Humans in the Biosphere Chapter 6

Section 6-1

A Changing Landscape

Earth as an Island

- Earth is similar to an island because all the organisms that live on Earth share a limited resource base and depend on it for their long-term survival.

Human Activities

- Humans participate in food webs and chemical cycles which provide:
  - breathable air
  - drinkable water
  - fertile soil

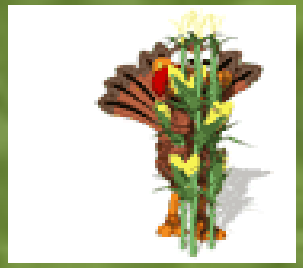
- Ecosystem processes provide us with "services" such as storage and recycling of nutrients.
- If we don't get these "goods and services" from the environment, we will need to spend money to produce them.

Hunting and Gathering

- Way our ancestors obtained food.
- Caused mass extinction of animals in North America about 12,000 years ago.
- Groups of people still practice this method today:
  - Bushmen in Africa
  - Pygmies
  - Eskimos

- Most use technology such as guns, snowmobiles, or manufactured tools.

Agriculture



- About 11,000 years ago, humans began the practice of farming, or agriculture.
- Also included raising animals.
- One of the most important developments in human history.
- Provides a dependable food supply that can be produced in large quantities and stored for later use.
- Lead to large settlements and stable communities.

From Traditional to Modern Agriculture

- Machinery helped farmers with cultivation.
- World exploration led to an exchange of crops around the globe.
- Large scale irrigation in dry areas appeared in the Western US allowing deserts to become breadbaskets

- New varieties of crops were developed to produce higher yields.

- These crops were grown using monoculture in which large fields are planted with a single variety year after year.
- Chemical fertilizers boosted plant growth and pesticides controlled crop-damaging insects.

The Green Revolution

- The green revolution greatly increased the world's food supply.
- Plant breeder's developed highly productive "miracle strains" of wheat and rice.
- Modern techniques were introduced to countries that were suffering from food shortages.
- Helped the world food production double.

Challenges for the Future

- Modern agriculture has created ecological challenges.
  - Increased use of pesticides which:
    - contaminate water
    - damage beneficial insects
    - accumulate in the environment
  - Finding enough water for irrigation
    - Ogallala aquifer in Midwest expected to run dry within 20 to 40 years.

- Need for developing new approaches to protect natural resources

Industrial Growth and Urban Development

- Industrial Revolution transformed human society.
- Mass-produced farm machinery makes efficient, large-scale agriculture possible.
- Energy produced from fossil fuels pollutes the air, water, and soil.
- Dense communities produce wastes.
- Suburban growth consumes farmland and natural habitats.

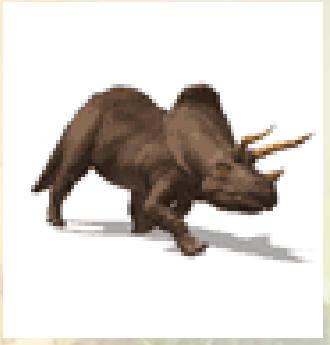
Renewable and Nonrenewable Resources

Section 6-2

Classifying Resources

- **Environmental goods and services may be classified as either renewable or nonrenewable.**
- **A renewable resource can regenerate if it is alive, or can be replenished by biochemical cycles if they are nonliving.**
  - **A tree because a new tree can grow in place of an old tree.**
- **A renewable resource is not necessarily unlimited.**
  - **Fresh water can easily become limited by drought or overuse.**

- **A nonrenewable resource is one that cannot be replenished by natural processes.**
  - **Fossil fuels - coal, oil, and natural gas are nonrenewable resources. When they are depleted, they are gone forever.**



Sustainable Development

- **Sustainable development is a way of using natural resources without depleting them, and providing for human needs without causing long-term environmental harm.**
- **Human activities can affect the quality and supply of renewable resources such as:**
  - **land**
  - **forest**
  - **fisheries**
  - **air**
  - **fresh water**

Land Resources

- **Land is a resource that provides space for human communities and raw materials for industry.**
- **Land also includes the soils in which crops are grown.**
- **The most fertile soil is in the uppermost layer called topsoil.**
- **Plowing the land can break up the soil**
- **Soil erosion is the wearing away of surface soil by water and wind.**
  - **The Midwest loses roughly 47 metric tons of topsoil/hectare every year!**

- In dry climates, a combination of farming, overgrazing, and drought has turned once productive areas into deserts a process called desertification.
- Some sustainable-development practices guard against these problems:
  - Contour plowing - fields are plowed across the slope to reduce erosion
  - Leaving the stems and roots of the previous year's crop in place
  - Planting a field with rye rather than leaving it unprotected from erosion.

Forest Resources

- Forests have been called the "lungs of the Earth" because they remove CO_2 and produce O_2.
- Forests provide:
  - Wood for homes, paper, fuel
  - Store nutrients
  - Provide habitats and food for organisms
  - Moderate climate
  - Limit soil erosion
  - Protect freshwater supplies

- Worldwide, about half of the area originally covered by forests and woodlands has been cleared.
- Only about one-fifth of the world's original old-growth forests remain.
- Deforestation or loss of forests can lead to severe erosion as soil is exposed to heavy rains.
- Grazing or plowing after deforestation can change local soils and microclimates that may prevent regrowth of trees.

- **Sustainable-development strategies for forest management:**
  - **Mature trees are harvested selectively to promote growth of younger trees**
  - **Foresters plant, manage, harvest, and replant tree farms.**
  - **Tree geneticists are also breeding new, faster-growing tree varieties that produce high quality wood.**

Fishery Resources

- Fishes and other animals that live in water are a valuable source of food for humanity.

Overfishing

- Overfishing, or harvesting fish faster than they can be replaced by reproduction, greatly reduced the amount of fish in parts of the world's ocean.
- From 1950-1990, the world fish catch grew from 19 million tons to more than 90 million tons.
- The declining fish populations are an example of the "tragedy of commons".

- "Tragedy of commons" is when people from several countries take advantage of a resource but no one take responsibility for maintaining it.
- Sustainable-development strategies:
  - Guidelines were created by the U.S. National Marine Fisheries Service
    - specified how many fish, and of what size, could be caught in various parts of the oceans.
    - regulations helped fish populations recover

Aquaculture

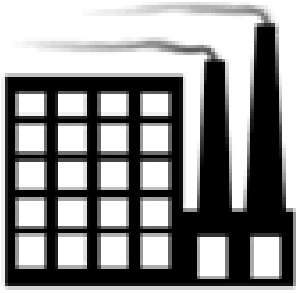
- Aquaculture is the raising of aquatic animals for human consumption.
- It also helps to sustain fish resources.
- If it is not managed properly, aquaculture can pollute water and damage aquatic ecosystems.

Air Resources

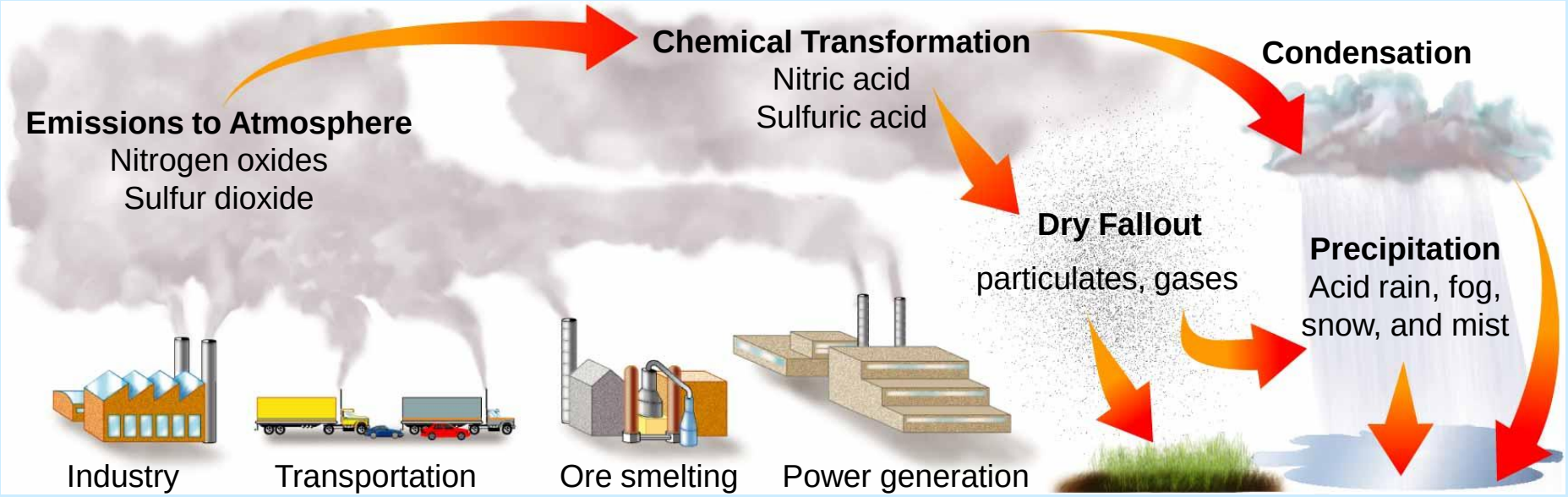
- **Air is a resource that affects people's health and it's quality remains a challenge for modern society.**
- **Smog is mixture of chemicals that occurs as a gray-brown haze in the atmosphere.**
- **Smog is due to automobile exhaust and industrial emissions.**

- **Smog is a pollutant.**
- **A pollutant is a harmful material that can enter the biosphere through land, air, or water.**
- **The burning of fossil fuels can release pollutants into the atmosphere.**
- **Toxic chemicals are nitrates, sulfates, and particulates which are microscopic particles of ash and dust.**

- **Factories control their emissions from smokestacks.**
- **Strict automobile emission standards and clean-air regulations have greatly improved air quality in the US.**



Formation of Acid Rain

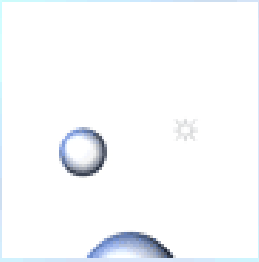


Nitrogen and sulfur compounds when combined with water vapor forms acid rain.

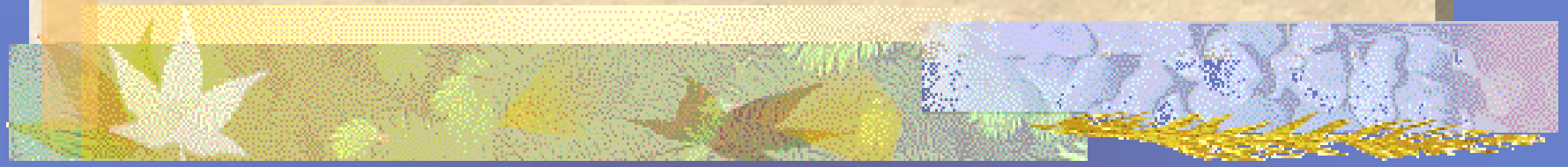
Freshwater Resources

- Americans use billions of liters of freshwater daily for drinking and washing to watering crops and making steel.
- Pollution threatens water supplies in several ways:
  - Improperly discarded chemicals in streams and rivers
  - Waste on land can seep through soil and enter groundwater
  - Domestic sewage (sinks and toilets)

- Sustainable use of water is to protect natural systems involved in the water cycle.
  - Wetlands purify water passing through them.
  - Forests and other vegetation help to purify the water that seeps into the ground.
- Water conservation is an important aspect of sustainable development.
- More than three quarters of all water consumed is used in agriculture.



Biodiversity

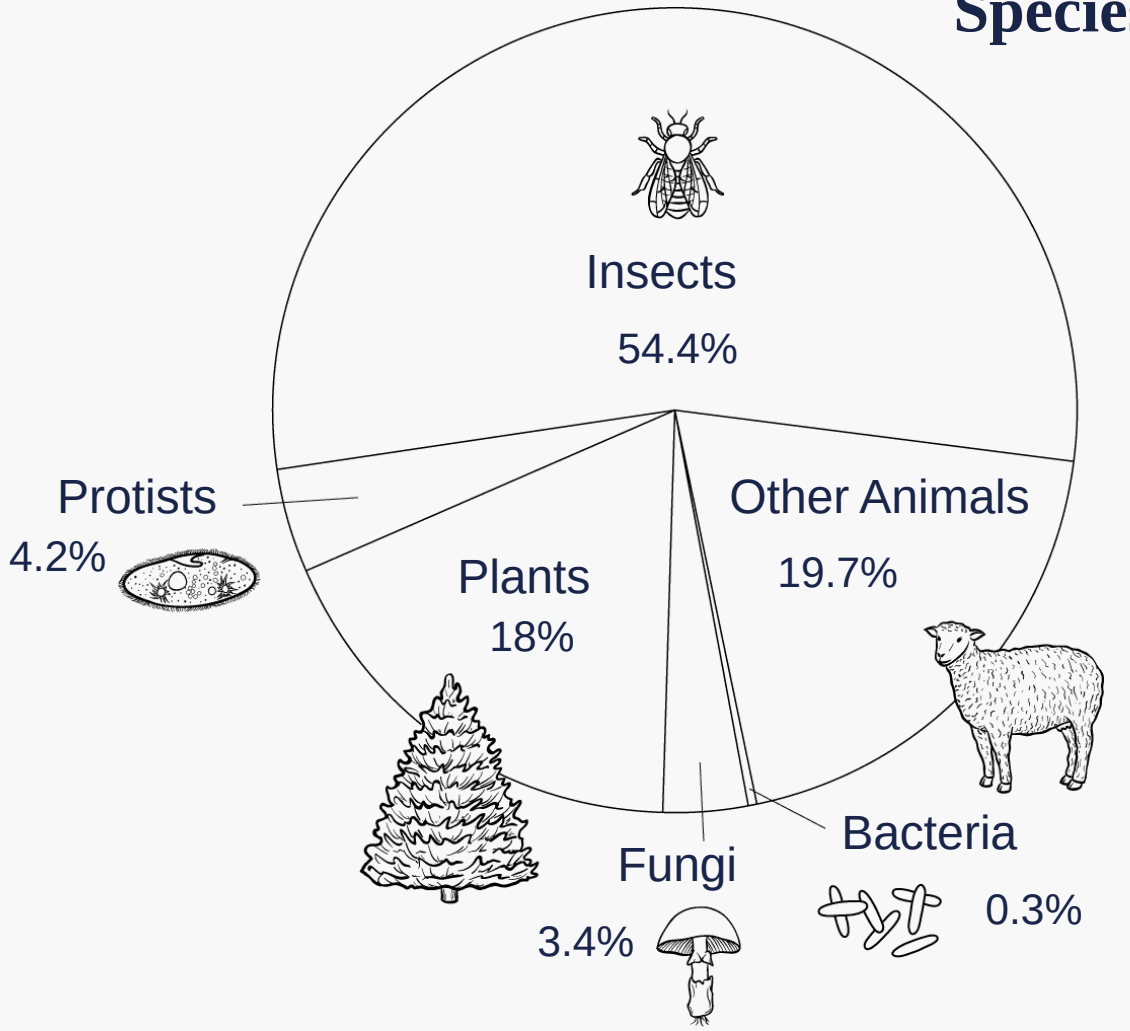


Section 6-3

The Value of Biodiversity

- Biodiversity is the sum total of the genetically based variety of all organisms in the biosphere.
- Ecosystem diversity includes the variety of habitats, communities, and ecological processes in the living world.
- Species diversity refers to the number of different species in the biosphere.

Species Diversity



- Genetic diversity refers to the sum total of all the different forms of genetic information carried by all organisms living on Earth today.
- Biodiversity is one of Earth's greatest natural resources providing us with:
  - Foods
  - Industrial products
  - Medicines (antibiotics, heart drugs, anticancer drugs, painkillers)

Threats to Biodiversity

- Human activity can reduce biodiversity by:
  - altering habitats
  - hunting species to extinction
  - introducing toxic compounds into food webs
  - introducing foreign species to new environments
- Altering ecosystems can lead to:
  - Extinction - species disappears from all or part of its range.
  - Endangered species - a species whose population size is declining in a way that places it in danger of extinction.

Habitat Alteration

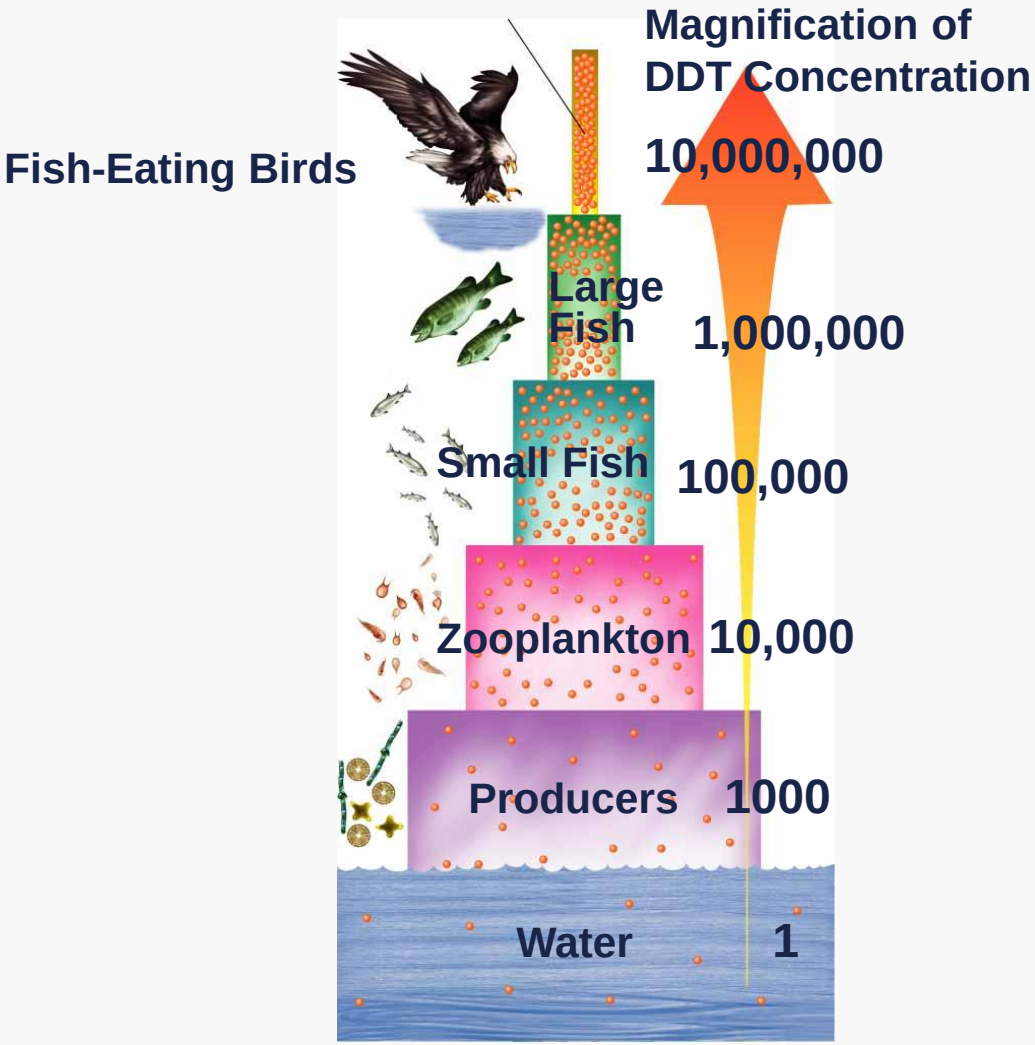
- As habitats disappear, the species that live in those habitats vanish.
- Habitat fragmentation occurs when development often splits ecosystems into pieces.
- The pieces of the habitat become biological "islands".(habitat surrounded by different habitat)
  - New York's Central Park is an island of trees and grass in a sea of concrete.

Demand for Wildlife Products

- Some animals species have been hunted to extinction for food or other products.
  - meat, fur, hides, horns, tusks
- Hunting threatens rare animals in Africa, South America, and Southeast Asia.
- CITIES bans international trade in products derived from a list of endangered species.
- Today, endangered species are protected from hunting.

Pollution

- DDT is a historical case of a pesticide being passed through the food chain.
  - Nonbiodegradable (cannot be broken down)
  - Not eliminated form an organisms body
- Because it remains stored in an organisms tissues, it has the ability to be passed through the food chain.


Magnification of
DDT Concentration
Fish-Eating Birds
10,000,000
Large
Fish
1,000,000
Small Fish
100,000
Zooplankton
10,000
Producers
1000
Water
1

- Biological magnification is a process where concentrations of a harmful substance increase in organisms at higher trophic levels in a food chain or food web.
- DDT caused egg shells of osprey, brown pelicans and eagles to thin threatening survival.
- Banned in early 1970's in the U.S.
- Populations of endangered birds has recovered.

Introduced Species

- Apparently harmless plants and animals are introduced into new habitats.
- Invasive species reproduce rapidly because their new habitats lack predators that control their population.
  - Zebra mussels (Great Lakes)
  - Cane toads (Australia)
  - Leafy spurge (Northern Great Plains)

Conserving Biodiversity

- Conservation is used to describe the wise management of natural resources.
- The modern science of conservation biology seeks to protect biodiversity.

Strategies for Conservation

- Manage individual species to keep them from becoming extinct.
  - Zoos have captive breeding programs (ferrets)
- Protecting entire ecosystems
- Ensures that the natural habitat and many species are preserved at the same time
  - Parks and preserves
  - Marine sanctuaries

- "Hot spots" have been designated as a priority location where significant numbers of habitats and species are in immediate danger.

Conservation Challenges

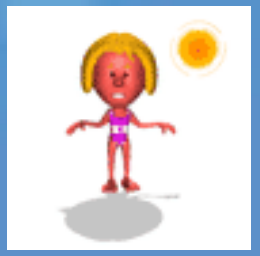
- Protecting resources for the future can require people to change the way they earn their living today.
- Conservation efforts attempt to maximize benefits while minimizing economic costs.

Charting a Course for the Future

Section 6-4

Ozone Depletion

- Ozone layer is 20-50 kilometers above the Earth's surface.
- Molecules of ozone consist of O_3.
- Ozone at ground level is a pollutant.
- The ozone layer absorbs the harmful UV rays from the sun.
- Overexposure to UV rays causes:
  - sunburn
  - cancer
  - damages eyes
  - decreases and organisms' resistance to disease



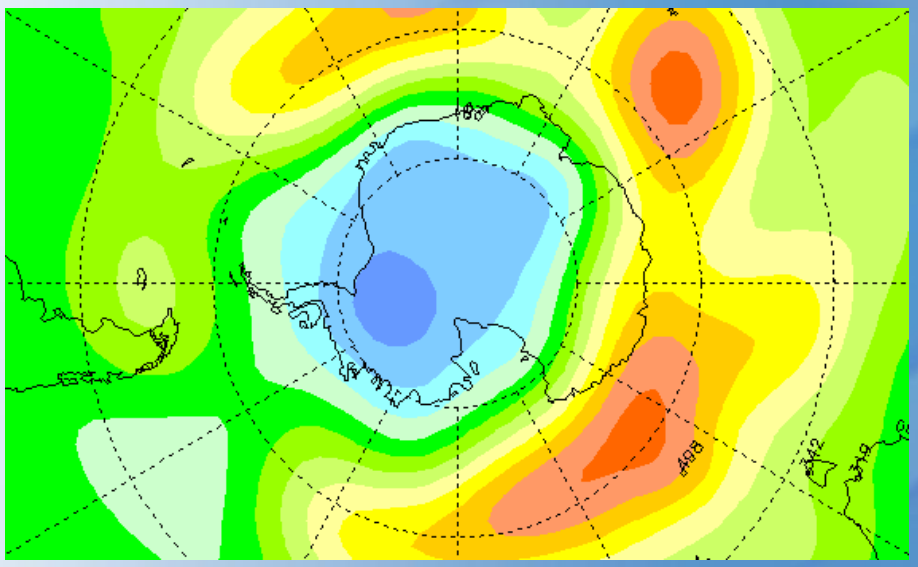
- The ozone layer serves as a global sunscreen.
- In 1970's scientists found a "hole" over Antarctica during winter.
- That hole has grown larger and a similar "hole" has now appeared over the Arctic.
- Gases called chloroflurocarbons, or CFCs were found to damage the ozone layer.

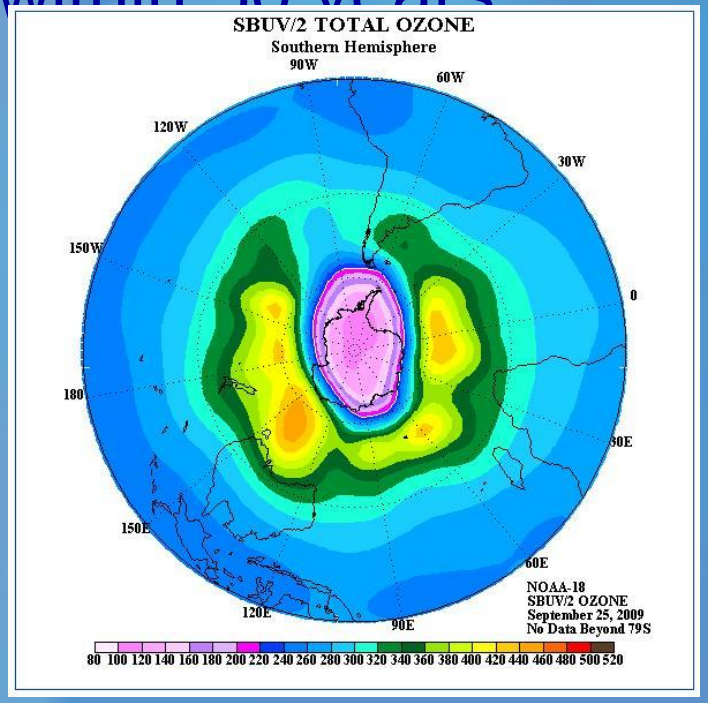
  - CFCs were used in:
    - Aerosol cans

    - Coolant in refrigerators, freezers, and air conditioners

    - Production of plastic foams

- In 1987, the U.S., and many nations began reducing the use of CFCs.
- Today, most uses of CFCs are banned.
- Current data that the ozone holes should shrink and disappear within 50 years





1980

http://www.theozonehole.com/

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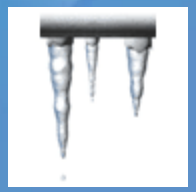
Global Climate Change

- Since the late 19th century, average temperatures on Earth's surface have risen about 0.6 Celsius degrees.
- Since 1980, average temperatures have risen between 0.2 and 0.3 Celsius degrees.
- The 1990s were the warmest decade ever with 1998 the warmest since record keeping began.
- Global warming is the increase in average temperature of the biosphere.
- One sign is melting of polar ice.



Evidence of Global Warming

- Researchers must determine whether the current warming trend is part of a larger, natural cycle of climate change, or whether it is caused by human activity.
- The most widely accepted hypothesis is the warming is related to human activities that are adding carbon dioxide and other greenhouse gases to the atmosphere faster than the carbon cycle can remove it.
- The atmosphere is now retaining more heat.

Possible Effects of Global Warming

- Average global surface temperatures will increase 1 to 2 Celsius degrees by the year 2050.
  - Sea levels may rise enough to flood some coastal areas.
  - Parts of North America may experience more droughts during the summer growing season.
- Long-term change in climate will affect ecosystems and threaten the organisms that live there.

The Value of a Healthy Biosphere

- The scientists concern with these changes is due to the importance of the goods and services we get from the environment.
  - Water purification to waste recycling
  - Pollination of many crop plants by insects
  - Reservoir of new medicines and new varieties of crops
- People must make wise choices in the use and conservation of resources.