Kickoff (9/3/13):
Let's say that a deer consumes 2,000 g of foraging material in a 24 hour period. If an area has 40,000 kg of foraging material, and there are 25 deer in the population, how many days until all the foraging material is gone?

What would happen after the end of that time?

How is the carrying capacity affected?

"Population Dynamics" worksheet

Problems:

1. How many deer may be supported within the entire area show on the "Deer Distribution Map"? Use the "Land Area, Forage, and Deer Distribution Chart" for help on this answer. 131 deer.

2. Referring to the map, if deer could be confined to individual areas, how many deer could be supported in Open field A? Open field B? Pine forest I? Pine forest II?

67 50 9 5

3.a. If a housing development were to be built in open field A, what percentage of the deer habitat would be lost? 38%

b. What percentage of the total deer herd would theoretically be lost? 51%

c. If open field A were developed, where would the deer from this area go?

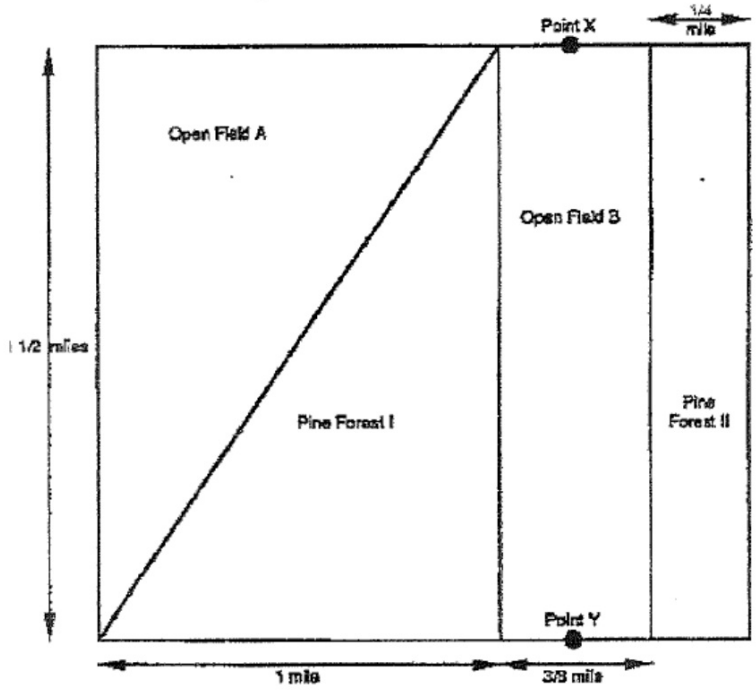
d. What would the effect be on the surrounding areas?

4.a. A proposal to build a highway has been submitted to the municipality where the map area is located. The highway would run from Point X to Point Y in Open Field B. If built, this highway will destroy a 101 foot wide portion of the habitat. What percentage of the deer habitat will be lost? 1.2%

b. How many deer will be theoretically eliminated in Open Field B if this highway is built?

c. If the proposed highway were to be built in Pine Forest II instead of Open Field B, would a larger or smaller number of deer theoretically be eliminated?

Deer Distribution Map



Land Area, Forage, and Deer Distribution Ch

Land Type	Area in Square Feet	Area in Acres	Amount of Forage Produced/Year in Pounds
Open Field A	20,908,800	480	240,000
Pine Forest I	20,908,800	480	33,600
Open Field B	15,681,600	360	180,000
Pine Forest II	10,454,400	240	16,800
Total Area	67,953,600	1,560	470,400

VOLUME

1 acre of open field = 500 pounds of forage per year
1 acre of pine forest = 70 pounds of forage per year
1 adult deer requires 3,600 pounds of forage per year to survive

LENGTH

¼ mile = 1,320 feet
3/8 mile = 1,980 feet
1 mile = 5,280 feet
1½ miles = 7,920 feet

AREA

1 acre = 43,560 square feet

Kickoff (9/4/14):

Scientists hypothesize that the use of certain pesticide is causing a decline in the population of honeybees. How would the continued use of pesticides most impact the environment?

Kickoff (9/7/12):

1. State two reasons why we should value biodiversit

2. What is the biggest threat to biodiversity? Name another threat to biodiversity.

Kickoff (9/8/14):

1. List three ways that humans can affect our environment.

2. Explain the steps that lead to eutrophication.

3. Explain biomagnification

Step 1. Excess nutrient (N,P)

2. algal bloom

3. Bacterial decomposition/respiration

4. O_2↓

5. fish kill

Sources
- fertilizer run
- agricultural r
- sewage d.s
- industrial w

16.1 Human Population Growth And Natural Resources

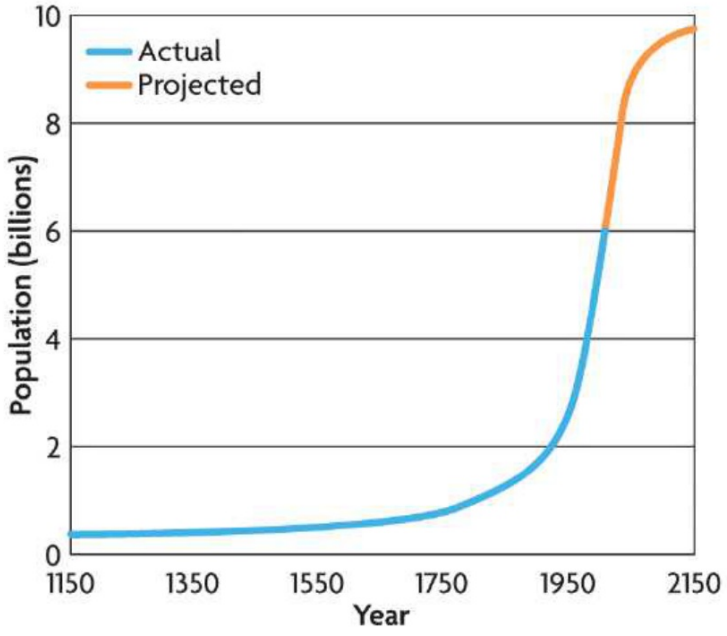
KEY CONCEPT

As the human population grows, the demand for Earth's resources increases.

16.1 Human Population Growth And Natural Resources

Earth's human population continues to grow.

- Earth's human carrying capacity is unknown.



16.1 Human Population Growth And Natural Resources

- Technology has helped to increase Earth's carrying capacity.
  - gas-powered farm equipment
  - medical advancements

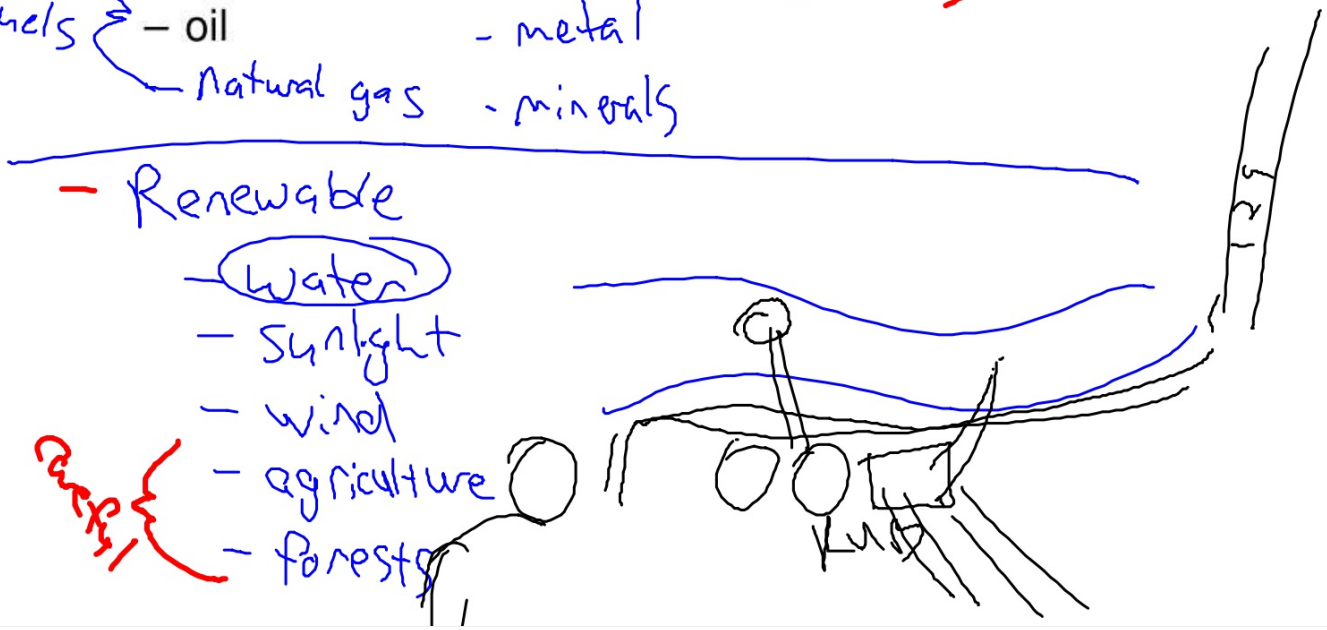
16.1 Human Population Growth And Natural Resources

- **The growing human population exerts pressure on Earth's natural resources.**
  - Nonrenewable resources are used faster than they form.

fossil fuels
- coal
- oil
- natural gas

- uranium (ore)
- metal
- minerals

- Renewable
  - water
  - sunlight
  - wind
  - agriculture
  - forests



16.1 Human Population Growth And Natural Resources

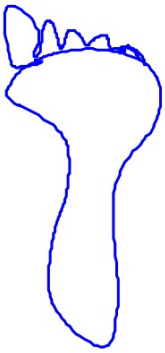
- Renewable resources cannot be used up or can replenish themselves over time.
  - wind
  - water
  - sunlight
- Growing use of nonrenewable resources may lead to a crisis.
- Resources must be properly managed.

16.1 Human Population Growth And Natural Resources

- **Effective management of Earth's resources will help meet the needs of the future.**
  - Earth's resources must be used responsibly.
  - Careless use of resources makes them unavailable to future generations.
  - Easter Island is an example of irresponsible resource use.

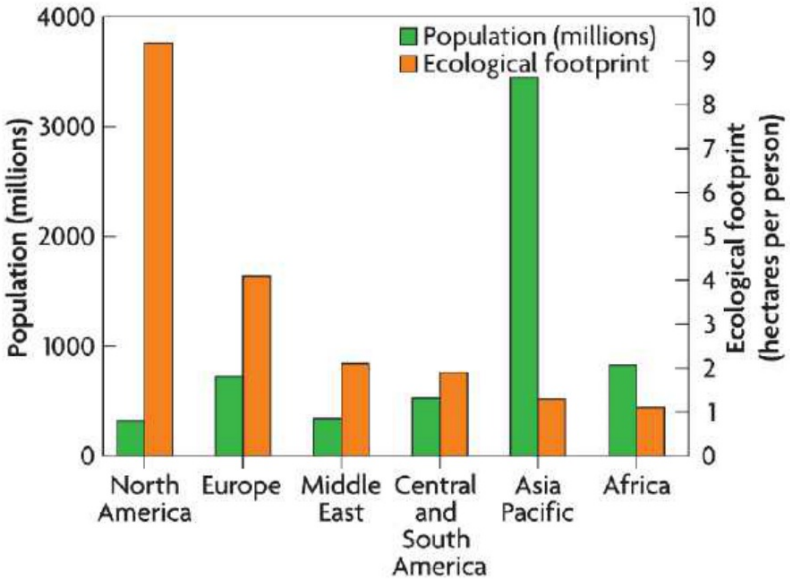
16.1 Human Population Growth And Natural Resources

- An ecological footprint is the amount of land needed to support a person.
- The land must produce and maintain enough
  - food and water
  - shelter
  - energy
  - waste



16.1 Human Population Growth And Natural Resources

- Several factors affect the size of the ecological footprint.
  - amount and efficiency of resource use
  - amount and toxicity of waste produced



16.2 Air Quality

KEY CONCEPT

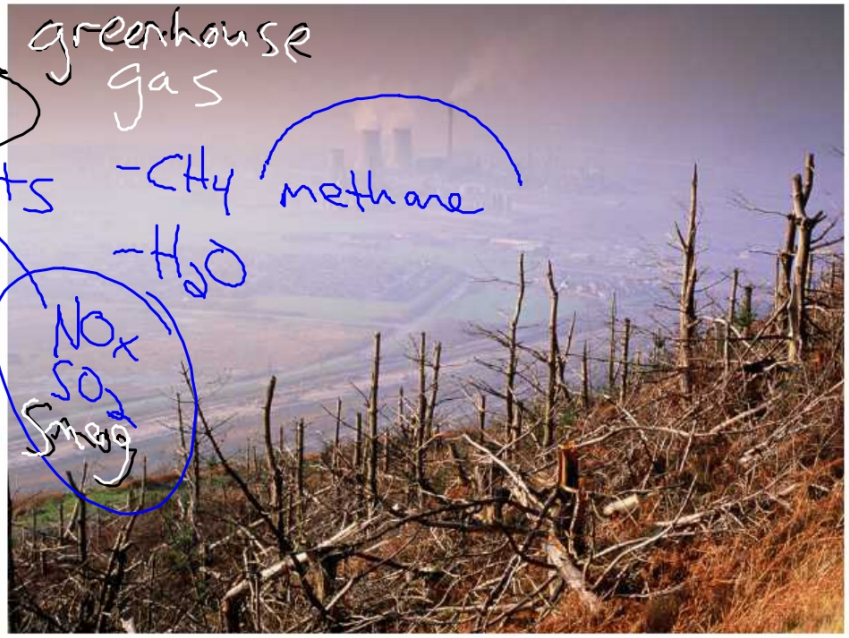
Fossil fuel emissions affect the biosphere.

Combustion – "burning"

1. CO_2 emissions
2. pollutants
3. acid rain

greenhouse gas
- CH_4 methane
- H_2O

NO_x
SO_2
Smog



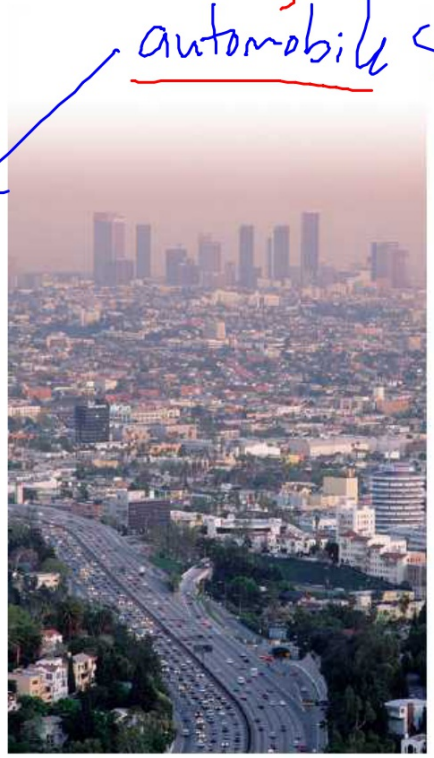
Ways humans negatively impact environment

- Air quality
- Water quality
- land pollution (changing surface)
  - desertification
- climate change
- eutrophication

16.2 Air Quality

Pollutants accumulate in the air.

- Pollution is any undesirable factor added to the air, water, or soil.
- Smog is one type of air pollution.
  - sunlight interacts with pollutants in the air
  - pollutants produced by fossil fuel emissions
  - made of particulates and ground-level ozone



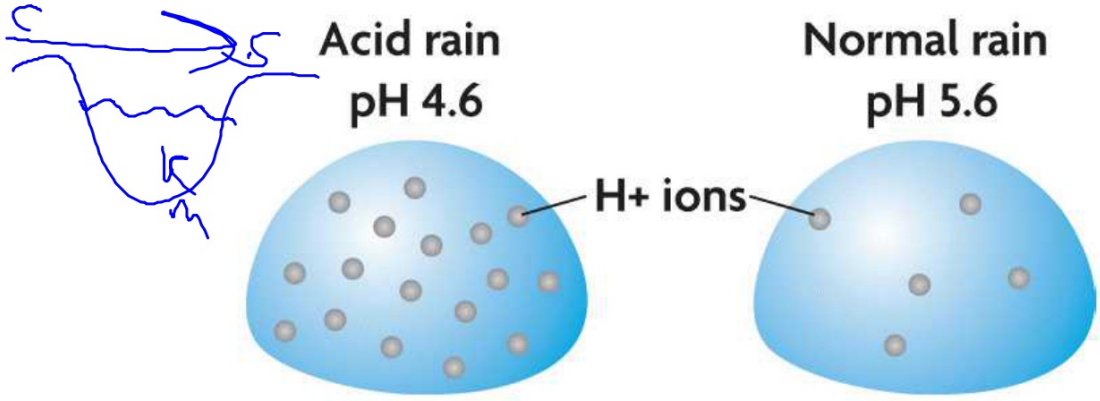
burning coal
automobiles

O_3 + Sunlight → Smog

Ozone

16.2 Air Quality

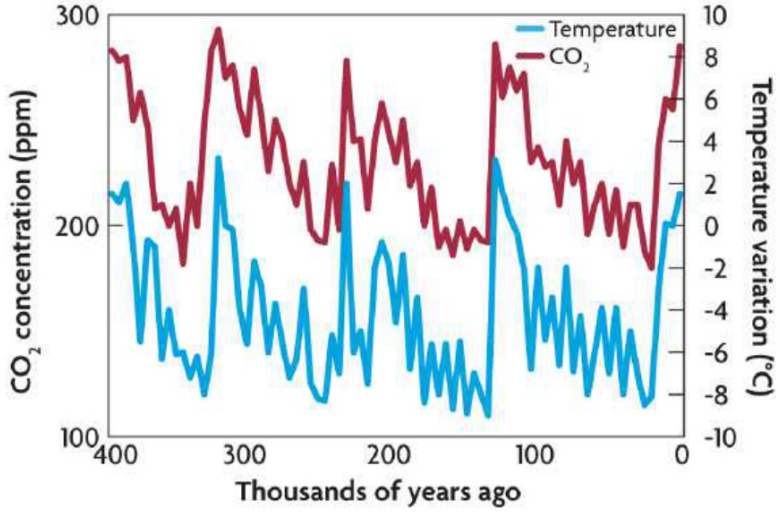
- Smog can be harmful to human health.
- Acid rain is caused by fossil fuel emissions.
  - produced when pollutants in the water cycle cause rain pH to drop
  - can lower the pH of a lake or stream
  - can harm trees



16.2 Air Quality

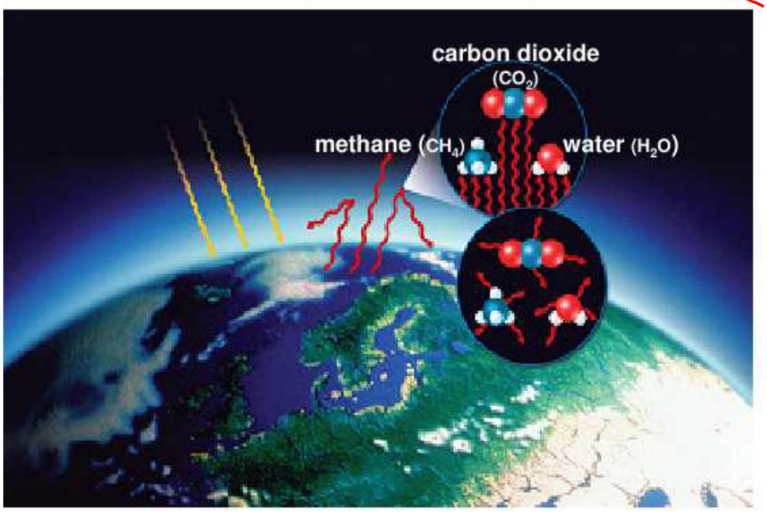
Air pollution is changing Earth's biosphere.

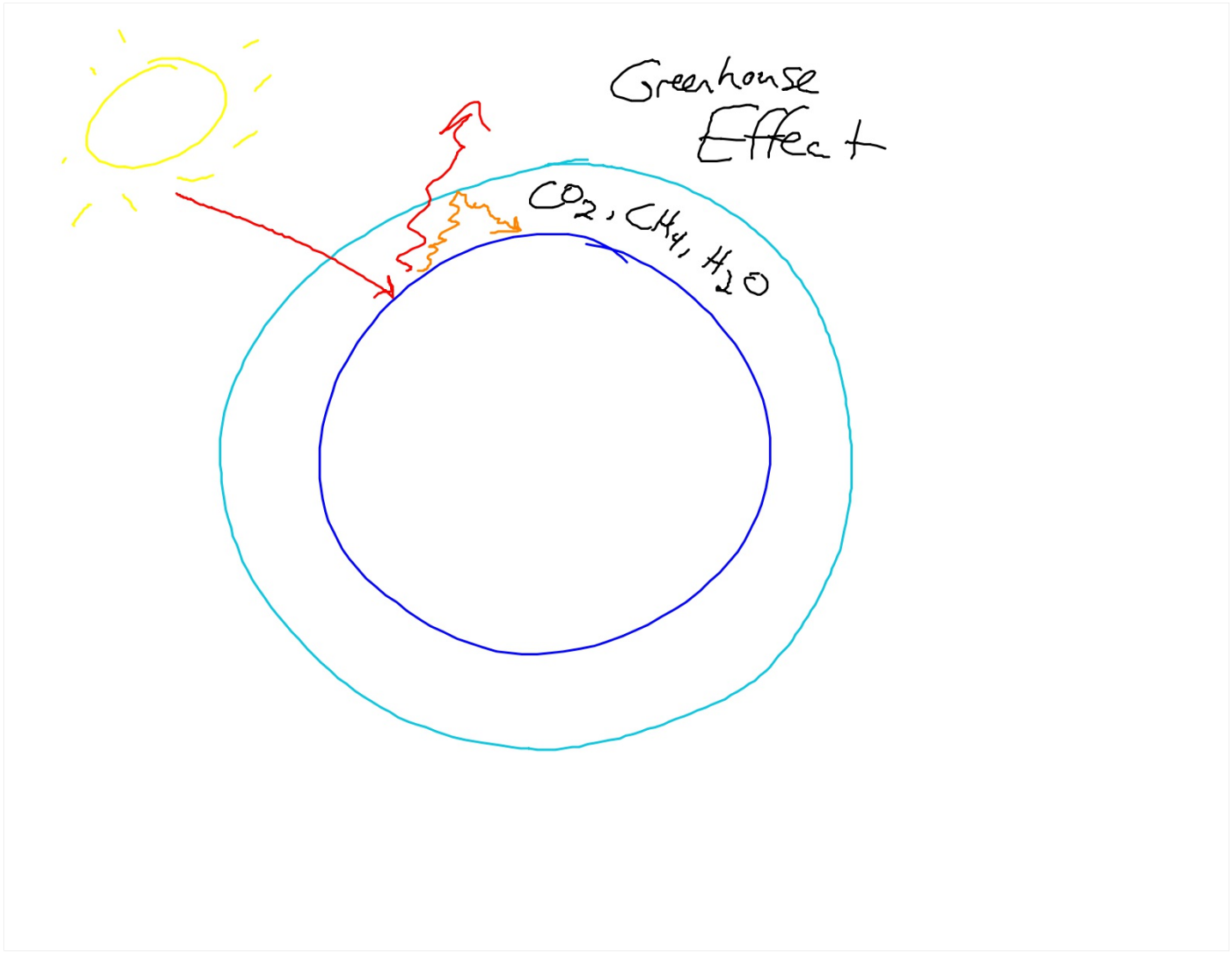
- The levels of atmospheric carbon dioxide rise and fall over time.
- High levels of carbon dioxide are typical of Earth's warmer periods.



16.2 Air Quality

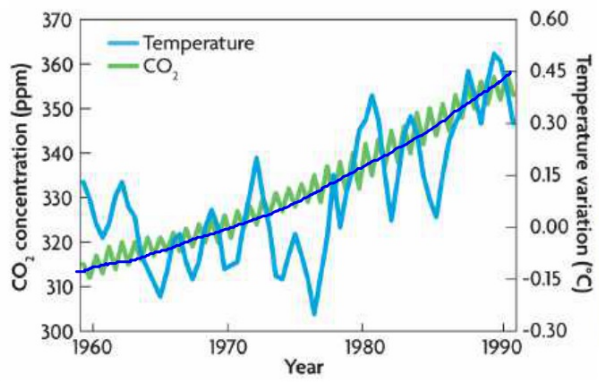
- The greenhouse effect slows the release of energy from Earth's atmosphere.
  - sunlight penetrates Earth's atmosphere
  - energy is absorbed and reradiated as heat
  - greenhouse gases absorb longer wavelengths
  - Greenhouse gas molecules rerelease infrared radiation

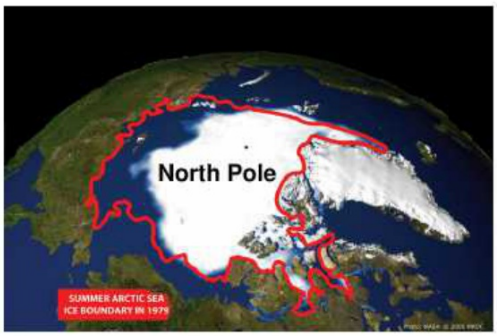



Greenhouse Effect
CO_2, CH_4, H_2O

16.2 Air Quality

- Global warming refers to the trend of increasing global temperatures.





16.3 Water Quality

KEY CONCEPT

Pollution of Earth's freshwater supply threatens habitat and health.

16.3 Water Quality

Water pollution affects ecosystems.

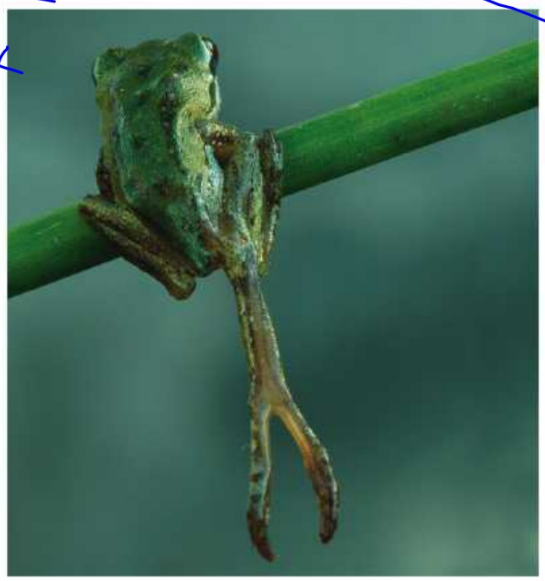
- Pollution can put entire freshwater ecosystems at risk.

point sou

nonpoint s

16.3 Water Quality

- Indicator species provide a sign of an ecosystem's health.
  - amphibians
  - top predators

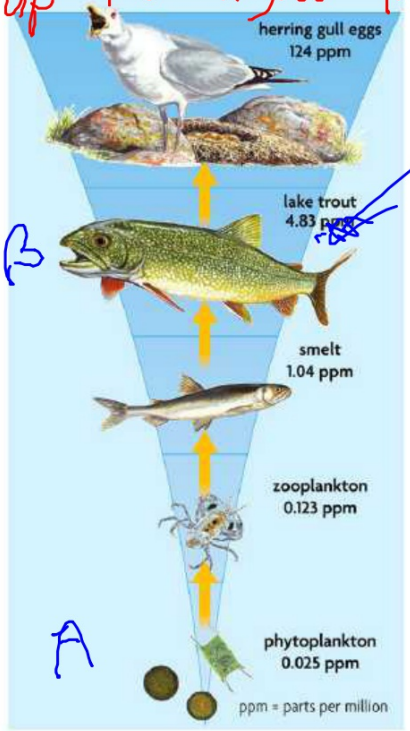


likely to go extinct

Sensitive to environmental changes

16.3 Water Quality

- **Biomagnification causes accumulation of toxins in the food chain.**
  - Pollutants can move up the food chain.
    - predators eat contaminated prey
    - pollution accumulates at each stage of the food chain
  - Top consumers, including humans, are most affected.



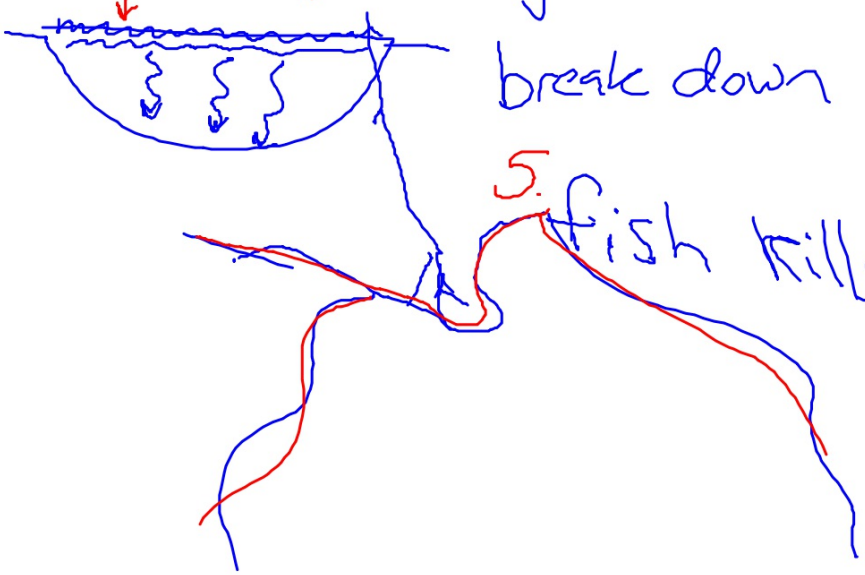
Fort Loudoun Reservoir	Loudon, Blount	Entirety (14,600 acres)	PCBs Mercury (upper portion only)	Commercial fishing for catfish prohibited by TWRA. No catfish or larg bass over two pounds should be eaten. Do not eat largemouth bass f Little River embayment. Due to mercury, precautionary advisory for a largemouth bass from Highway 129 to the confluence of Holston and Broad rivers (534 acres).*

Eutrophication - 1. the excessive input of nutrients (N, P) into an aquatic ecosystems. 2. Start to see algal bloom. 3. Bacteria break down algae. 4. O_2 ↓

5. fish kills

zero O_2: an

Sources:
- Sewage discharge
- fertilizer runoff
- industrial discharge
- agricultural runoff



Pesticides - persistent → DDT

- insecticides
- herbicides
- rodenticides
- fungicides

target organisms

non-target organisms

16.4 Threats To Biodiversity

KEY CONCEPT

The impact of a growing human population threatens biodiversity. → The # of different species in an area.

- Species div
- genetic div

16.4 Threats To Biodiversity

- **Preserving biodiversity is important to the future of the biosphere.**
  - The loss of biodiversity has long-term effects.
    - loss of medical and technological advances
    - extinction of species
    - loss of ecosystem stability

Complexity = Stability

16.4 Threats To Biodiversity

Loss of habitat eliminates species.

- Habitat fragmentation prevents an organism from accessing its entire home range.
  - occurs when a barrier forms within the habitat
  - often caused by human development

16.4 Threats To Biodiversity

- Habitat corridors are a solution to the problem.
  - corridors can be road overpasses or underpasses
  - allow species to move between different areas of habitat

16.4 Threats To Biodiversity

Introduced species can disrupt stable relationships in an ecosystem.

- An introduced species is one that is brought to an ecosystem by humans.
  - accidental
  - purposeful
- Invasive species can have an environmental and economic impact.

nutria

16.4 Threats To Biodiversity

- Invasive species often push out native species.
  - Burmese python (Florida Everglades)

16.4 Threats To Biodiversity

- Invasive species often push out native species.
  - mice (Australia)

16.4 Threats To Biodiversity

- Invasive species often push out native species.
  - kudzu (southeastern United States)

16.5 Conservation

KEY CONCEPT

Conservation methods can help protect and restore ecosystems.

16.5 Conservation

- **Sustainable development manages resources for present and future generations.**
  - Sustainable development meets needs without hurting future generations.
    - resources meet current needs
    - resources will still be available for future use

16.5 Conservation

- The timber industry has started to adopt sustainable practices.
- Global fisheries have adopted several sustainable practices.
  - rotation of catches
  - fishing gear review
  - harvest reduction
  - fishing bans

16.5 Conservation

- **Conservation practices focus on a few species but benefit entire ecosystems.**
  - The Endangered Species Act works to protect individual species from extinction.
  - A listed species is often called an umbrella species.
    - the habitat in which the species lives must be protected
    - other species are protected because they share the ecosystem

16.5 Conservation

Protecting Earth's resources helps protect our future.

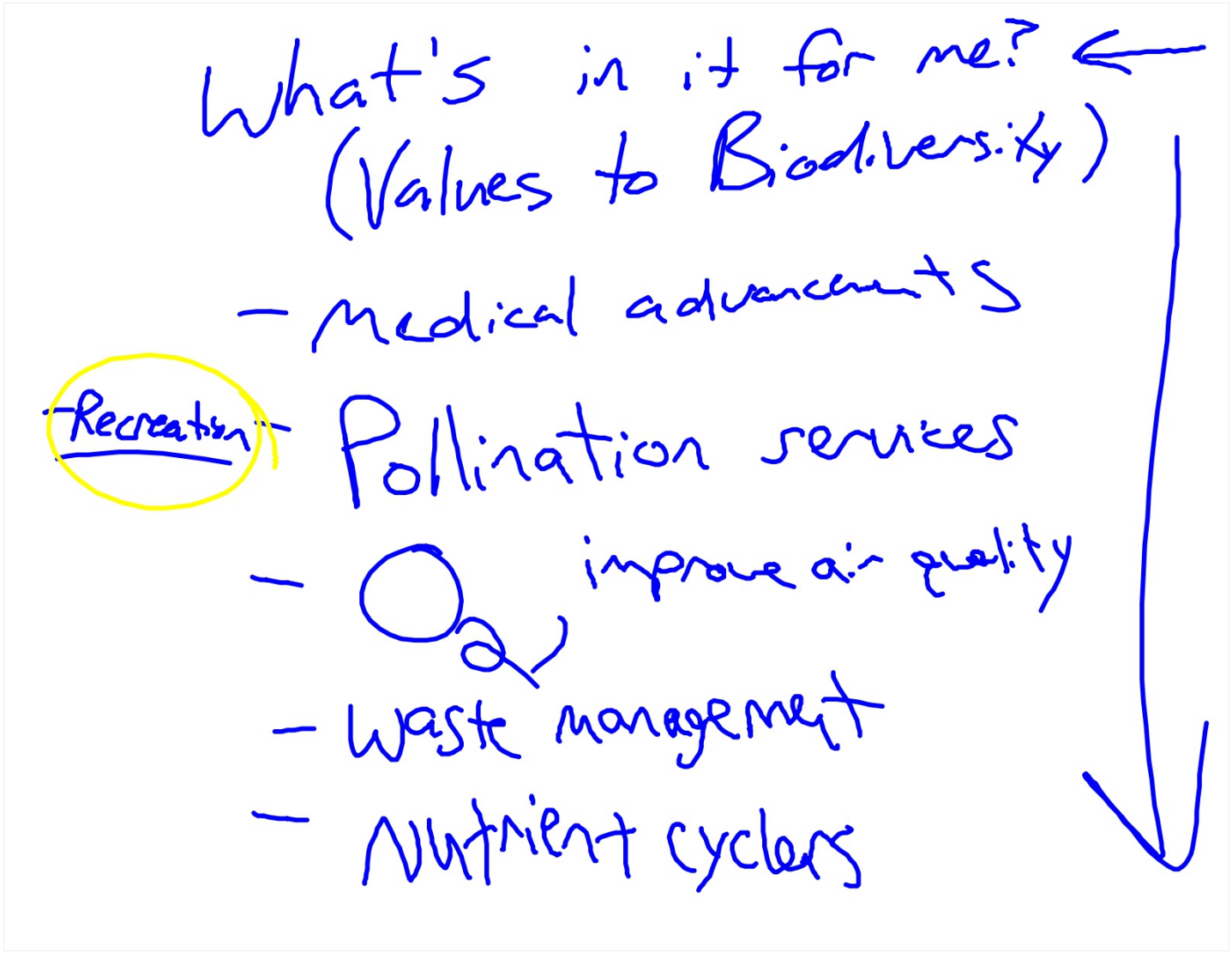
- The Environmental Protection Agency (EPA) was created in 1970.
- The EPA develops policies and regulations to protect the environment.
- Legislation helps to protect the environment and endangered species.
  - Clean Air Act
  - Clean Water Act
  - Endangered Species Act

16.5 Conservation

- The National Park Service helps manage public lands.
- The park system includes over 390 areas, covering 84 million acres.

16.5 Conservation

- There are several ways that people can help protect the environment.
  - control population growth
  - develop sustainable technology and practices
  - protect and maintain ecosystems


What's in it for me?
(Values to Biodiversity)
- medical advancements
- Recreation
- Pollination services
- O_2 improve air quality
- waste management
- Nutrient cyclers

Biodiversity Loss and Extinction

- **Biodiversity** is a broad term used to describe the diversity of genes, species, and ecosystems in a region.
- **Extinction** is the elimination of all the individuals of a particular species.
  - Extinction is a natural and common event in the history of biological evolution.
  - It, and the resulting loss of biodiversity, is also a major consequence of human domination of the Earth.

Biodiversity Loss and Extinction

- Over the past few hundred years, humans are estimated to have increased the extinction rate by a factor of 1,000 to 10,000 times above background rates typical over the planet's history.
  - 1/8 of bird species, 1/4 of mammal species, 1/3 of amphibian species, and 1/2 of turtle species are threatened.
  - 10% of the world's coral reefs have been lost.
  - Mangrove forests are reduced by over 1% a year.
  - 25% of global land is used to raise crops.

Biodiversity Loss and Extinction

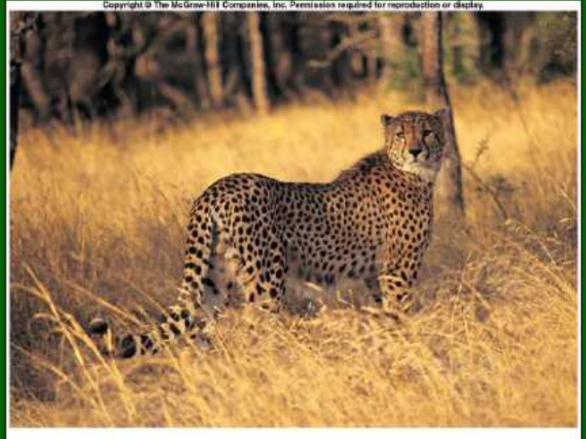
- Local extinctions, although relatively common, indicate the future of a species is not encouraging.
- As population is reduced in size, some of the genetic diversity is likely to be lost.
- Certain kinds of species are more likely to go extinct than others:
  - Species with small, dispersed populations
    - Successful breeding is difficult.

Biodiversity Loss and Extinction

- Organisms in small, restricted areas, such as islands.
  - Environmental changes have large effect.
- Specialized organisms
  - Relying on constancy of a few key factors.
- Organisms at higher trophic levels.
  - Low population sizes and reproductive rates.

Biodiversity Loss and Extinction

range of tolerance



Most Likely to Become Extinct

Least Likely to Become Extinct

Biodiversity Loss and Extinction

- As human populations grew, and their tools became more advanced, the impact a single human could have on surroundings increased.
- Environmental modifications allowed larger, dense human populations to survive, but at the expense of previously existing ecosystems.
- Nearly all the Earth's surface has been affected in some way by human activity.

Describing Biodiversity

- When humans exploit an area, they influence species diversity.
  - They convert natural ecosystems to human-managed ecosystems.
    - They harvest certain species for their use.
    - They specifically eliminate species that compete with desirable species.
    - They introduce nonnative species to an area.

The Value of Biodiversity

- Nutrient cycling
  - Carbon, nitrogen, phosphorus, and other chemical elements are cycled through ecosystems.
- Cultural Uses / Recreation
  - Enjoyment of landscapes, individual organisms, scientific study, educational activities, and the spiritual significance of places.
- Water regulation and supply
  - Intact soil and vegetation slow water flow, allowing it to penetrate the soil and recharge aquifers.
  - Water is available for agriculture, industry, and domestic use.

The Value of Biodiversity

- Disturbance regulation and erosion control
  - Land can be disturbed by fire, flood, windstorms, landslides, or human actions.
  - Colonization of these sites by plants and animals heals the scars and prevents continued damage.
- Waste Treatment
  - Decomposer organisms remove excess nutrients and pollutants from air, water, and soil.
- Food and Raw Materials
  - Many people harvest wild plants and animals as food and medicine. Plants feed livestock, provide building materials, and firewood.

The Value of Biodiversity

- Atmospheric and Climate Services
  - Many atmospheric gases are cycled between organisms and the atmosphere.
    - Removal of carbon dioxide in photosynthesis helps control the warming of the planet.
    - Nitrogen and sulfur are modified by organisms.
    - Ozone provides protection from UV light.
- Recreation
  - Natural areas provide recreational opportunities.
- Biological Control Services
  - All organisms have complex interrelationships. Some help remove pests.

The Value of Biodiversity

- Pollination Services
  - Many insects are pollinators. Careless use of insecticides can negatively affect agricultural production.
- Habitat/Refuges
  - Refuges protect species, serve as nursery sites, and provide temporary stopping places for migratory species.

The Value of Biodiversity

- Genetic Resources
  - If an organism goes extinct, we have lost the ability to use it for our own needs.
  - Wild ancestors of our food grains are thought to be extinct.
  - 50% of our common drugs come from plants and animals.
- Soil Formation
  - Weathering of rock, aided by bacteria, fungi, tiny animals, and plants roots build soil.
  - Our food supply depends on the protection and management of soil.

The Value of Biodiversity

- A case can be made that all species have an intrinsic value and a fundamental right to exist.
  - Extinction is not necessarily bad, but human-initiated extinction is.
  - Experiencing natural landscapes and processes is an important human right.

Value of Biodiversity

- Pollination services
- Waste management
- Nutrients
- recreational

Threats to Biodiversity

- Five major human activities threaten to reduce biodiversity.
  - Habitat loss / fragmentation
    - Overexploitation
  - Introduction of exotic species
    - Predator and pest control activities
    - Climate change

Threats to Biodiversity

- About 40% of the world's land surface has been converted to cropland and permanent pasture.
- Typically, the most productive natural ecosystems (forests and grasslands) are the first to be modified by humans.
- Pressures to modify the environment are greatest in areas with high population density.

Threats to Biodiversity

- Originally, half of the U.S., three-fourths of Canada, and almost all of Europe, and significant portions of the rest of the world were forested.
- **Deforestation** is the process of destroying a forest, often for the purposes of fuel, building materials, or to clear land for farming.

Threats to Biodiversity

- **Clear cutting** is the removal of all trees in an area. It is economical but increases erosion, especially on steep slopes.
- **Patchwork clear cutting** is clear cutting in small, unconnected patches; preserves biodiversity.
- **Selective harvesting** is single species tree harvesting. It is not as economical, but reduces ecosystem damage.

Threats to Biodiversity

Clear cutting

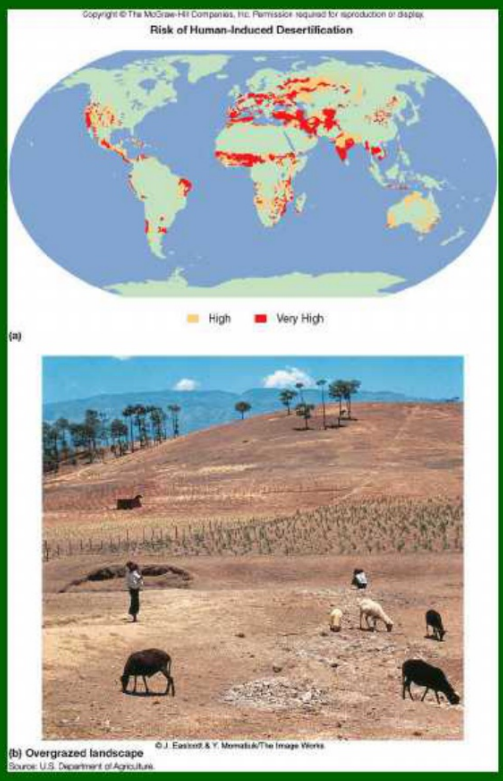
Threats to Biodiversity

- Several concerns are raised by tropical deforestation:
  - It significantly reduces species diversity in the world.
  - It impacts the climate via lowered transpiration.
  - Deforested lands are easily eroded.
  - Without the forests to trap CO_2, there may be increased global warming.
  - Human population pressure is greatest in tropics, and still increasing.

Threats to Biodiversity

- The conversion of rangelands to grazing by domesticated animals has major impacts on biodiversity.
  - Selective eating habits of livestock tend to reduce certain species of native plants and encourage others.
  - Important to regulate number of livestock on rangelands, especially in dry areas.
    - Overgrazing is a severe problem where human population pressures are great.
    - **Desertification** is the process of converting arid or semiarid land to desert because of improper human use.

Threats to Biodiversity



Desertification

Habitat Loss in Aquatic Ecosystems

- Freshwater systems are often modified for navigation, irrigation, flood control, or power production.
- All of these processes may alter natural ecosystems and change numbers or kinds of aquatic organisms present.

Threats to Biodiversity

- Systematic killing of certain organisms that interfere with human activities also results in reduced biodiversity.
  - Large predators have been locally exterminated because they preyed on domestic animals.
  - Passenger pigeons became extinct primarily because of increased conversion of forested land.

Threats to Biodiversity

- The role of climate change on the survival of species has become an issue.
  - Many species live near the limit of their physiological tolerance. A slight change in the temperature may push them over the brink.
  - Amphibians, corals, and arctic species are greatly affected by climate change.
    - Planet warming may have caused a fungal disease in frogs.
    - Melting sea ice is changing migration patterns and food availability.

Threats to Biodiversity

What Is Being Done to Preserve Biodiversity?

- The World Conservation Union (IUCN) lists over 16,000 species as threatened with extinction.
  - IUCN classifies species in danger of extinction into four categories:
    - Endangered
    - Vulnerable
    - Rare
    - Indeterminate

What Is Being Done to Preserve Biodiversity?

- Awareness and concern about loss of biodiversity are high in many developed countries.
- Most vulnerable species in these areas have already been eliminated.
- Loss of biodiversity is not a high priority for the general public in developing countries.
- They are more concerned with immediate needs of food and shelter than long-range issues such as species extinction.

What Is Being Done to Preserve Biodiversity?

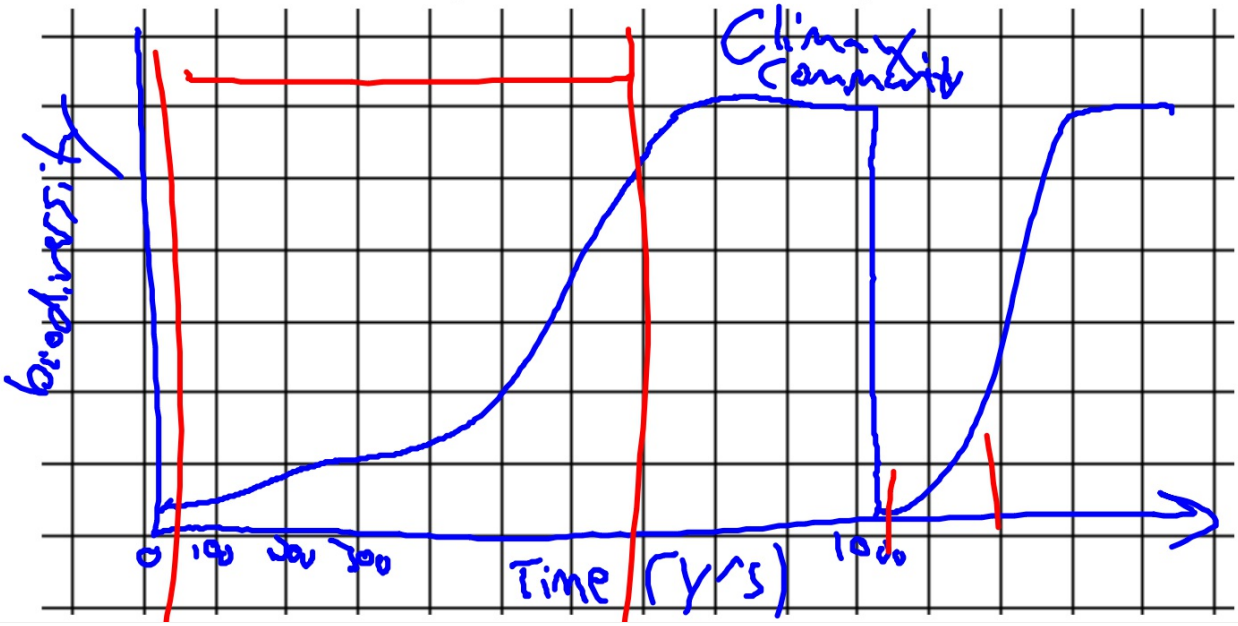
- **Endangered species** are those that have such small numbers that they are in immediate danger of becoming extinct.
- **Threatened species** could become extinct if a critical environmental factor is changed.
  - The preservation question ultimately becomes one of assigning value to the species.
  - Amendments to ESA have weakened ability of U.S. government to add new species to the list.

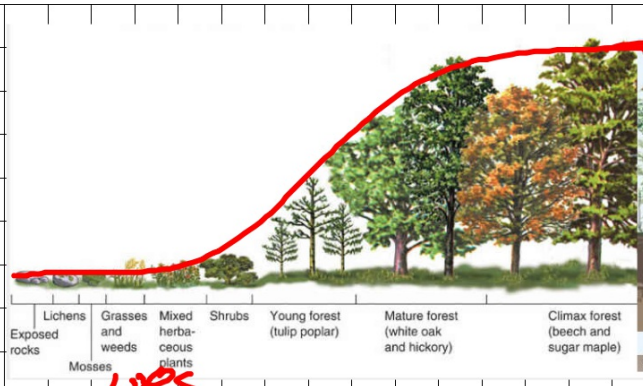
What Is Being Done to Preserve Biodiversity?

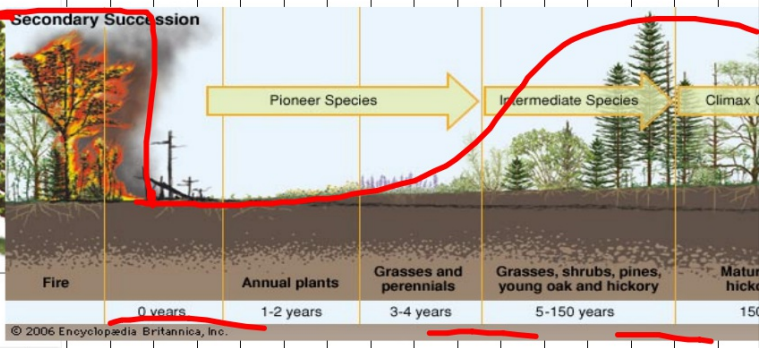
- Habitat Analysis and Management
  - Managing a particular species requires an understanding of the habitat needs of that species.
  - An animal's habitat must provide food, water, and cover.
    - Cover conceals or protects animals from the elements or enemies.
  - Modifications made to enhance the success of a species are known as **habitat management.**

Kickoff (9/12/14):

1. Explain the relationship between ecological succession and biodiversity. Make a graph to support your response. In your graph, start with primary succession, include a disturbance, and finish with a climax community after secondary succession.







- desert
- deciduous forest
- tropical rain forest
- tundra
- grasslands
- taiga

Kickoff (9/10/13):

1. List three ways that humans can affect our environment.

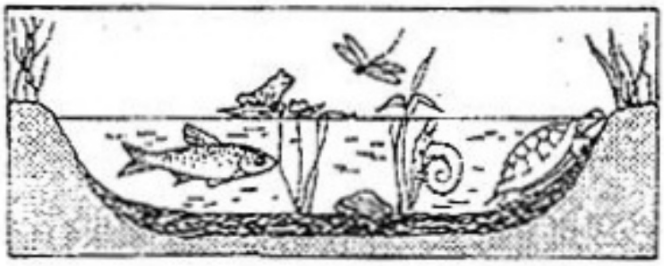
2. Based on your list from above, explain how they ca threaten biodiversity and lead to extinction.

Succession, a series of environmental changes, occurs in all ecosystems. The stages that any ecosystem passes through are predictable. In this activity, you will place the stages of succession of two ecosystems into sequence. You will also describe changes in an ecosystem and make predictions about changes that will take place from one stage of succession to another.

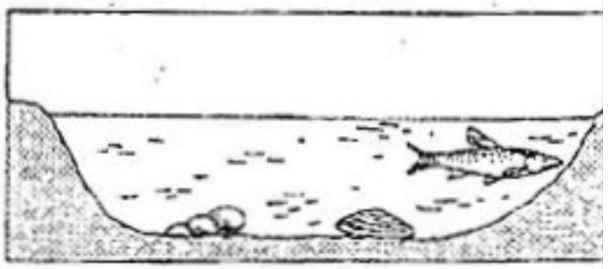
The evolution of a body of water from a lake to a marsh can last for thousands of years. The process cannot be observed directly. Instead, a method can be used to find the links of stages and then to put them together to develop a complete story.

The water level of Lake Michigan was once 18 meters higher than it is today. As the water level fell, land was exposed. Many small lakes or ponds were left behind where there were depressions in the land. Below are illustrations and descriptions of four ponds as they exist today. Use the illustrations and descriptions to answer the questions about the ponds.

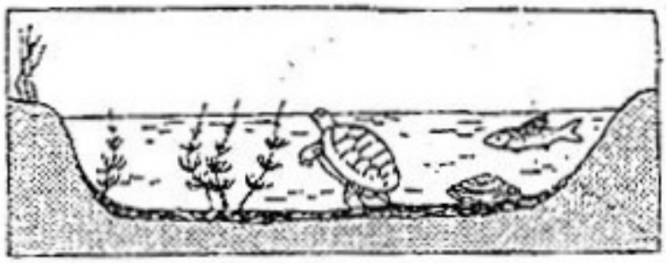
Pond A



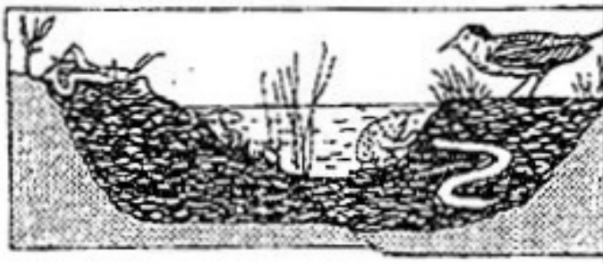
Pond B



Pond C



Pond D



Pond A: Cattails, bulrishes, and water lilies grow in the pond. These plants have their roots in t bottom of the pond, but they can reach above the surface of the water. This pond is an ideal habitat for the animals that must climb to the surface for oxygen. Aquatic insect larvae are abundant. They serve as food for larger insects, which in turn are food for crayfish, frogs, salamanders, and turtles.

Pond B: Plankton growth is rich enough to support animals that entered when the pond was connected to the lake. Fish make nests on the sandy bottom. Mussels crawl over the bottom.

Pond C: Decayed bodies of plants and animals form a layer of humus over the bottom of the pond. Chara, a branching green algae, covers the humus. Fish that build nests on the bare bottom have been replaced by those that lay their eggs on the Chara.

Pond D: The pond is so filled with vegetation that there are no longer any large areas of open water. Instead, the pond is filled with grasses. The water dries up during the summer months.

Questions

1. Write the letters of the ponds in order from the youngest, to the oldest.

_____

2. Black bass and bluegill make their nests on sandy bottoms. In which pond would you find them? _____

3. What will happen to the black bass and blue gill as the floor of the ponds fills with organic debris? _____

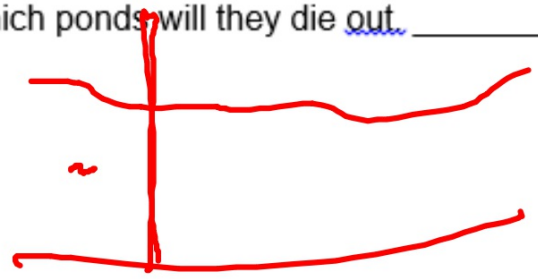
4. Golden shiner and mud minnows lay their eggs on Chara. In which pond would you find them? _____

5. Some amphibians and crayfish can withstand periods of dryness by burying themselves in mud. In which pond(s) would they survive? _____

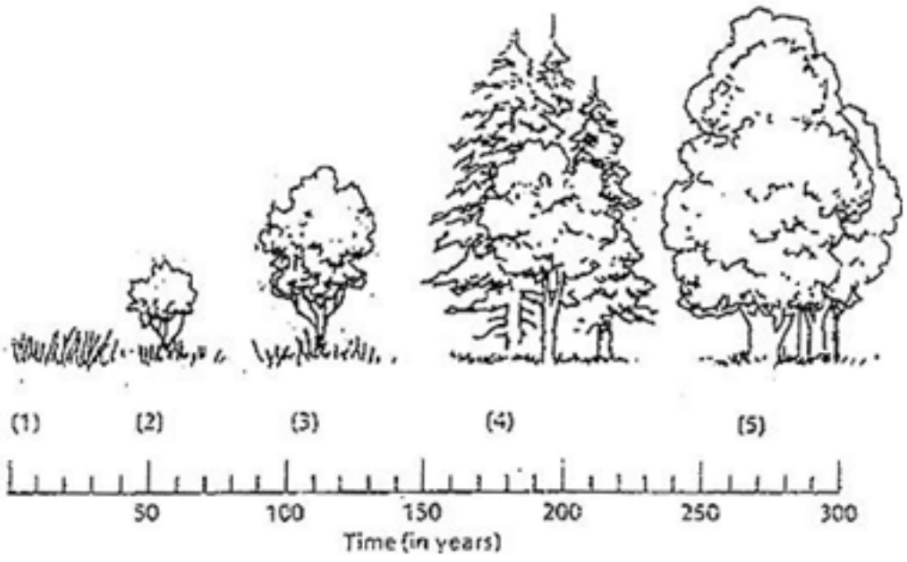
6. Dragonfly nymphs spend their early stages clinging to submerged plants. Then, they climb to the surface, shed their skins and fly away as dragonflies. Which pond is best suited for dragonflies? _____

7. In which pond will gill breathing snails be replaced by lung breathing snails that climb to the surface to breathe? _____

8. Some mussels require a sandy bottom in order to maintain an upright position. In which ponds will they die out _____



9. The climax community in the area of Michigan is a beech-maple forest. Aft the ponds are filled in, the area will undergo another series of stages of succession. This is illustrated below. Briefly explain what is happening in the diagram below.




DEAD
END

14.5 Ecological Succession

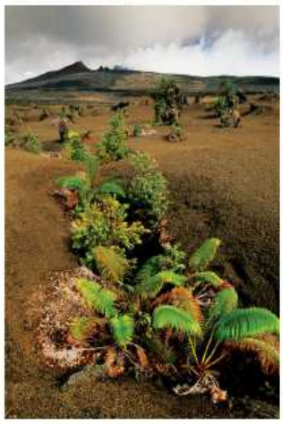
KEY CONCEPT

Ecological succession is a process of change in the species that make up a community. → change in an ecosyste over tim

14.5 Ecological Succession

- **Succession occurs following a disturbance in an ecosystem.**

  - Succession regenerates or creates a community after a disturbance.
    - a sequence of biotic changes
  - 2° – damaged communities are regenerated
  - 1° – new communities arise in previously uninhabited areas



Primary Succession - "1st ecosyste"

- 100s - 1000s years
- starts with bare rock
- starts with no soil
- lichens & mosses (pioneer species)
- Examples: volcanoes
  glacial retreat
  pond → forest
  strip mining

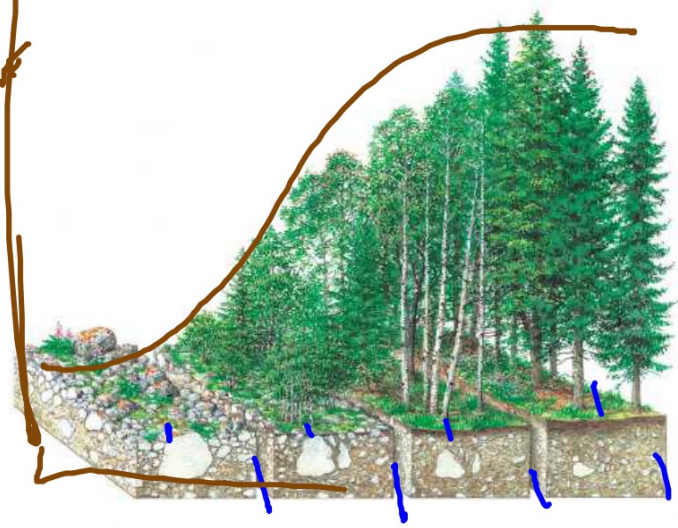
14.5 Ecological Succession

Humus - decaying matter that becomes

- There are two types of succession.
  - primary succession — started by pioneer species
  - secondary succession

bare rock
↑ lichens/mosses

examples - lava flow
- glacial retre



biodiv

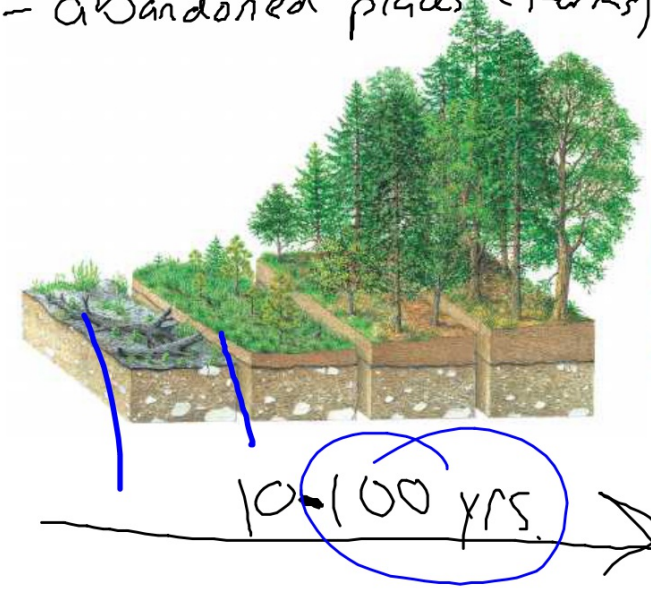
Time

taiga

14.5 Ecological Succession

- There are two types of succession.
  - secondary succession — started by remaining species
    - starting over after a distur
    - soil is already there

ex: forest fire
- natural disaster
- abandoned places (farms)

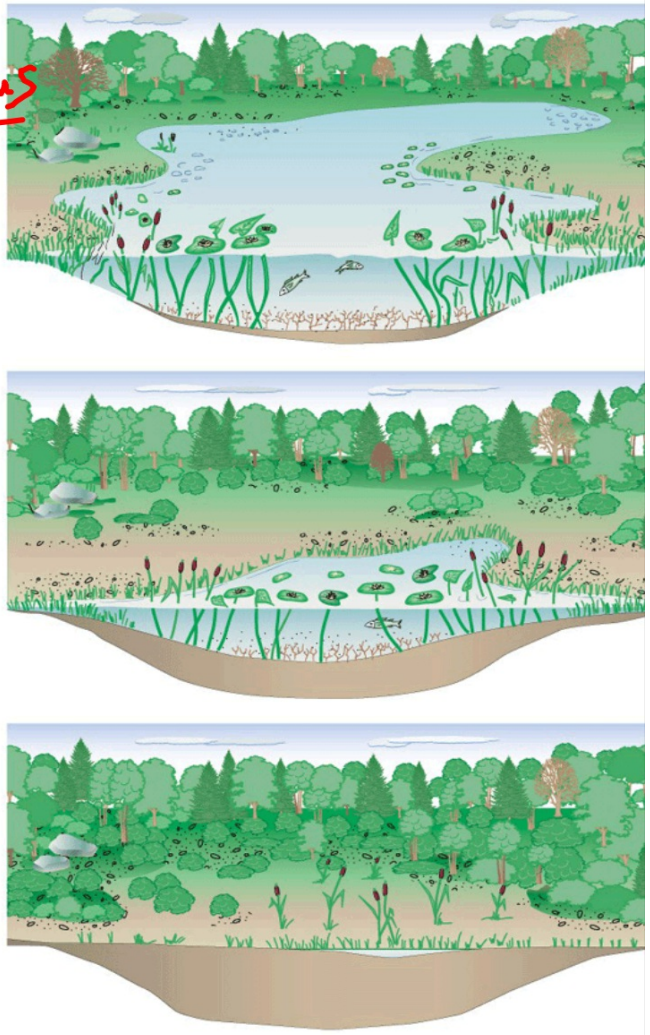


From Lake to Forest

1° Humus

- **Build Up of Sediments**
  Water entering a standing body of water usually carries nutrients and sediments. These materials build up on the bottom of the lake or pond.

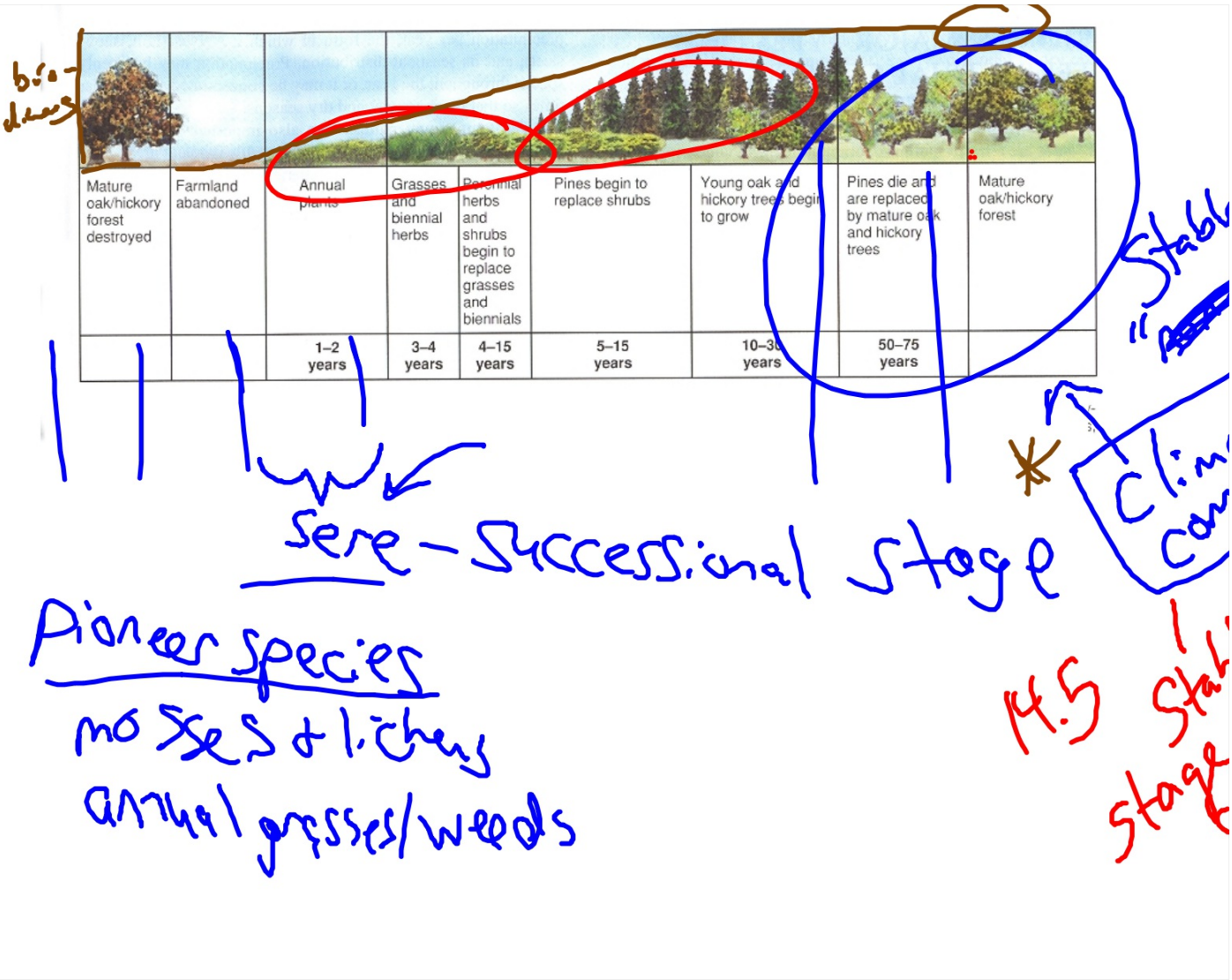
- **Formation of a Wetland**
  Over time, the pond or lake is filled with sediments. Plants grow in the new soil and the pond or lake starts becoming a wetland. The wetland then may develop into a forest.



(a)

http://volcanoes.usgs.gov/hazards/lava/


USGS


Mature oak/hickory forest destroyed
Farmland abandoned
Annual plants
Grasses and biennial herbs
Perennial herbs and shrubs begin to replace grasses and biennials
Pines begin to replace shrubs
Young oak and hickory trees begin to grow
Pines die and are replaced by mature oak and hickory trees
Mature oak/hickory forest
1–2 years
3–4 years
4–15 years
5–15 years
10–3
50–75 years
sere - successional stage
Pioneer species
mosses & lichens
annual grasses/weeds
Stable
14.5

1 A slowly retreating glacier exposes bare rock where nothing lives, and primary succession begins.

2 Most primary succession begins with lichens. Acids from the lichens begin breaking the rocks into small particles. These particles mix with the remains of dead lichens to start forming soil. Lichens are an example of a pioneer species.

3 After many years, there is enough soil for mosses to grow. The mosses eventually replace the lichens. Insects and other tiny organisms begin to live there. When they die, their remains add to the soil.

4 Over time, the soil deepens, and the mosses are replaced by ferns. The ferns may slowly be replaced by grasses and wildflowers. If there is enough soil, shrubs and small trees may grow.

5 After hundreds or even thousands of years, the soil may be deep and stable enough to support a forest.

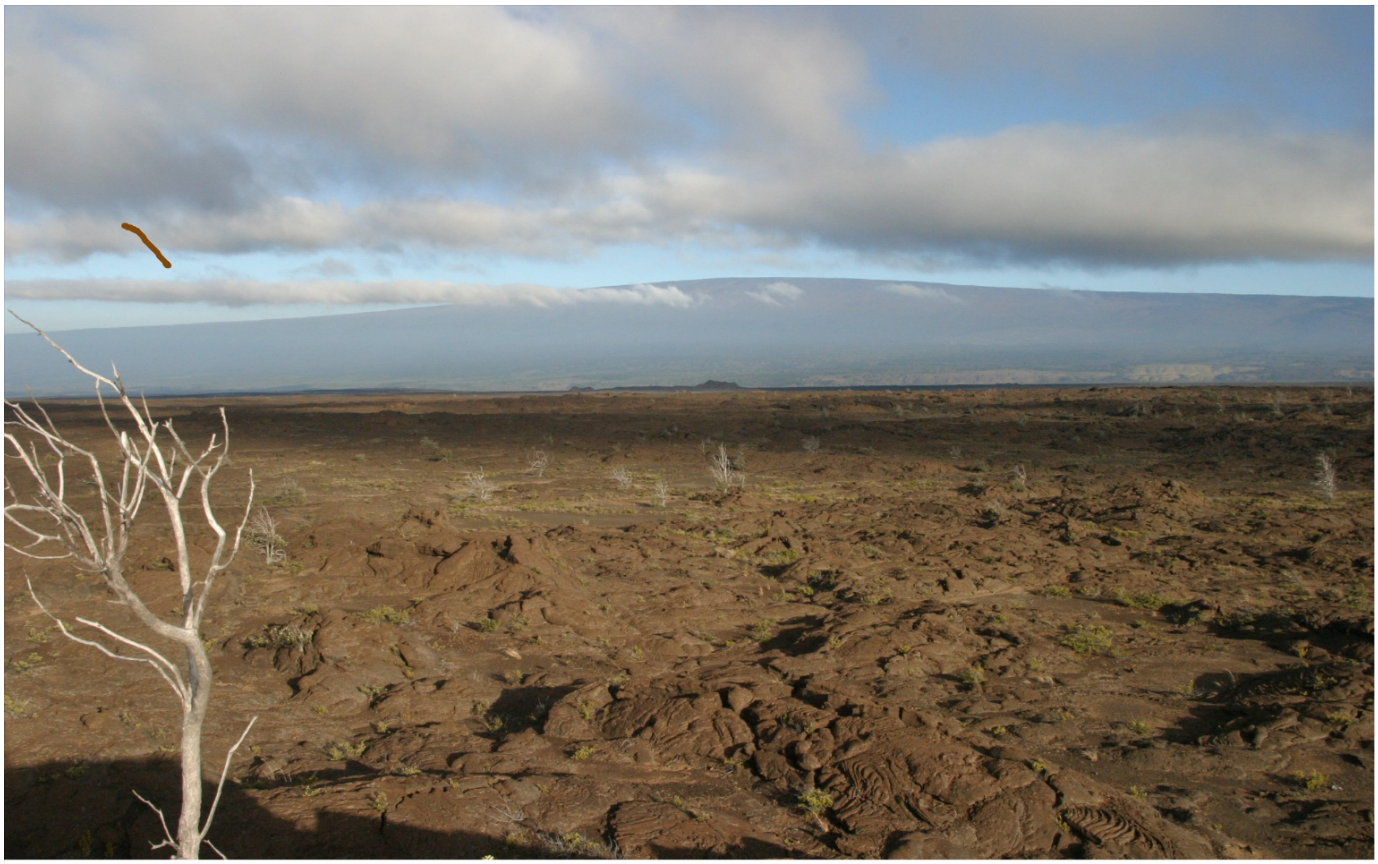
1 The first year after a farmer stops growing crops or the first year after some other major disturbance, weeds start to grow. In farming areas, crab grass is the weed that often grows first.

2 By the second year, new weeds appear. Their seeds may have been blown into the field by the wind, or insects may have carried them. Horseweed is common during the second year.

3 In 5 to 15 years, small conifer trees may start growing among the weeds. The trees continue to grow, and after about 100 years, a forest may form.

4 As older conifers die, they may be replaced by hardwoods, such as oak or maple trees, if the climate can support them.

Decatur County Courthouse, Inc



_____ 2. After one year, the burned forest in Yellowstone National Park
   a. had barely changed.
   b. had begun to grow back.
   c. had completely grown back.
   d. was still completely destroyed.

_____ 3. What of the following statements describes succession?
   a. a lake drying up over time
   b. a forest being destroyed
   c. a community quickly growing back
   d. a community growing over time

PRIMARY SUCCESSION

4. The first organisms to start a process of succession are called _____.
5. The types of organisms that are usually the pioneer species in primary succession are _____.
6. Over time, the remains of _____ add to the soil.
7. What process occurs in an area where bare rock is transformed into soil?

   _____

   _____

8. How long does it take for an area of bare rock to become a forest?

_____ 9. Secondary succession may occur in an area if
a. no disturbances occur there for hundreds of years.
b. soil is left intact after a major disturbance.
c. a glacier retreats from the area.
d. a farmer continually grows crops in the area.

_____ 10. What is usually the first plant to grow in secondary succession?
a. conifers
b. crops
c. crab grass
d. horseweed

_____ 11. In secondary succession, how long does it take for a forest to form?
a. 5–15 years
b. 100 years
c. 250 years
d. 1,000 years

MATURE COMMUNITIES AND BIODIVERSITY

12. What is a climax species?

_____

_____

13. Why is biodiversity important to communities of organisms?

_____

_____

_____

_____

14. What are organisms that live in a mature community able to do?

Section: Ecological Succession

Imagine that you have been hired to oversee the maintenance of a public forest. Answer the follow questions to describe how you would approach th task:

- **How would you evaluate the health of the forest**
- **What actions would you take to keep the forest healthy?**
- **What factors might pose a threat to the health o the forest? How would you prevent these factors from causing harm?**