Points to Ponder

• What does the human population growth look like in the MDCs and the LDCs?
• What is the biotic potential and the carrying capacity?
• What are the renewable and nonrenewable resources that we use?
• Explain how human activities impact water, food, minerals, land, and energy.
• What is biodiversity?
• What are the direct and indirect values of biodiversity?
• Explain how our current society is unsustainable.
• What are some ways we can increase rural and urban sustainability?
• How is the quality of life assessed?
24.1 Human population growth

Human population growth

- ~ 7 billion presently on the planet with ~ 78 million added per year

- **Growth rate** is determined by the number of births and deaths each year

- Human population is growing exponentially

- **Biotic potential** is the maximum growth rate under ideal conditions that is usually limited by the environment

- **Carrying capacity** is the leveling off of growth to a level that can be sustained by the environment indefinitely

- Some argue humans have already passed the carrying capacity and others suggest the earth can carry 50-100 billion people
Human population growth

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Billions of People

Year

1750 1800 1850 1900 1950 2007 2250

12

highest growth
lowest growth

less-developed countries

more-developed countries
Comparing more and less developed countries

- MDCs have a low population increase averaging ~0.1% (US is ~0.6%)

- LDCs are having a 1.6% growth rate but some countries (most in Africa) are increasing at a much higher rate

- Even though the world’s growth rate has slowed down the population will continue to increase because more women are entering the reproductive years than leaving them
24.1 Human population growth

Age structure in MDCs and LDCs

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a. More-developed countries (MDCs)

b. Less-developed countries (LDCs)

c. © Still Pictures/Peter Arnold/Photolibrary
Planetary resources

- **Nonrenewable resources** are limited in supply
  - Amount of land, fossil fuels, and minerals

- **Renewable resources** are able to be replenished naturally
  - Water, plants, and animals for food and solar energy

- Pollution is a side effect of resource consumption and increases as the population increases
Land

- **Beaches**
  - 40% of world’s population lives within 60 miles of a coastline
  - This leads to beach erosion and habitat loss
  - The loss of wetlands is a problem because it is a buffer from coastal storms and are important spawning areas for many marine organisms

- **Semi-arid lands**
  - Semi-arid lands are being converted to desert-like conditions (desertification)
    - e.g. Overgrazing, removal of vegetation

- **Tropical rainforests**
  - Deforestation can lead to infertile agricultural or grazing land as well as loss of biodiversity
24.2 Human use of resources and pollution

### Land

#### a.
- Severely eroded
- Moderately eroded

#### b.
- Desert
- Desertification risk
- Desertification

#### b.
- 10,000 yr ago
- Today
  - Temperate forests
  - Tropical forests

#### Images:
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- © Carlos Dominguez/Photo Researchers, Inc.
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Water

• 70% of freshwater worldwide is used for irrigation

• In MDCs more water is used for bathing, toilets, and watering lawns than for drinking and cooking

• Dams change the flow of rivers, lose a lot of water, and can be filled in by sediment

• Aquifers are being drained of water for our needs

• Withdrawal of this groundwater can lead to sinkholes and saltwater intrusion
24.2 Human use of resources and pollution

Water

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a. Agriculture uses most of the freshwater consumed.

b. Industrial use of water is about half that of agricultural use.

c. Domestic use of water is about half that of industrial use.

a: © Corstock Images/Alamy RF; b: © Jeremy Samuelson/FoodPix/Getty Images; c: © Stockbyte/PunchStock RF
Food comes from growing crops, raising animals, and fishing.

Harmful farming methods
- Planting only a few genetic varieties
- Heavy use of fertilizers, pesticides, and insecticides
- Excessive fuel consumption and irrigation

Current farming methods lead to soil loss, degradation, and salinization.

There is some controversy over genetically engineered crops.

Raising livestock accounts for a lot of the pollution associated with farming.

Raising livestock is energy intensive.
24.2 Human use of resources and pollution

Food

a. Polyculture
b. Contour farming
c. Biological pest control

© Leah Bristol/Visuals Unlimited; © Inga Spence/Visuals Unlimited; Courtesy V. Jane Windsor, Division of Plant Industry, Florida Department of Agriculture & Consumer Services
Energy

- **Nonrenewable resources**: fossil fuels (oil, natural gas, coal)
  - Burning of fossil fuels is harmful to the environment
  - 75% of the world’s energy supply comes from fossil fuels
  - The build up of greenhouse gases will lead to global warming

- **Renewable sources**: hydropower, geothermal energy, wind, and solar energy
  - Wind and solar energy are expected to become more common
  - Solar-hydrogen revolution suggests that solar energy will replace fossil fuel energy
24.2 Human use of resources and pollution

Energy

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Minerals

- Nonrenewable raw materials that are mined from the Earth’s crust
- Includes fossil fuels, nonmetallic (sand, phosphate), and metallic raw materials (copper, iron)
- Consumption of minerals contributes to hazardous wastes
- Production of plastics, pesticide, herbicides produce a lot of waste
- CFC’s are damaging the ozone shield
- Wastes entering bodies of water can be biologically magnified
What occurs during biological magnifications?

<table>
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<tr>
<th>DDT Concentration</th>
<th>25 ppm in predatory birds</th>
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<tbody>
<tr>
<td></td>
<td>2 ppm in large fish</td>
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<tr>
<td></td>
<td>0.5 ppm in small fish</td>
</tr>
<tr>
<td></td>
<td>0.04 ppm in zooplankton</td>
</tr>
<tr>
<td></td>
<td>0.000003 ppm in water</td>
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</table>
Loss of biodiversity

• **Biodiversity** is the variety of life on the planet

• **Loss of biodiversity:**
  – **Habitat loss**: coral reefs and rainforests are of particular concern because they have high species diversity
  – **Alien species**: exotic species can become invasive species that out compete native species
  – **Pollution**: results in acid deposition, global warming, ozone depletion, and synthetic organic compounds including endocrine-disrupting contaminants
  – **Overexploitation**: occurs when humans extract enough individuals from a wild population that it becomes seriously reduced in numbers (exotic pets, hunting, fishing)
  – **Disease**: caused by human encroachment on wildlife habitats
Loss of biodiversity

- Habitat Loss
- Alien Species
- Pollution
- Overexploitation
- Disease

<table>
<thead>
<tr>
<th>Cause</th>
<th>% Species Affected</th>
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<tbody>
<tr>
<td>Habitat Loss</td>
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<tr>
<td>Alien Species</td>
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<tr>
<td>Pollution</td>
<td>40</td>
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<tr>
<td>Overexploitation</td>
<td>60</td>
</tr>
<tr>
<td>Disease</td>
<td>80</td>
</tr>
</tbody>
</table>

b. © Gunter Ziesler/Peter Arnold/Photolibrary
Direct value of biodiversity

• **Medicinal value**
  – Many drugs are derived from living organisms
    • e.g., Rosy periwinkle and cancer, antibiotics

• **Agricultural value**
  – Food and fibers from agricultural crops
  – Biological pest controls
  – Wild pollinators

• **Consumptive value**
  – Most freshwater and marine harvests depend on wild caught animals
  – Wild fruits and vegetables, fibers, and honey
  – Trees are used for wood and other products
Direct value of biodiversity

Wild species, like the rosy periwinkle, are sources of many medicines.

Wild species, like many marine species, provide us with food.

Wild species, like the nine-banded armadillo, play a role in medical research.
24.3 Biodiversity

Direct value of biodiversity

Wild species, like the lesser long-nosed bat, are pollinators of agricultural and other plants. Wild species, like rubber trees, can provide a product indefinitely if the forest is not destroyed.

Wild species, like ladybugs, play a role in biological control of agricultural pests.
Indirect value of biodiversity

- **Waste disposal**
  - Decomposers breaking down organic matter and other wastes to inorganic nutrients
  - Breaking down and immobilizing pollutants
- **Provision of freshwater**
  - Provides us with needed water for drinking and irrigation
  - Forests and other ecosystems exert a “sponge effect”
- **Prevention of soil erosion**
- **Biogeochemical cycles**
  - Biodiversity within an ecosystem contributes to the biogeochemical cycles
- **Regulation of climate**
  - Forests help regulate the climate by taking up CO$_2$
- **Ecotourism**
- **Existence value**
  - Knowing that a species exists gives it value
Our unsustainable society

• Population growth in the LDCs is at a high rate
• Consumption in the MDCs is at a high rate
• Agriculture uses a lot of the land, water, and fossil fuels and produces pollution
• Almost ½ of the agricultural yield feeds our farm animals
• It takes about 10 lbs of grain to produce about 1 lb of meat therefore the overeating of meat in the MDCs is wasteful
• Currently we mostly use nonrenewable forms of energy leading to acid deposition, global warming, and smog
• As the human population grows we encroach on other species that results in habitat loss and species extinction
Unsustainable activities

24.4 Working toward a sustainable society

deforestation and desertification
erosion of topsoil and groundwater depletion
overfishing and loss of terrestrial habitats
urban sprawl and wildlife habitat loss
pesticide, fertilizer, and hazardous waste accumulation
air and water pollution and global warming

Rural sustainability

• Plant a variety of crops and trees
• Use farming techniques that promote healthy soil and decrease destruction and pollution
• Use integrated pest management
• Preservation and restoration of wetlands
• Use recycling and composting
• Use renewable energy forms such as wind and biofuel
• Buy locally
Urban sustainability

- Design energy efficient and mass transit transportation
- Cool and heat buildings using every efficient means
- Create “green roofs” and “greenbelts”
- Plant native grasses to attract butterflies and bees
- Recycle business equipment
Assessing quality of life

- The GNP is a measure of money flow that does not take into account whether activities are environmentally or socially harmful.

- Measure that includes noneconomic indicators is a better index of quality of life.
  - Index of Sustainable Economic Welfare (ISEW)
  - The Genuine Progress Indicator (GPI)

- Humans do not like to sacrifice their comfort levels therefore we continue to exploit our environment and its resources.

- It takes an informed individual, creativity, and desire to bring about change for the better.