural interactions and integrate these with human uses of the natural world.
Cultural Changes & the Environment: Hunter-Gatherer Culture

- Hunter-gatherers
- Nomadic: seasonal movement
- Limited and local environmental impact
- Generally work with natural processes
Cultural Changes & the Environment: The Agricultural Revolution

- Agriculture
- Slash and burn/shifting cultivation
- Essentially sustainable resource use
- Increased environmental impact
Cultural Changes & the Environment: The Industrial Revolution

- Industrial Revolution – Mid 1700’s
- Machines replaced human and animal labor in the manufacture and transportation of goods.
  - Steam engines converting heat energy into forward motion was central to this transformation.
- Shift to dependence on non-renewable resources such as fossil fuels
- Dramatic increase in environmental impact
<table>
<thead>
<tr>
<th>Person</th>
<th>Invention</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>James Watt</td>
<td>First reliable Steam Engine</td>
<td>1775</td>
</tr>
<tr>
<td>Eli Whitney</td>
<td>Cotton Gin, Interchangeable parts for muskets</td>
<td>1793, 1798</td>
</tr>
<tr>
<td>Robert Fulton</td>
<td>Regular Steamboat service on the Hudson River</td>
<td>1807</td>
</tr>
<tr>
<td>Samuel F. B. Morse</td>
<td>Telegraph</td>
<td>1836</td>
</tr>
<tr>
<td>Elias Howe</td>
<td>Sewing Machine</td>
<td>1844</td>
</tr>
<tr>
<td>Isaac Singer</td>
<td>Improves and markets Howe's Sewing Machine</td>
<td>1851</td>
</tr>
<tr>
<td>Cyrus Field</td>
<td>Transatlantic Cable</td>
<td>1866</td>
</tr>
<tr>
<td>Alexander Graham Bell</td>
<td>Telephone</td>
<td>1876</td>
</tr>
<tr>
<td>Thomas Edison</td>
<td>Phonograph, Incandescent Light Bulb</td>
<td>1877, 1879</td>
</tr>
<tr>
<td>Nikola Tesla</td>
<td>Induction Electric Motor</td>
<td>1888</td>
</tr>
<tr>
<td>Rudolf Diesel</td>
<td>Diesel Engine</td>
<td>1892</td>
</tr>
<tr>
<td>Orville and Wilbur Wright</td>
<td>First Airplane</td>
<td>1903</td>
</tr>
<tr>
<td>Henry Ford</td>
<td>Model T Ford, Assembly Line</td>
<td>1908, 1913</td>
</tr>
</tbody>
</table>
Oil Replaces Coal
Population Growth

Revolutions allowed the human population to grow much faster
  • Better medical care
  • Modern sanitation methods
  • Ability to store and transport food
World Population

Fig. 1-1 p. 2

- Black Death—the Plague
- 2-5 million years ago
- 8000 years ago
- Agricultural revolution
- Industrial revolution
Main Environmental Problems

Resource Depletion
Pollution
Loss of Biodiversity
Air Pollution
- Global climate change
- Stratospheric ozone depletion
- Urban air pollution
- Acid deposition
- Outdoor pollutants
- Indoor pollutants
- Noise

Biodiversity Depletion
- Habitat destruction
- Habitat degradation
- Extinction

Major Environmental Problems

Water Pollution
- Sediment
- Nutrient overload
- Toxic chemicals
- Infectious agents
- Oxygen depletion
- Pesticides
- Oil spills
- Excess heat

Food Supply Problems
- Overgrazing
- Farmland loss and degradation
- Wetlands loss and degradation
- Overfishing
- Coastal pollution
- Soil erosion
- Soil salinization
- Soil waterlogging
- Water shortages
- Groundwater depletion
- Loss of biodiversity
- Poor nutrition

Waste Production
- Solid waste
- Hazardous waste
What is the “Tragedy of the Commons”?

• ARTICLE: published in 1968 by Garrett Hardin.

• CONCEPT: a shared resource in which any given user reaps the full benefit of his/her personal use, while the losses are distributed amongst all users. Result? Tragedy all around.
What is the “Tragedy of the Commons”?

- CLASSIC EXAMPLE: cows on shared pasture.

- What are other examples of commons?
  - Air
  - Water
  - Scenery
Economics

• Supply and Demand
• Costs and Benefits
• Risk Assessment
Developed or Developing

• Developed
  • United States, Canada, Japan
  • Higher average income, slower population growth, high energy use, high pollution, diverse industrial economies

• Developing
  • Mexico, Indonesia
  • Shorter life expectancy, simple and agriculture based economies, rapid population growth
# Indicators of Development

## Indicators of Development for the United States, Japan, Mexico, and Indonesia

<table>
<thead>
<tr>
<th></th>
<th>Measurement</th>
<th>U.S.</th>
<th>Japan</th>
<th>Mexico</th>
<th>Indonesia</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Health</strong></td>
<td>life expectancy in years</td>
<td>77</td>
<td>81</td>
<td>71.5</td>
<td>68</td>
</tr>
<tr>
<td><strong>Population growth</strong></td>
<td>per year</td>
<td>0.8%</td>
<td>0.2%</td>
<td>1.7%</td>
<td>1.8%</td>
</tr>
<tr>
<td><strong>Wealth</strong></td>
<td>gross national product per person</td>
<td>$29,240</td>
<td>$32,350</td>
<td>$3,840</td>
<td>$640</td>
</tr>
<tr>
<td><strong>Living space</strong></td>
<td>people per square mile</td>
<td>78</td>
<td>829</td>
<td>133</td>
<td>319</td>
</tr>
<tr>
<td><strong>Energy use</strong></td>
<td>per person per year (Btu)</td>
<td>351</td>
<td>168</td>
<td>59</td>
<td>18</td>
</tr>
<tr>
<td><strong>Pollution</strong></td>
<td>carbon dioxide from fossil fuels per person per year (tons)</td>
<td>20.4</td>
<td>9.3</td>
<td>3.5</td>
<td>2.2</td>
</tr>
<tr>
<td><strong>Waste</strong></td>
<td>garbage produced per person per year (kg)</td>
<td>720</td>
<td>400</td>
<td>300</td>
<td>43</td>
</tr>
</tbody>
</table>
Ecological Footprint

- Amount of land in acres or hectares needed to support one person in a particular country.
Ecological Footprints

The ecological footprints of different countries are represented in the bar chart. India has the smallest footprint, followed by Mexico. The U.S. has the largest footprint, while Britain is in the middle. The ecological footprint is measured in acres.
Ecological Footprint

### Per Captia Ecological Footprint (Hectares of land per person)
- **United States**: 10.9
- **The Netherlands**: 5.9
- **India**: 1.0

### Total Ecological Footprint (Hectares)
- **United States**: 3 billion hectares
- **The Netherlands**: 94 million hectares
- **India**: 1 billion hectares
Sustainability

**Sustainability** is the condition in which human needs are met in such a way that a human population can survive indefinitely.

Sustainability is a key goal of environmental science.