Ecological Footprints

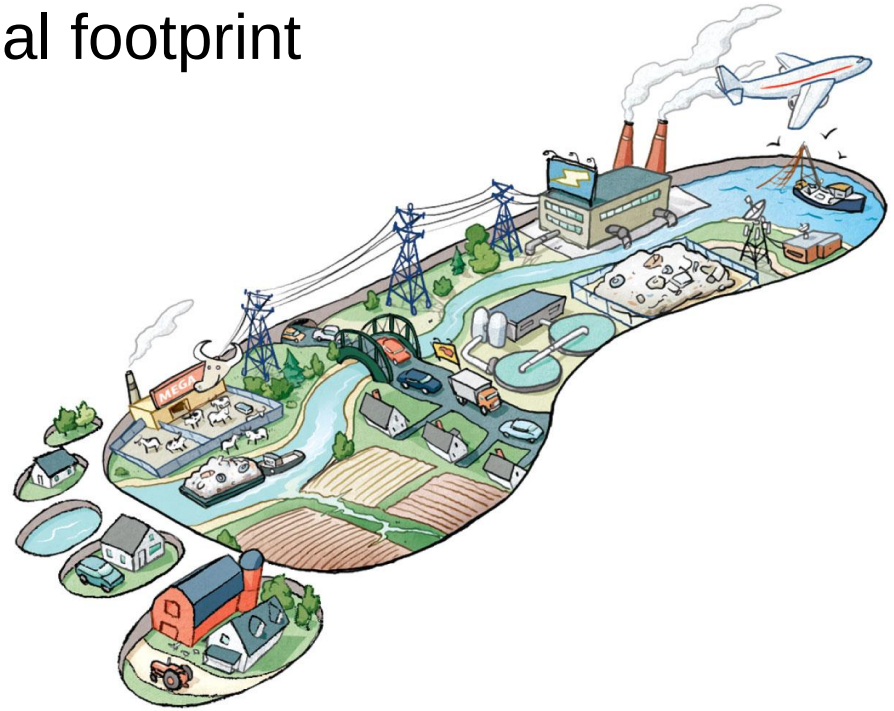
Learning Objectives

- Explain how the ecological footprints of typical Americans compare to the global average.
- Describe the Anthropocene.

Our Changing Ecological Footprints

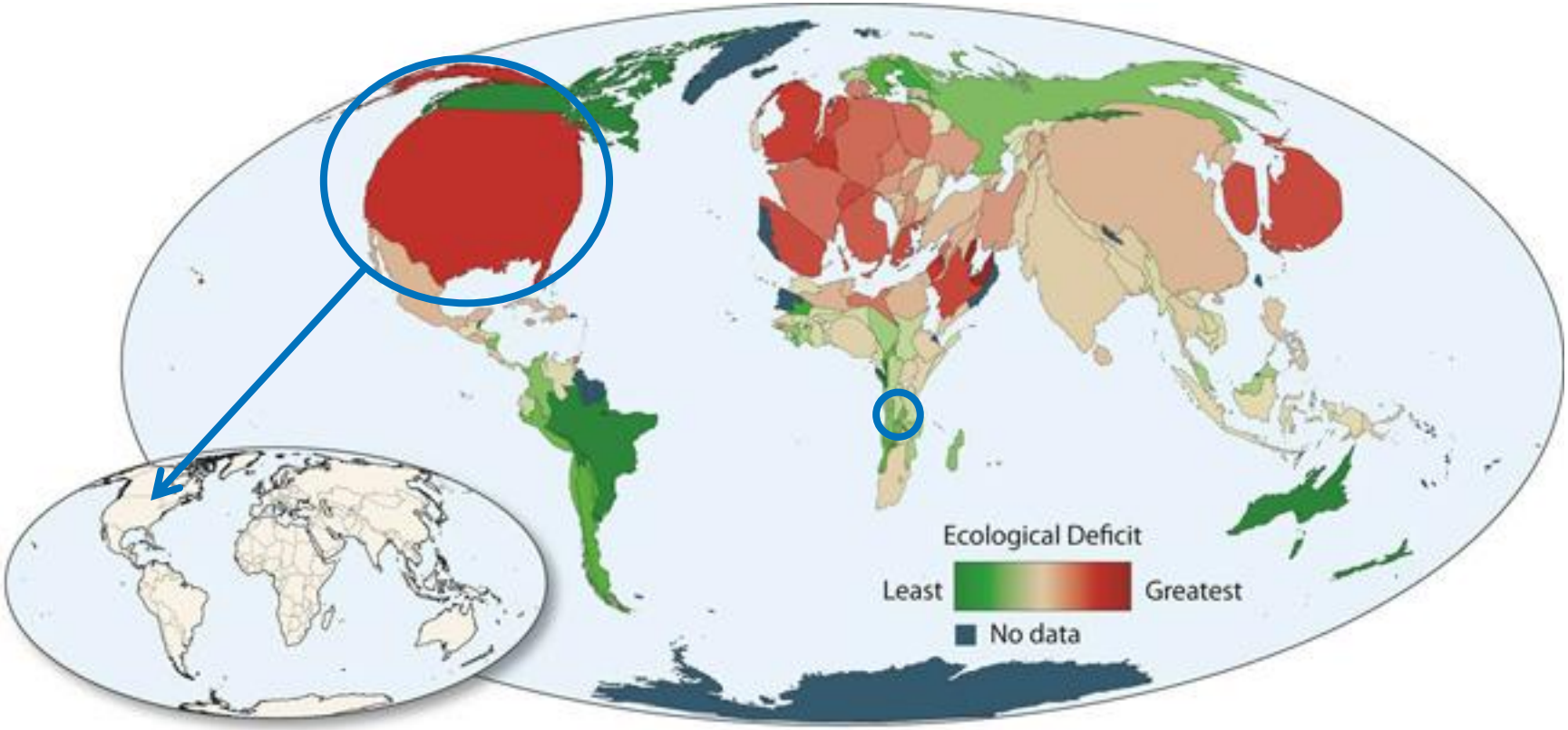
Ecological footprint: the total area of healthy land and water ecosystems needed to provide the resources you use.

*Calculate your ecological footprint using the handout



National and Global Ecological Footprints

The average American has an ecological footprint over four times larger than the global average.

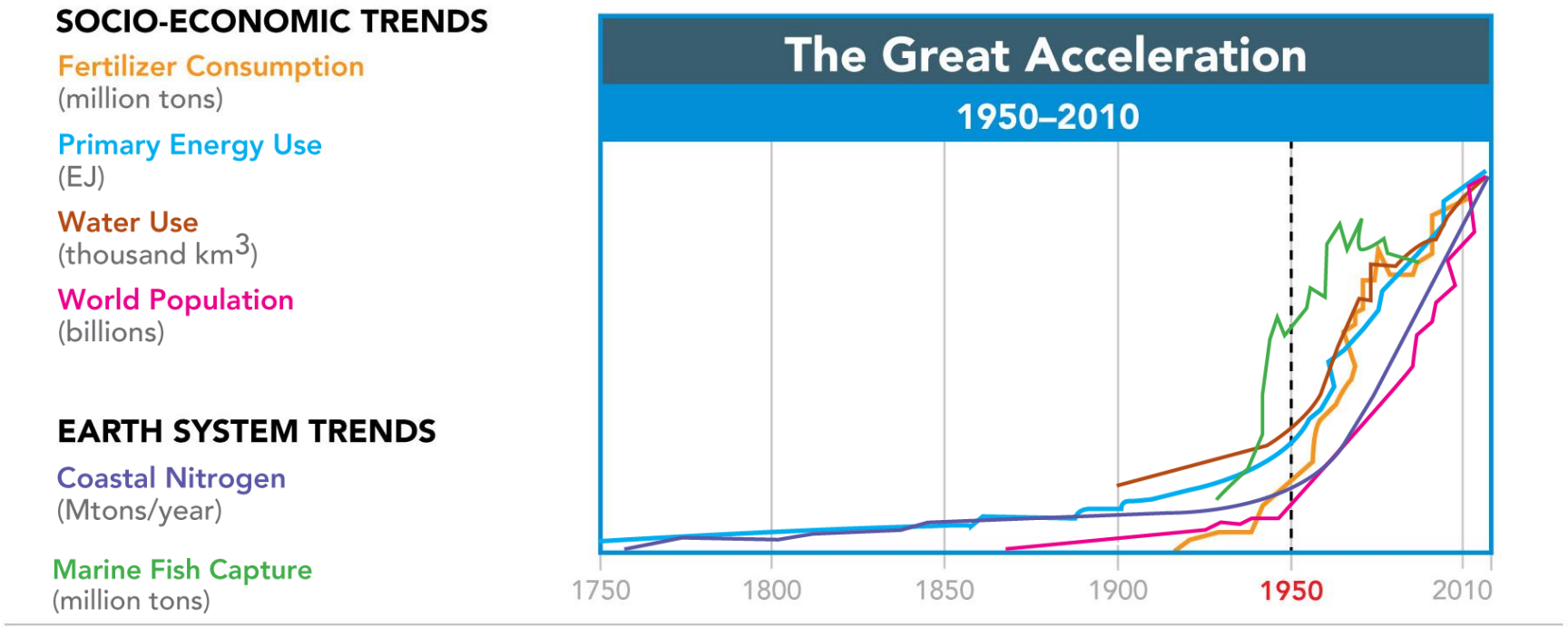


The Age of Humans

The Great Acceleration

- Started during the 1950s

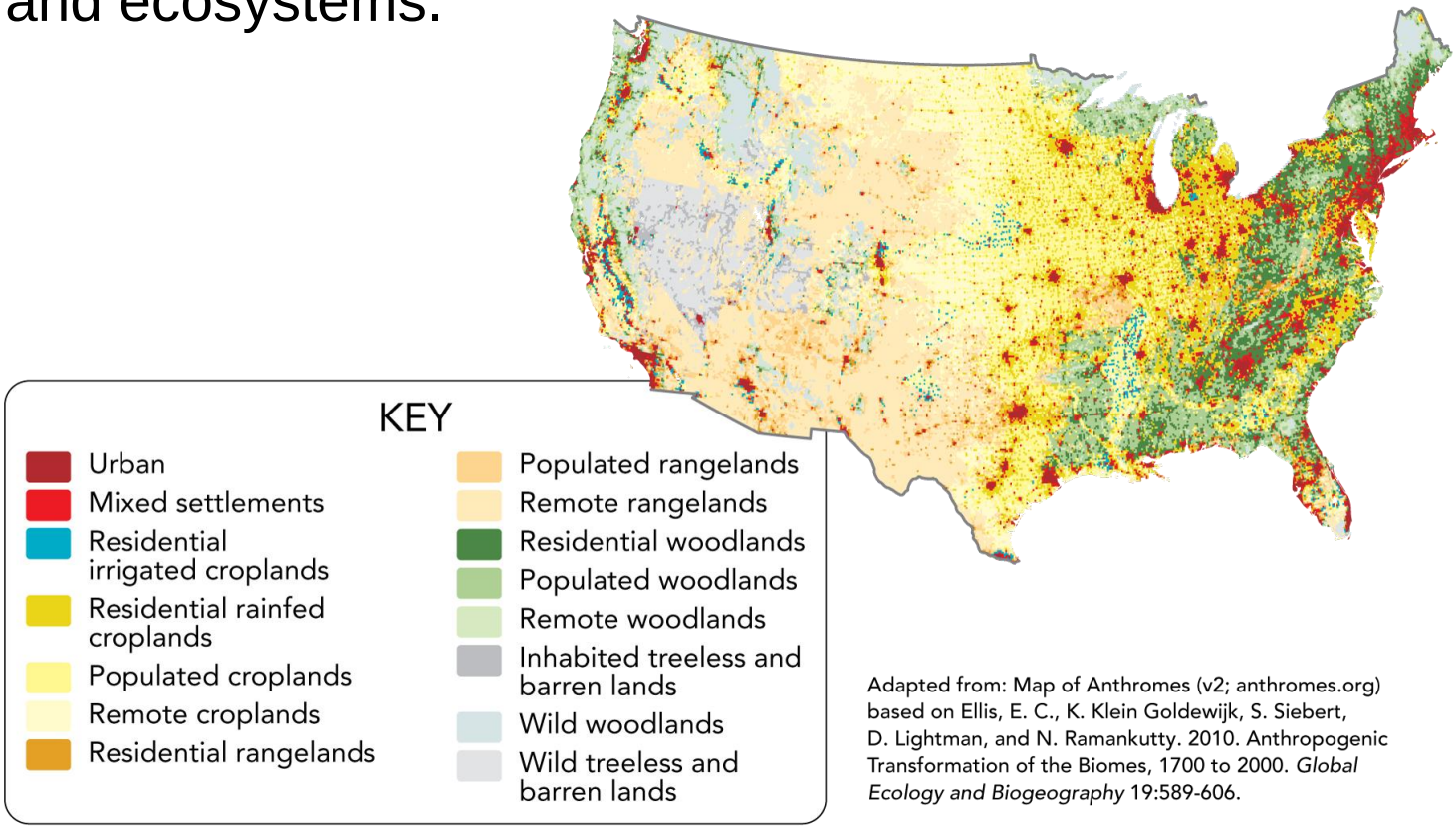
*with your group make 5 observations about the graph



Sources: (1) Olivier Rousseau, IFA; IFA database. (2) A Grubler, International Institute for Applied Systems Analysis (IIASA); Grubler et al. (2012). (3) M Flörke, Centre for Environmental Systems Research, University of Kassel; Flörke et al. (2013); aus der Beek et al. (2010); Alcamo et al. (2003). (4) HYDE database; Klein Goldewijk et al. (2010). (5) Mackenzie et al. (2002). (6) Data are from the FAO Fisheries and Aquaculture Department online database (Food and Agriculture Organization-FIGIS (FAO-FIGIS), 2013).

Anthromes: Human-Altered Biomes

- Human-altered biomes are referred to as **anthromes.**
- Anthromes are globally significant ecological patterns created by long-term interactions between humans and ecosystems.



Adapted from: Map of Anthromes (v2; anthromes.org) based on Ellis, E. C., K. Klein Goldewijk, S. Siebert, D. Lightman, and N. Ramankutty. 2010. Anthropogenic Transformation of the Biomes, 1700 to 2000. *Global Ecology and Biogeography* 19:589-606.

Extension:

With your group, discuss your ecological footprints and determine 5 strategies that people can use to reduce their ecological footprint the most.

Be prepared to explain them

Causes and Effects of Global Change

Learning Objectives

- Explain how human activities change the atmosphere and climate.
- Describe how changes in the atmosphere drive climate and other changes in global systems.
- Explain how human land uses can cause changes in global systems.
- Portray the different kinds of pollution that lead to global changes.

Changing Atmosphere and Climate

Data gathered confirm that atmospheric carbon dioxide levels have been increasing since the Industrial Revolution. In addition, data show that most of the carbon dioxide that is released comes from burning fossil fuels.

- **Climate change**: measurable long-term changes in averages of temperature, clouds, winds, precipitation, and the frequency of extreme weather events
- **Global warming:** increase in average global temperatures

- Watch BP: Climate Change

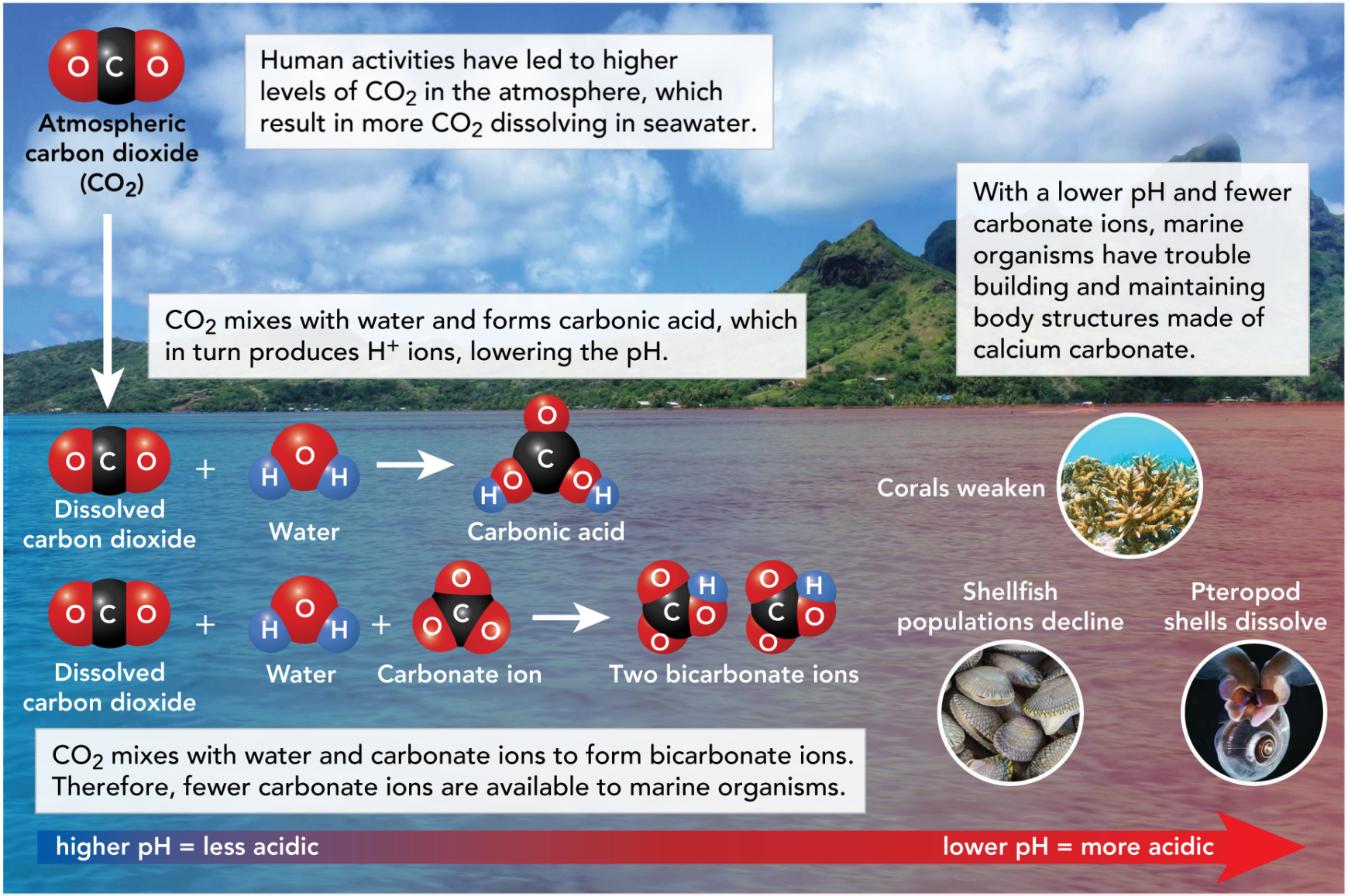
Threats to the Environment and Biodiversity

1. Climate Change-
    a) acid rain
    b) ocean acidification
    c) nitrogen enrichment
2. Changes in land use-
    a) Deforestation
    b) effects of agriculture
3. Development/Urbanization-
4. Habitat Changes-
    a) habitat loss
    b) habitat fragmentation
    c) habitat restoration
    d) hunting/fishing
    e) Invasive species

Threats to the Environment and Biodiversity

5. Pollution-
    a) CFCs/Stratospheric Ozone
    b) Ground level Ozone
    c) Industrial/Agricultural Pollution
        1) Biological Magnification

Ocean Acidification



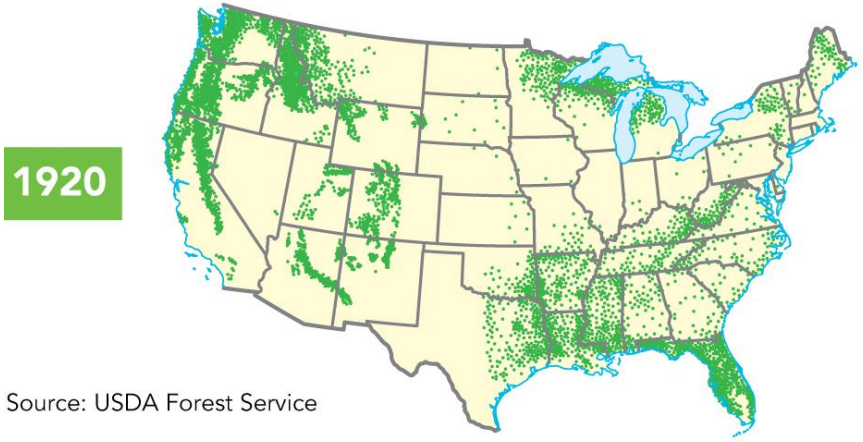
Changes in Land Use

Healthy forests:

- protect fresh water
- absorb carbon dioxide
- moderate climate

Deforestation, or loss of forests, can have negative effects on soil quality.

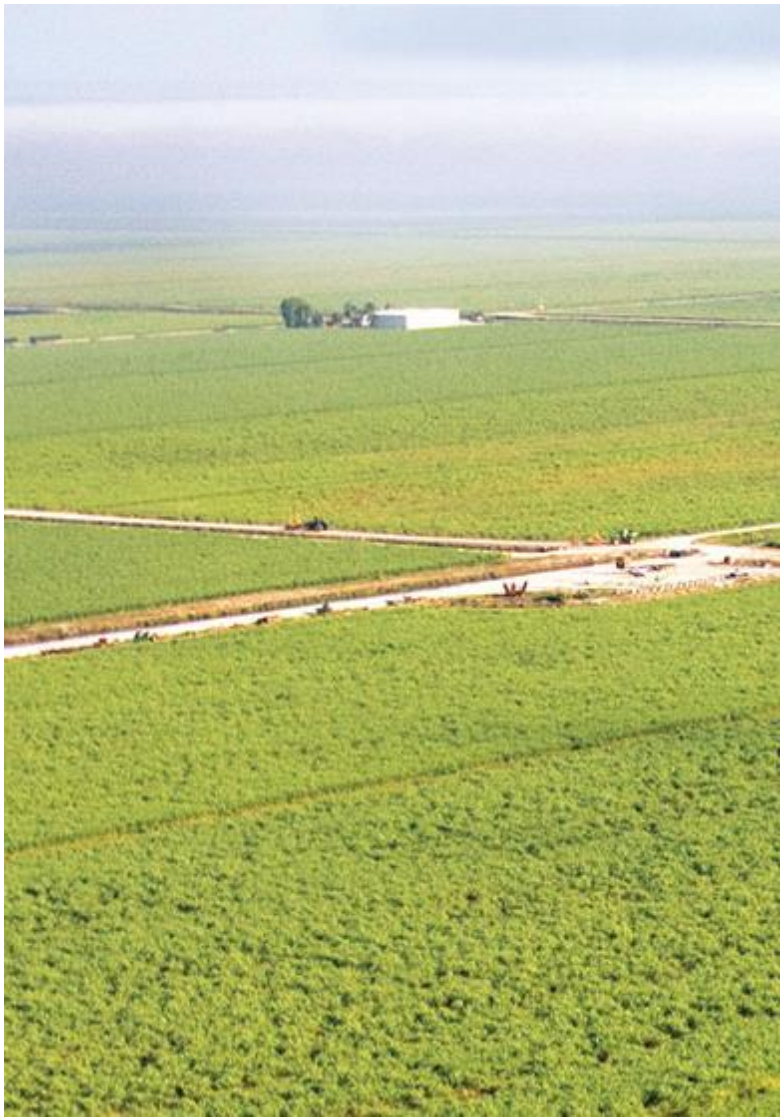
Source: USDA Forest Service



Source: USDA Forest Service

Monoculture

Monoculture involves planting large areas with a single highly productive crop year after year.



Habitat Loss, Fragmentation, and Restoration

- **Habitat loss:** When natural habitats are completely changed, species that once lived in that area can be lost to human development.
- **Habitat fragmentation:** causes biodiversity loss and makes ecosystems more vulnerable to other disturbances.
- **Habitat restoration:** ecological restoration recreates conditions that resemble an ecosystem that previously existed.

Threats to Biodiversity

Fragmentation of Habitat

- The separation of an ecosystem into small pieces of land is called habitat fragmentation.
- The smaller the parcel of land, the fewer species it can support.
- Fragmentation reduces the opportunities for individuals in one area to reproduce with individuals from another area.
- Carving the large ecosystem into small parcels increases the number of edges—creating edge effects.

Development/Urbanization

- As societies develop, more people move to cities and suburban areas.
- Dense communities of people produce large amounts of wastes.
- If wastes are not disposed of, they can affect air, water, and soil resources.

Invasive Species

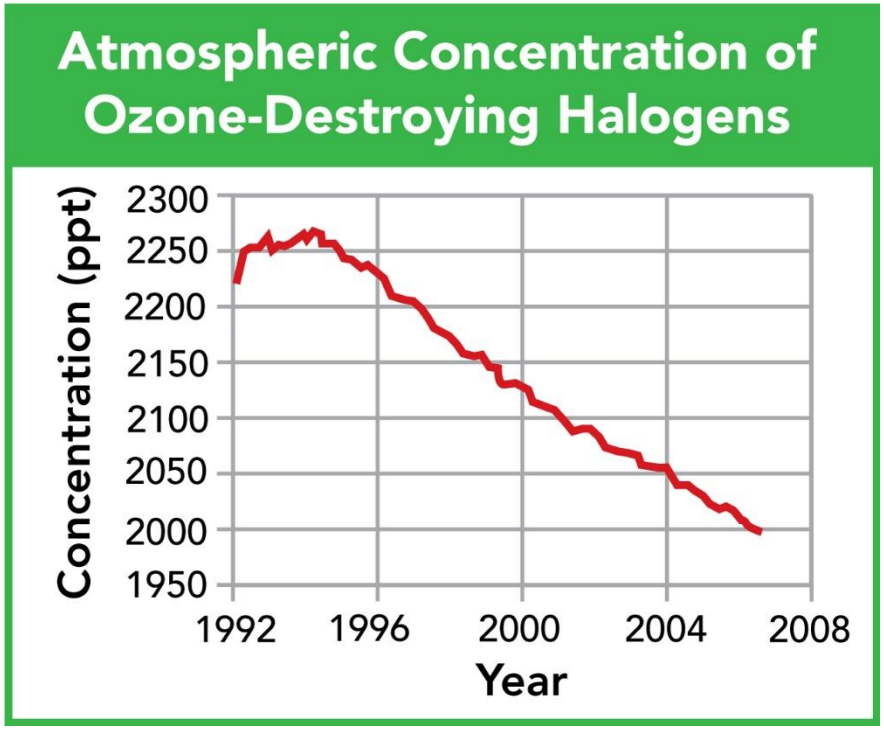
Organisms introduced to new habitats can become invasive.

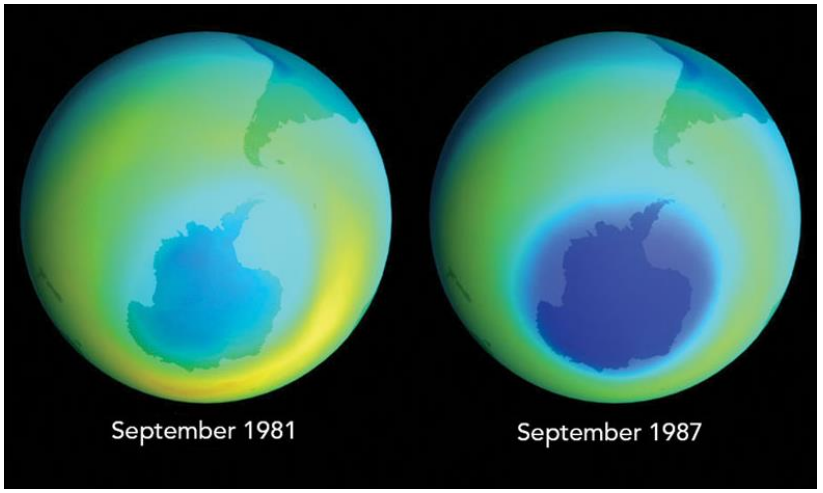
Many invasive species are carried to new habitats by human trade and travel.

CFCs and Stratospheric Ozone

CFCs are industrially produced gases. A few decades ago, these were banned because of their impact on the ozone layer.

The ozone layer absorbs ultraviolet light.



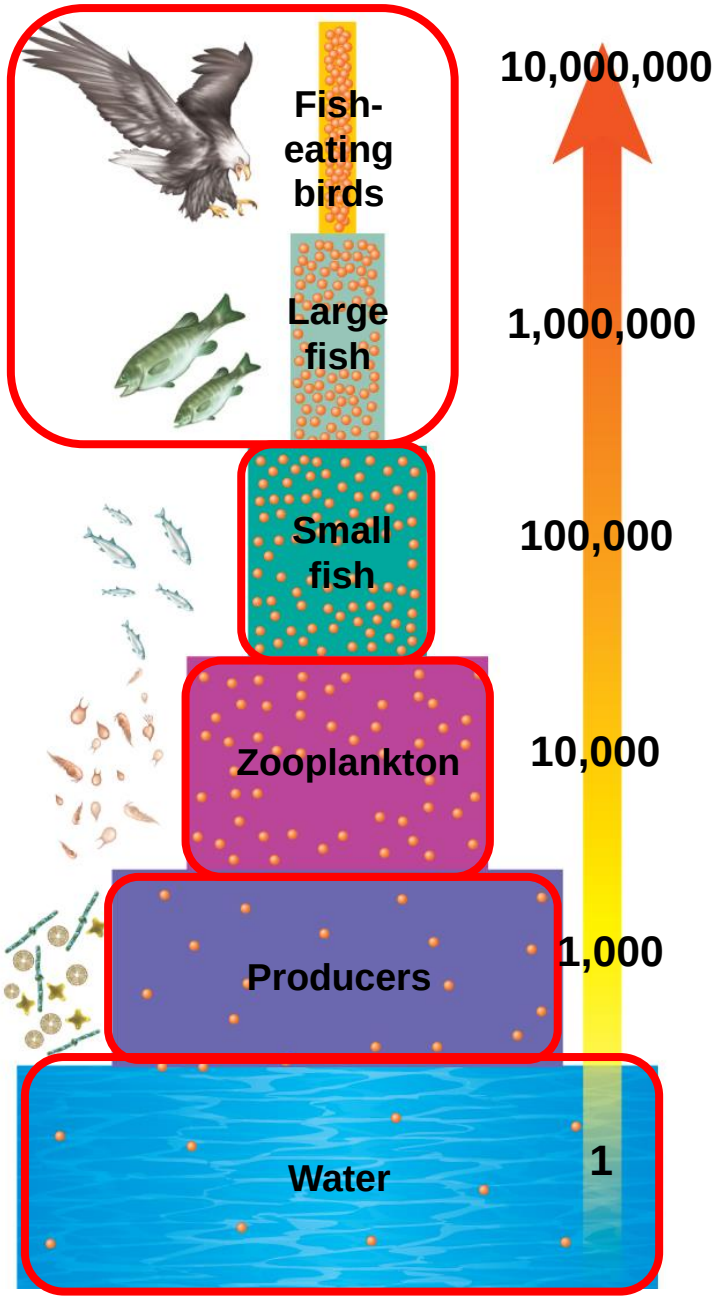


Threats to Biodiversity

- Watch the Amoeba Sisters: Biomagnification https://www.youtube.com/watch?v=TZk6vcmLcKw
- Do Biomagnification and Bioaccumulation Activity
- Fish in your diet article
- Minimata Disease

Industrial and Agricultural Pollution

- Industrial and agricultural chemicals
- Residential sewage
- Nonpoint sources

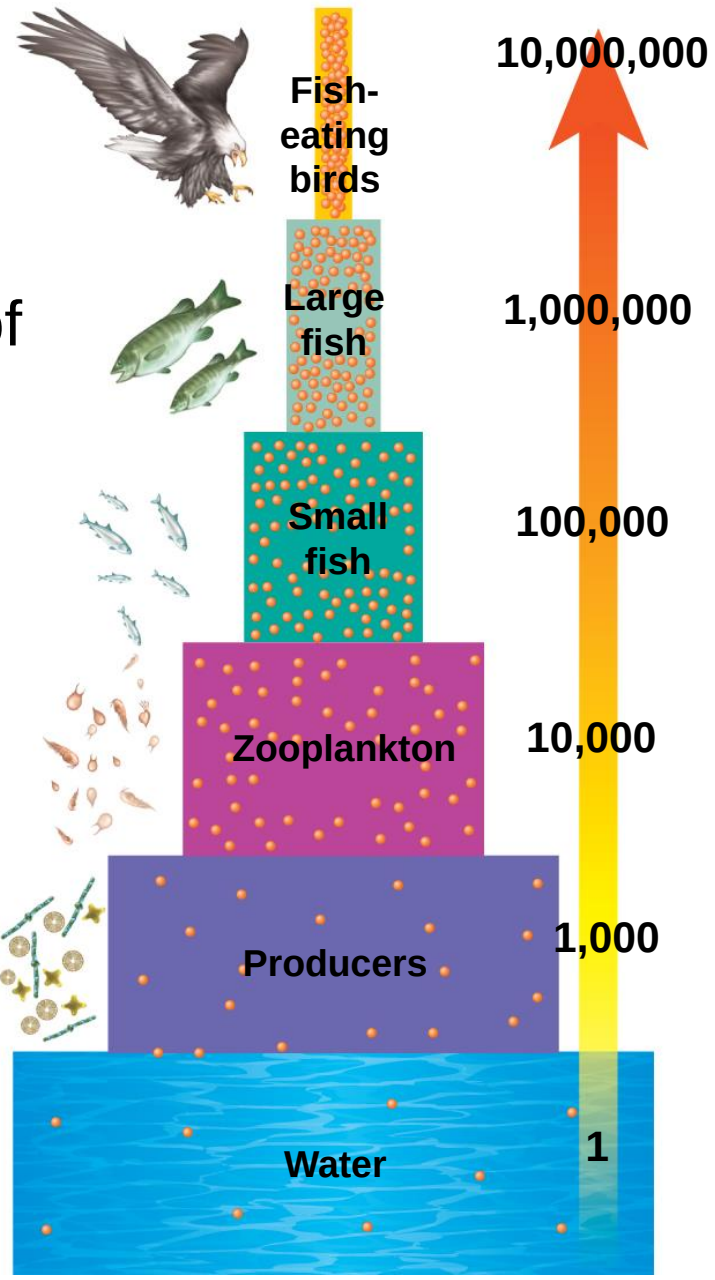


Biological Magnification

In a food chain, the concentration of a pollutant _____ as the number of organisms at a trophic level _____ .

increases

decreases



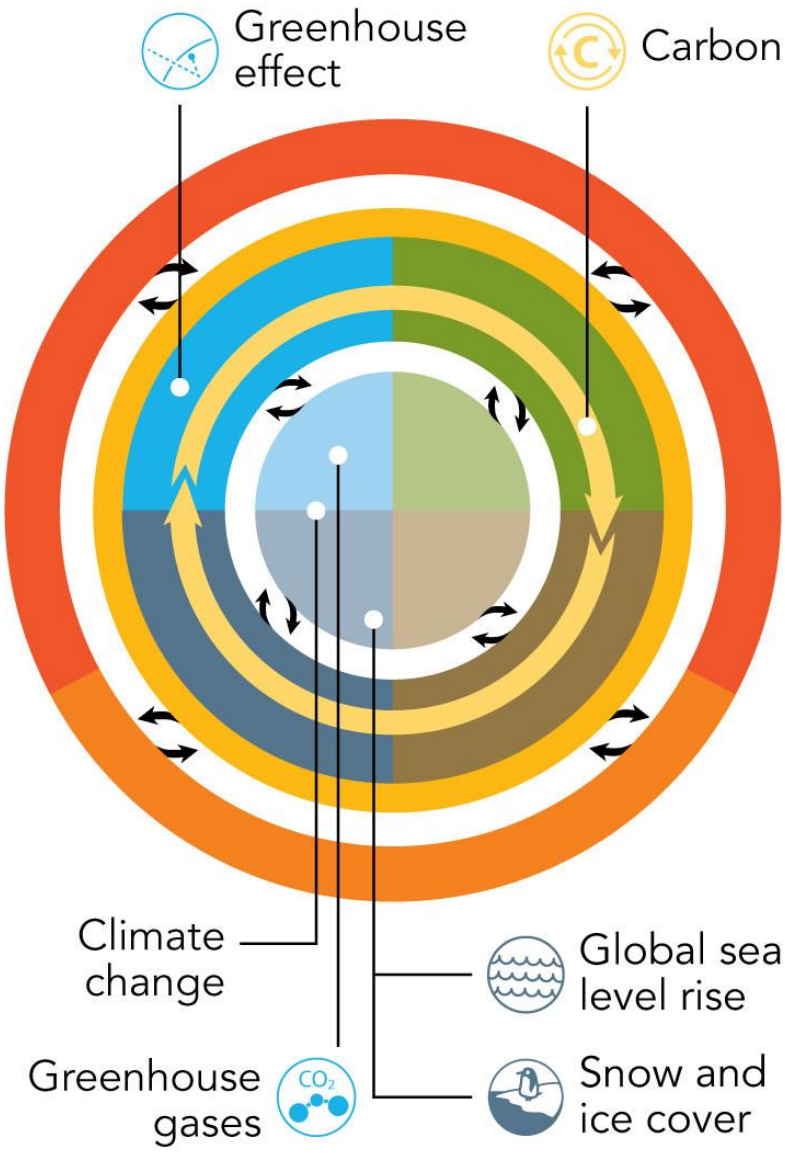
Measuring and Responding to Change

Learning Objectives

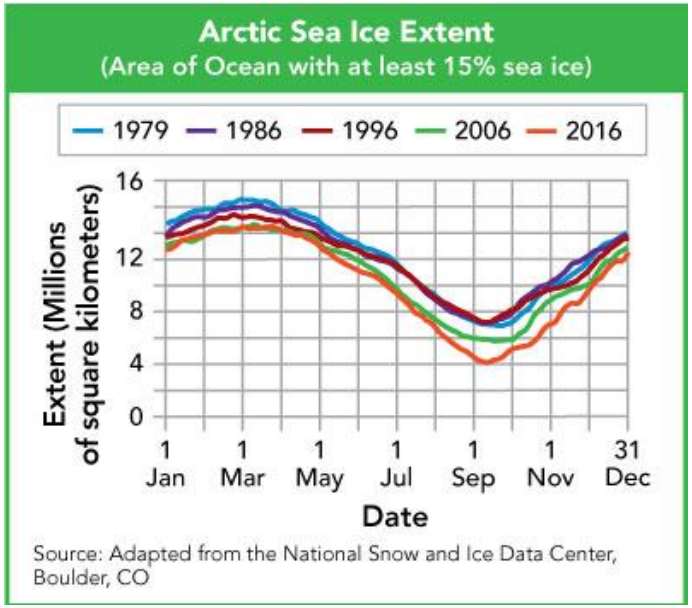
- Examine evidence that supports the claims that the climate is changing.
- List some impacts of climate change.
- Explain the role of science in responding to global change.

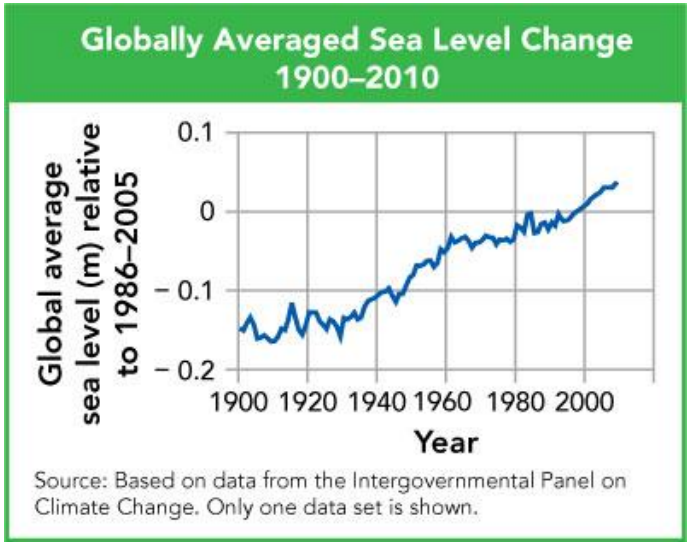
Climate Change: The Data

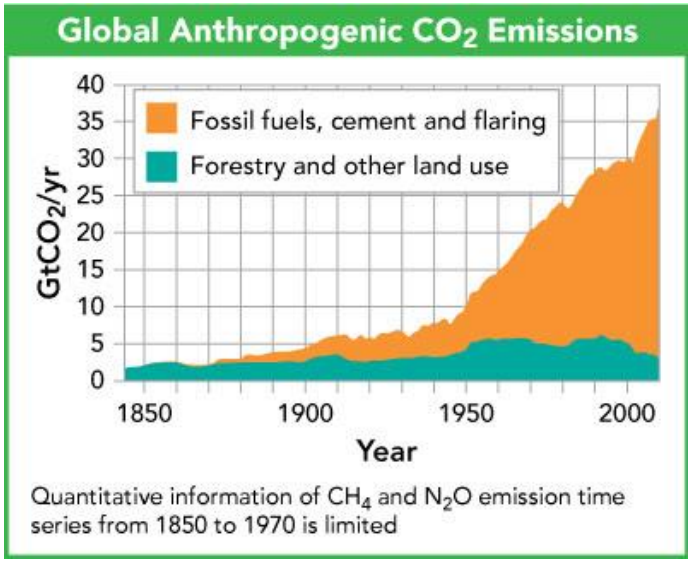
Data show that both the atmosphere and the oceans have been warming; that sea levels are rising; and that Arctic sea ice, glaciers, and snow cover are all decreasing.



IPCC Climate Data

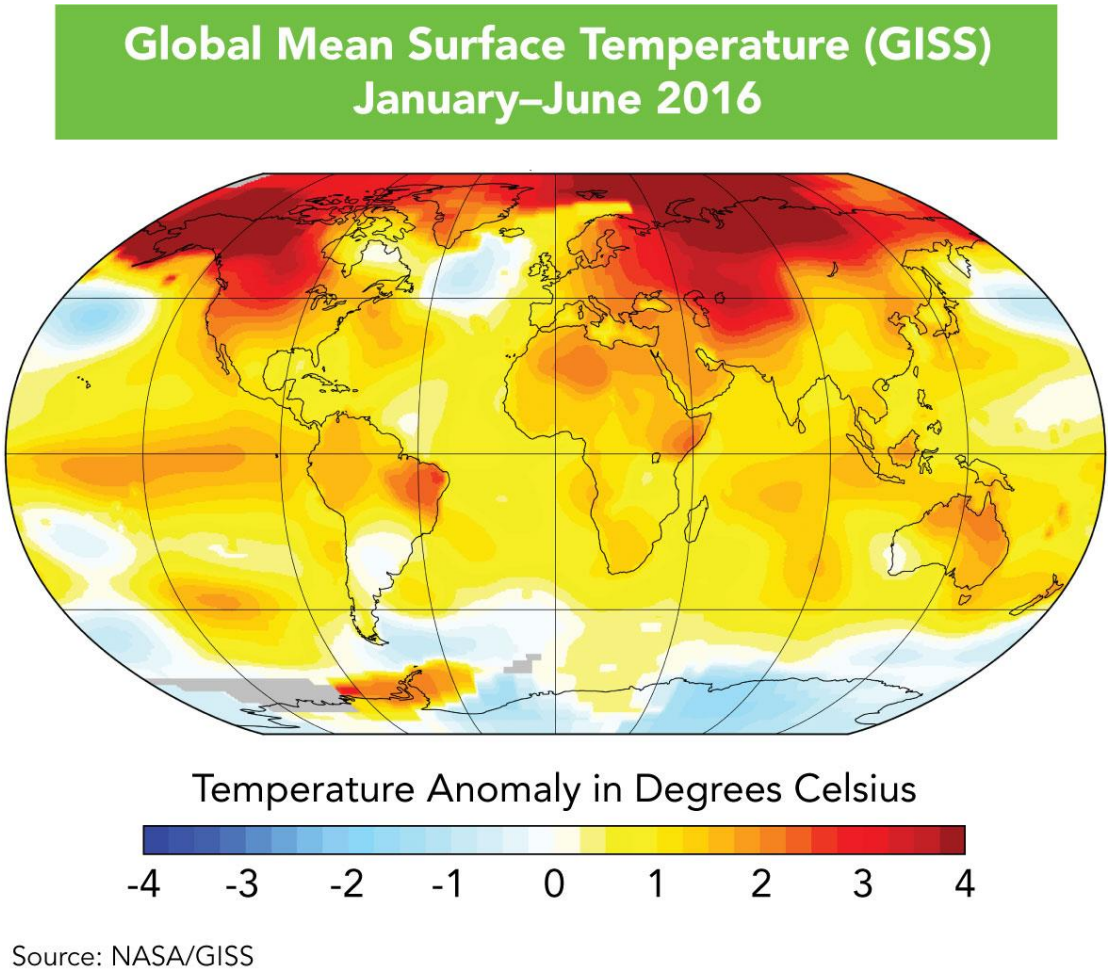






Climate Change Impacts

- Total precipitation and seasonal distribution of precipitation are changing.
- Heat waves are expected to become longer and more intense.
- Many areas will experience more episodes of extreme heat and storms.



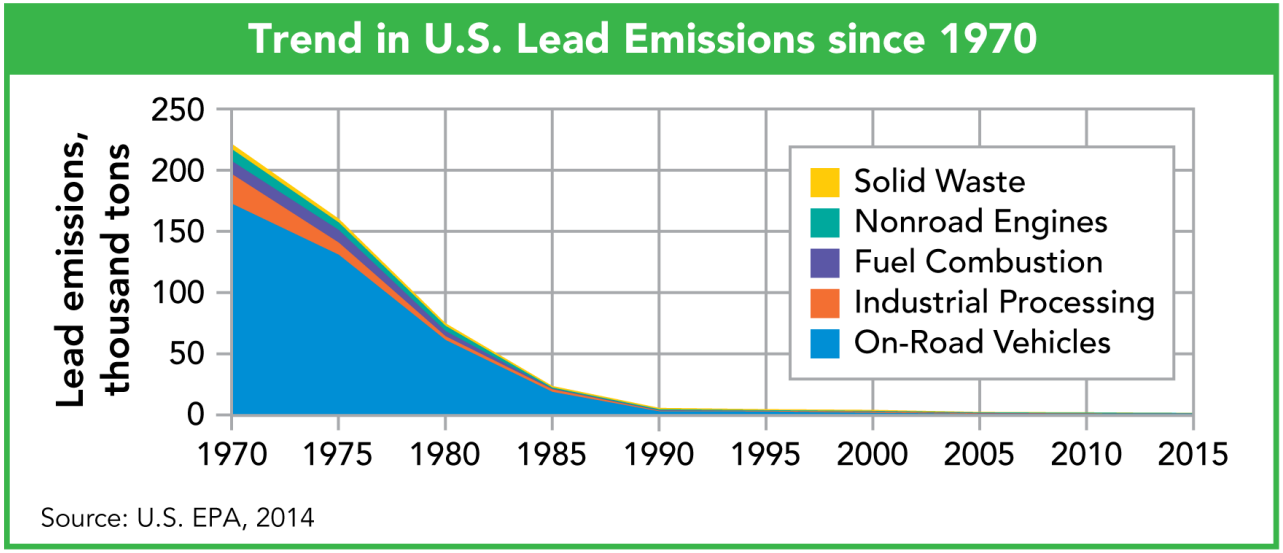
Designing Solutions

Scientific research can have a positive impact on the global environment by:

- recognizing a problem in the environment
- gathering data to document and analyze the problem and identify its cause; and
- guiding changes in our behavior based on scientific understanding

Environmental Successes

- Lead in drinking water
- Banning of CFCs
- Organisms being taken off endangered or threatened lists



Sustainability

Learning Objectives

- Identify the criteria that can be used to evaluate whether development is sustainable.
- Explain why innovation and resilience are important.

Sustainable Development

Using resources in ways that preserve ecosystem services is called **sustainable development.**

Sustainable development recognizes the links between ecology and economics.

United Nations Sustainable Development Goals

The United Nations has set 17 goals for sustainable development.

Sustainable development goals must not only enable people to survive, but to improve their situation.

Renewable Resources

Renewable resource: a resource that can be produced by a healthy ecosystem.

A single tree is renewable because a new tree can be planted in place of an old tree if it dies or is cut down.

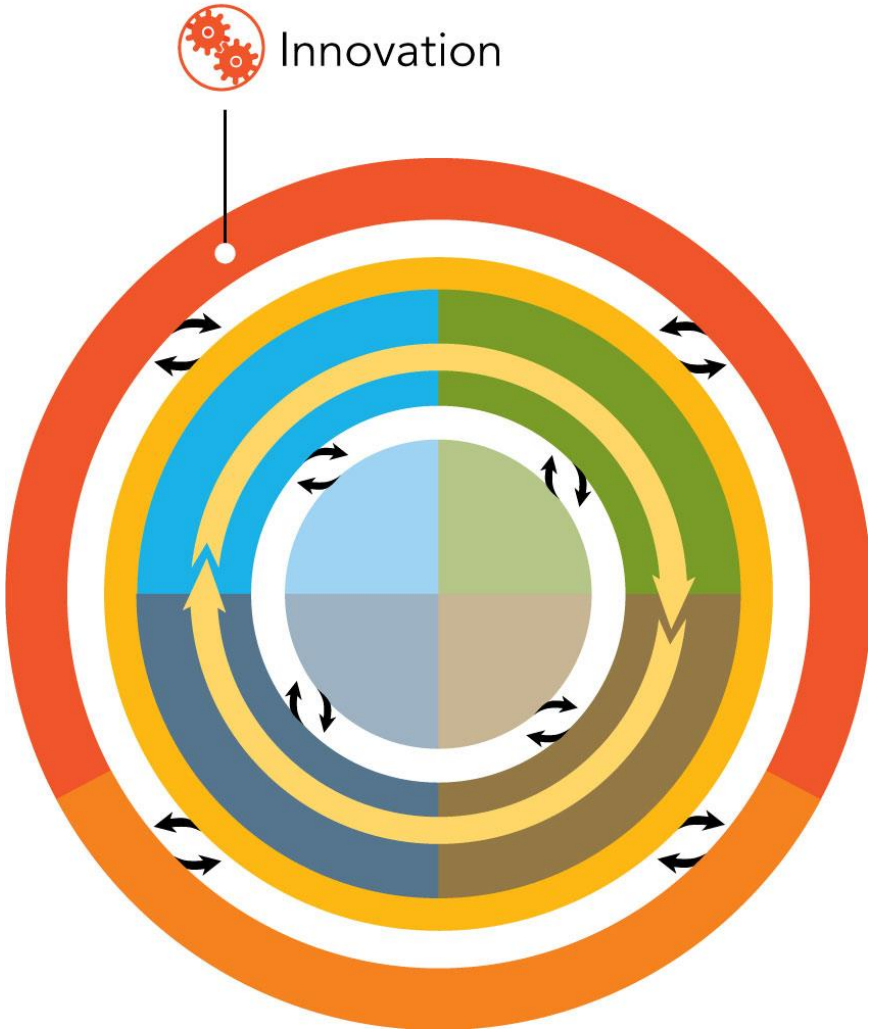
Nonrenewable Resources

Nonrenewable resource: a resource that cannot be replenished or replaced by a natural process.

Fossil fuels are nonrenewable because they come from buried organic materials that are millions of years old. When existing deposits are depleted, they are gone.

Innovation and Resilience

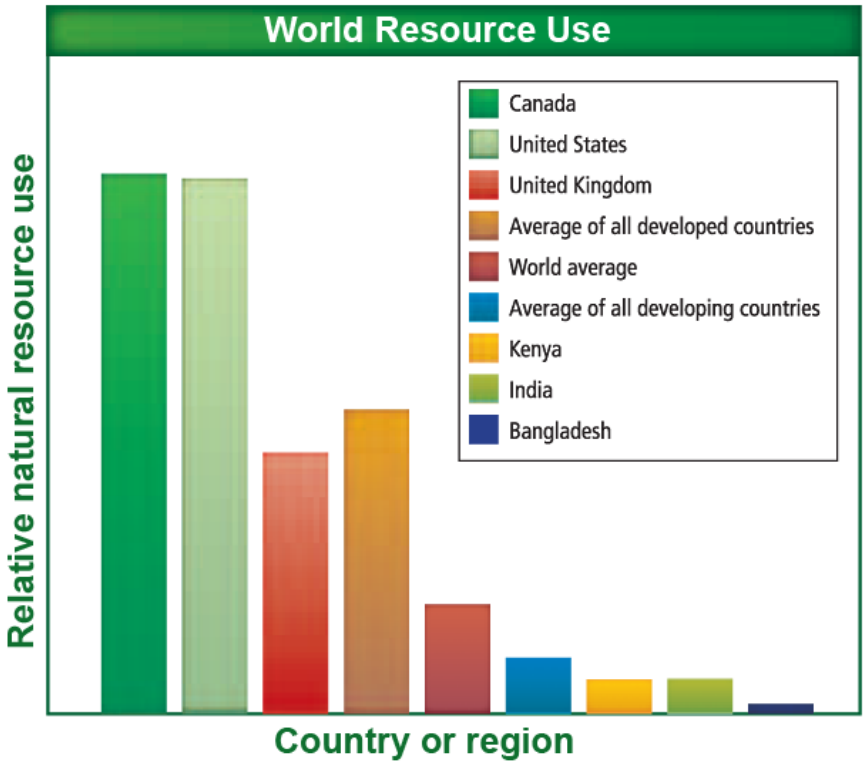
- **Resilience:** the ability to deal with change
- Sustainable development must be flexible enough to survive environmental stresses like droughts, floods, storms, and heat waves or cold snaps.



Conserving Biodiversity

Natural Resources

- The consumption rate of natural resources is not evenly distributed.



Conserving Biodiversity

- Resources that are replaced by natural processes faster than they are consumed are called renewable resources.
- Resources that are found on Earth in limited amounts or those that are replaced by natural processes over extremely long periods of time are called nonrenewable resources.

Conserving Biodiversity

- Sustainable use means using resources at a rate in which they can be replaced or recycled while preserving the long-term environmental health of the biosphere.

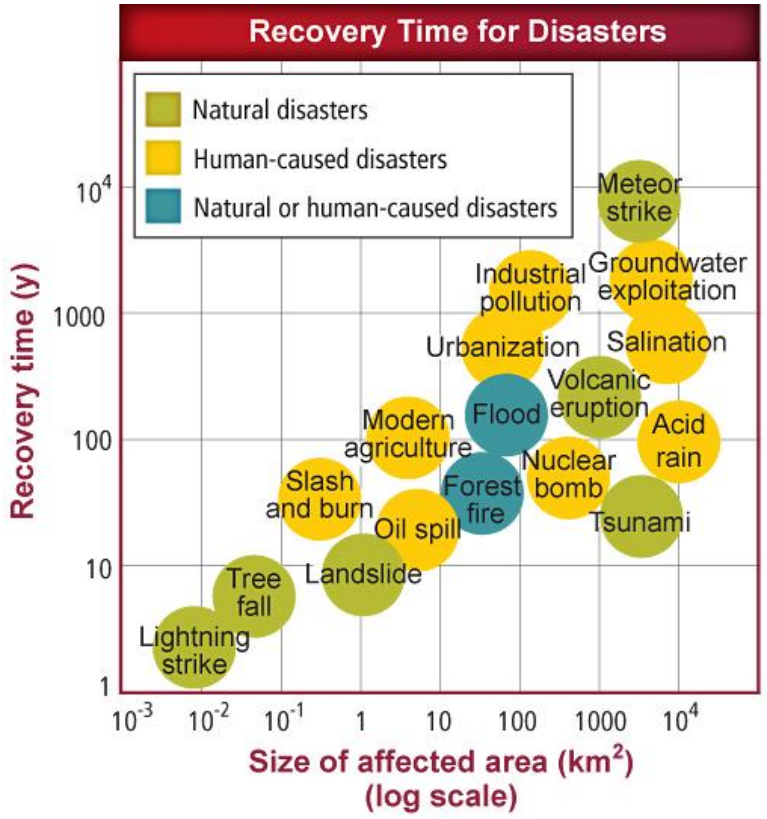
Lake Jackson Wildlife Corridor

High numbers of turtles being hit by cars on North Monroe Street

Remains of 90 road-killed turtles found along a 1/3 mile stretch of US Highway 27 at Lake Jackson in one day in February 2000, prior to construction of temporary fence

Lake Jackson Wildlife Corridor

Conserving Biodiversity



Restoring Ecosystems

- The larger the affected area, the longer it takes for the biological community to recover.

Conserving Biodiversity

Bioremediation

The use of living organisms, such as prokaryotes, fungi, or plants, to detoxify a polluted area is called bioremediation

Local Example:
Plants are used in the pond by the Tallahassee Mall to filter the water.

Conserving Biodiversity

Biological Augmentation

- Adding natural predators to a degraded ecosystem is called biological augmentation.