Great Idea:
Ecosystems are interdependent communities of living things that recycle matter while energy flows through.
Chapter Outline

- Ecology and Ecosystems
- The Law of Unintended Consequences
- Threats to the Global Ecosystem and Environment
Ecology and Ecosystems
Ecology and Ecosystems

- Ecology
  - Natural living systems
- Ecosystems
  - Biotic and abiotic components
- Community
  - Producers, consumers, decomposers
Characteristics of Ecosystems

- Every Ecosystem consists of both living and nonliving parts
- Energy flows through ecosystems
- Matter is recycled by ecosystems
- Every organism occupies an ecological niche
- Stable ecosystems achieve a balance among their populations
- Ecosystems are not permanent, but change over time
Every Ecosystem Consists of Both Living and Nonliving Parts

- **Abiotic**
  - Chemical and physical environment
- **Biotic**
  - Living organisms
  - Ecological community
    - All interacting individuals
Energy Flows Through Ecosystems

• Food Web
  – Interactions of organisms

• Trophic Levels
  – Photosynthetic plants
  – Herbivores
  – Carnivores
  – Decomposers

• Most energy is lost as heat
  – 10% is transferred
Matter is Recycled by Ecosystems

- Atoms continuously cycle
Every Organism Occupies an Ecological Niche

- Ecological niche
  - Mode of survival
- Each plant/animal fills a niche
  - Organisms compete for dominance
Stable Ecosystems Achieve a Balance Among Their Populations

- Homeostasis
  - Balance among populations
- Resources are limited
  - Some variation in populations
  - Overall relatively constant
Ecosystems Are Not Permanent, but Change Over Time

• Long Time Scale
  – Plate tectonics

• Short Time Scale
  – Glaciers
  – Human impact
The Law of Unintended Consequences

• It is virtually impossible to change on aspect of a complex system without affecting other parts of the systems, often in as-yet unpredictable ways.

• Examples:
  – Mississippi levees
  – Everglades Restoration
  – Lake Victoria
The Lake Victoria Disaster

• Lake Victoria
  – Largest freshwater lake in Africa

• Introduced species
  – Nile perch
    • Aggressive predator
    • Algae blooms
    • Snail populations carry disease
    • Roasting fish
      – Decimated forests
      – Increase in erosion
iClicker Question

- The branch of science that focuses on natural living systems in the broadest sense is called:
  - A paleontology
  - B biology
  - C ecology
iClicker Question

• Which best describes bacteria and fungi?
  – A they act as consumers in ecosystems
  – B they act as decomposers that renew the raw materials of life
  – C they act as producers and convert raw materials into essential carbon-based molecules
iClicker Question

Which statement about ecosystems is incorrect?

- A Energy flows through ecosystems
- B Every ecosystems consists of both living and nonliving parts
- C Ecosystems are permanent and do not change over time
- D Every organism occupies an ecological niche
- E Stable ecosystems achieve a balance among their populations
iClicker Question

- It is possible to change one aspect of a complex system without affecting other parts of the system.
  - A True
  - B False
Because ecosystems are so complex, it is sometimes difficult to draw unambiguous conclusions from field studies.

- A True
- B False
iClicker Question

• What is the estimated amount of trash the average American is responsible for each year?
  – A 0.4 tons
  – B 4 tons
  – C 40 tons
  – D 400 tons
Threats to the Global Ecosystem and Environment
The Problem of Urban Landfills

- Solid Waste
  - Nothing is ever thrown away
- Landfills
  - Decay slowed enormously
- Response
  - Recycling
  - Large depositories

![Pie charts comparing waste composition in 1986 and 2000](chart.png)
The Ozone Problem

- **Ozone**
  - Molecule of 3 oxygen atoms
  - Absorbs ultraviolet radiation

- **The Ozone Layer**
  - Detection
    - Aircraft sampling
    - Measure spectral lines from molecule
  - Stratosphere
    - Highest concentration
The Ozone Problem Part II

• The Ozone Hole
  – Concentration of ozone reduced
    • Yearly occurrence over Antarctica
  – Linked to chlorofluorocarbons (CFCs)
    • Breaks apart $O_3$ molecule

• Dealing with the Threat to the Ozone Layer
  – Reduction of CFCs
Acid Rain and Urban Air Pollution

• Burning introduces chemicals
  – Nitrogen oxides
  – Sulfur compounds
  – Hydrocarbons

• Effects
  – Air pollution
    • Production of bad ozone
  – Acid rain

• Reduction
  – Reduce emissions
    • Power plants
    • Vehicles
The Greenhouse Effect

- Greenhouse Effect
  - Traps heat on earth
- Global Warming
  - Climate change
- 3 main points
  - CO₂ is a greenhouse gas
  - Burning fossil fuels increases CO₂
  - Average global temperature has significantly increased
    - 1990s warmest decade
Debates About Global Climate Change

• Increased CO₂ levels
  – Responsible for temperature increase?

• World’s Oceans
  – CO₂ exchange with atmosphere
  – Current circulation

• Solar energy output
  – Varies over time

• Impact
  – Warming of Northern Hemisphere
  – Ecological impacts
  – Meteorological impacts

• Solutions
  – Kyoto accord
Debates About Global Climate Change
iClicker Question

• What is the formula for ozone?
  – A  O₃
  – B  O₂
  – C  Oz
iClicker Question

- The ozone hole is:
  - A a place where the atmosphere has disappeared
  - B a portion of the atmosphere that has no ozone
  - C a portion of the atmosphere where the ozone concentration has declined significantly
The problem of ozone depletion appears to be well on its way to being solved.

- A True
- B False
iClicker Question

• The greenhouse effect is a serious problem for life on Earth
  – A True
  – B False
iClicker Question

• Excessive greenhouse effect is a serious problem for life on Earth
  – A True
  – B False
• How long does it take to make the transition from one type of fuel to another?
  - A  3-5 years
  - B  10-20 years
  - C  30-50 years
  - D  100-200 years
iClicker Question

• Have you ever experienced being in a city on a smoggy day?
  – A yes
  – B no
  – C not sure
iClicker Question

• Do you believe the government should be doing more to study and understand global warming?
  – A yes
  – B no
  – C not sure
iClicker Question

• Would you be willing to change your driving habits now because the possibility exists that global warming will adversely affect the lifestyles of your grandchildren?
  – A yes
  – B no