Ecology

Honors Biology
CH. 24 p. 634-647
CH. 25 p. 652-659, 663-668, 673-677

Ecology

- Ecology is the study of organisms within their environment.
  - Matter cycles
  - Energy flows
- The sun is the ultimate source of energy on earth
- Trophic level- one step in a food chain or pyramid

Ecology terms

- **Habitat**- the place where a population of a species lives
- **Community**- the different species that live within the habitat
- **Ecosystem**- the biotic and abiotic factors of a habitat
  - **Abiotic**- the physical aspects of a habitat (soil, air, water)
  - **Biotic**- the living things in a habitat

Food Chains

- Producers- photosynthetic organisms that capture energy from the sun.
- Consumers- organisms that consume plants or other organisms to obtain energy.
- Decomposer- Bacteria and fungi that eat decayed organisms.

Food Chains

- Herbivores- animals that eat plants and other producers
- Carnivores- animals that eat other animals
- Omnivores- animals that eat both plants and animals
- Detritivores- organisms that eat organic wastes from dead organisms

Energy Pyramid

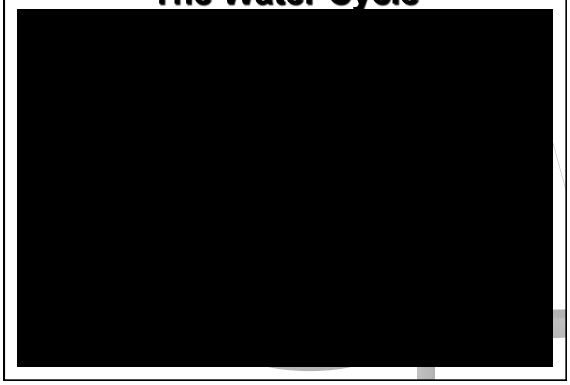
10% Rule

- Only 10% of the energy from one trophic level moves up to the next.
- 90% of the energy is lost -- given off as heat or wasted energy.

Biogeochemical cycles

- The Water cycle
  - Evaporation- water heated to water vapor
  - Condensation- water vapor becomes clouds
  - Precipitation- Rain, Hail, Snow, Sleet etc.
  - Runoff- drains into streams, rivers, lakes, oceans
  - Percolation- water goes into soil with ground water
  - Transpiration- water released from plants

The Water Cycle

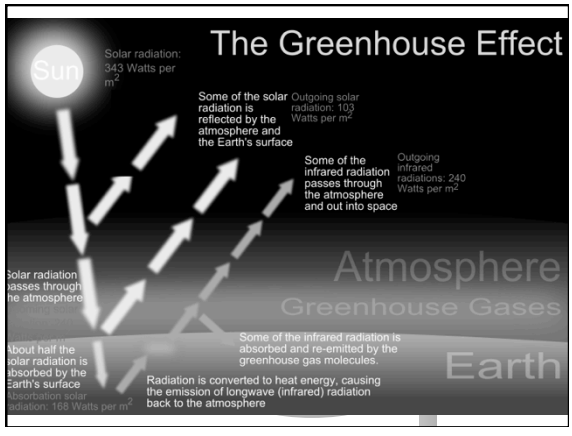


Carbon Cycle

- Photosynthesis- plants fix CO_2 in the air to make organic materials.
- Respiration- plants and animals through cellular respiration release CO_2 into the air.
- Combustion- when plants, wood, and fossil fuels (organic materials turned into coal, oil, and gas) are burned CO_2 is released into the atmosphere.
- Erosion- exposed limestone will release CO_2 into the water or air.

Greenhouse Effect

- Greenhouse gases- H_2O, CH_4, CO_2, NO, O_3, and CFC's absorb solar energy that is reflected by the earth the atmosphere
- The Greenhouse Effect keeps the earth's surface temperature stable.
- But the concentration of CO_2 increases due to combustion causing rises in the temperature of the earth.



The Nitrogen Cycle

- N_2 gas in the atmosphere is fixed in the soil by lightning and nitrogen fixing bacteria.
- Plant roots take in nitrogen in the form of ammonia (NH_3) nitrates (NO_3^{-1}) to make proteins.
- Animals obtain nitrogen from there food.
- Decomposition of dead organisms and wastes returns nitrogen to the soil
- Denitrifying bacteria returns nitrogen in the soil back into N_2 gas in the atmosphere.

The Nitrogen Cycle

- ~78% of the atmosphere is unusable N_2.
- Living things need nitrogen to build amino acids and nucleic acids
- **Nitrogen fixation-** N_2 gas is fixed in the soil by lightning and nitrogen fixing bacteria.
- **Ammonification-** bacteria in the soil convert decomposing organic materials into NH_3.
- **Nitrification-** ammonia is converted to to nitrites and nitrates
- **Assimilation-** Plant roots take in nitrogen in the form of ammonia (NH_3) nitrates (NO_3^{-1}) to make proteins
- **Denitrification-** reduction of nitrates by bacteria into nitrogen gas.

Limiting Factors

- Limiting Factors- an environmental factor such as food, temperature, water, or sunlight that restricts growth, metabolism or population size.
- Productivity of ecosystems and their organisms is affected by limiting factors.
- A resource in short supply keeps growth in check.
- Competition for an abundant resource can keep individual populations in check.
- Population Density- the number of individuals in an area.

Density Independent Factors

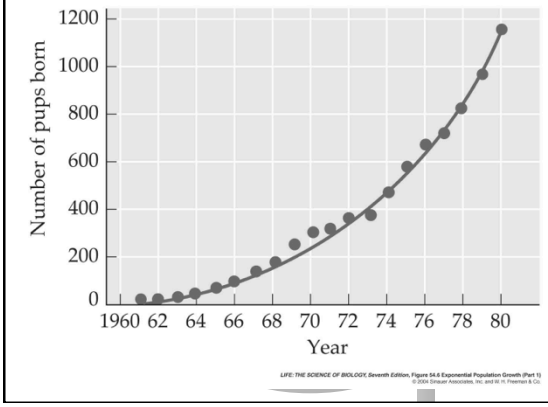
- Limiting Factor that is not affected by size of the population
- Most important:
  - Weather
  - Climate

Density Dependent Factors

- Limiting Factor that is more effective as population density increases
- Especially affects long lived organisms
  - Competition for food and other resources
  - Predation
  - Parasitism

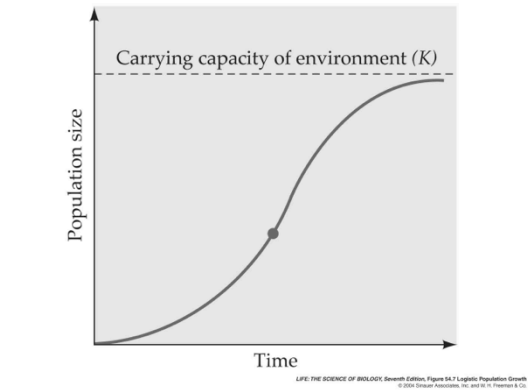
Exponential Growth

- If there is little competition for a resource, the population may experience a period of exponential growth.



Logistic Growth

- As population density (and competition) increases, growth becomes logistic and levels of at the carrying capacity.
- Carrying Capacity (k)- the maximum population size that can be supported by the available resources in a given area.



Exponential (J-Curve) vs. Logistic Growth (S-Curve)

[redacted]

Boom and Bust Cycle

- If growth is exponential until the carrying capacity is reached (and overshot), a massive death rate will follow.

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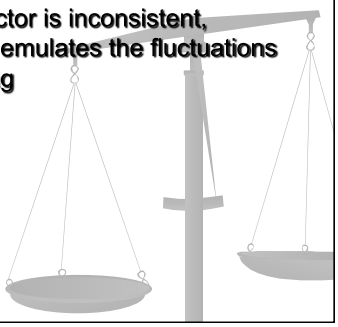
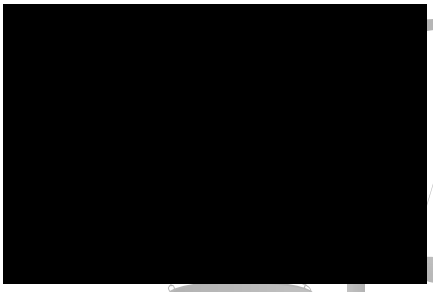
Predator-Prey Cycle

- If the limiting factor is inconsistent, population size emulates the fluctuations with a bit of a lag

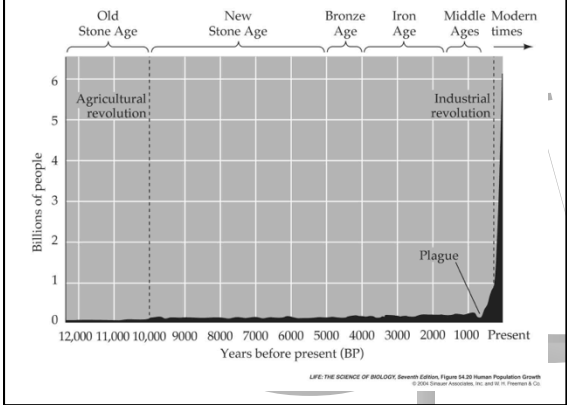


Predator Prey Cycle



Human Population Growth

- Why doesn't environmental resistance take effect?
  - Altering the environment
  - Technological advances in
    - Culture
    - Agriculture
    - Industry
    - Medicine



Ozone "Layer"

- Earth's atmosphere is divided into several layers, the lowest layer is called the troposphere, and next layer is called the stratosphere
- The Ozone Layer is not an actual layer but a concentration of O_3 molecules, located in the stratosphere, which is about 15-30km above Earth
- The ozone layer absorbs a portion of the radiation from the sun, preventing it from reaching the planet's surface.
- Most importantly it absorbs the portion of ultraviolet light called UVB

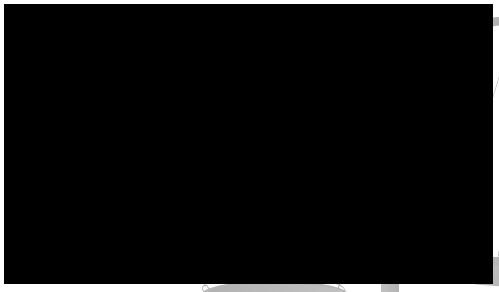
Ultra Violet B

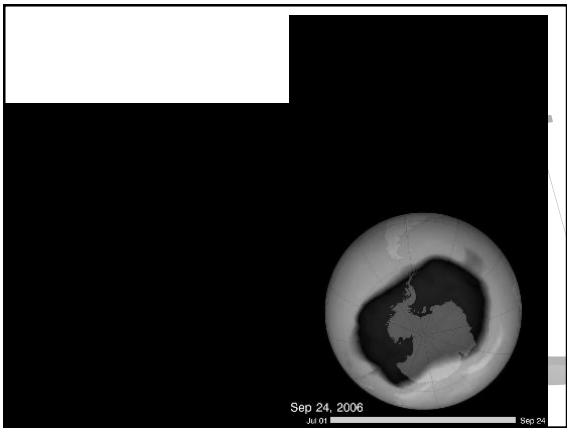
- UVB has been linked to skin cancer, cataracts, crop damage, and harm some forms of marine life

Ozone Depletion

- In the early 1970's, researchers began to investigate the effects of CFC's (chlorofluorocarbons) on the ozone
- CFC's contain chlorine, and are found in aerosol propellants, refrigerants, solvents, and many other products
- CFC's are so stable only exposure to strong UV radiation breaks them down; once CFC's are broken down chlorine is released
- One chlorine atom can destroy over 100,000 ozone molecules
- There is no actual "hole", but a low concentration of O_3

Ozone Depletion





Montreal Protocol

- International Treaty to phase out and ban the use of CFC's
- Opened for signatures in 1989, by 2009 all countries of the United Nations had signed.

Symbiosis

- **Symbiosis-** relationship of species that live together in a close, long term association.
- **Secondary compounds-** defensive chemicals in plants or animals
- **Niche-** the role a species plays within an ecosystem
  - Fundamental niche
  - Realized niche
- **Biodiversity-** the variety of organisms and species within an ecosystem.

Symbiotic Relationships

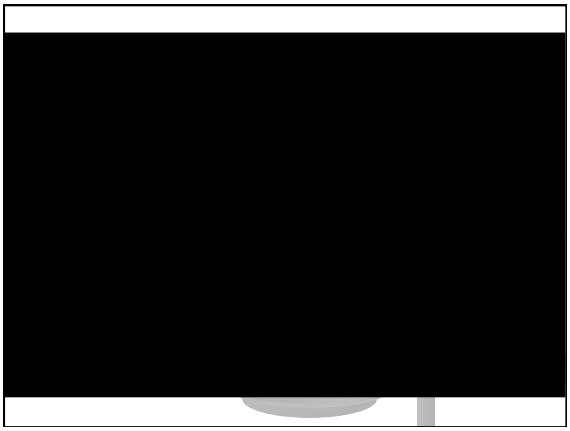
- **Competition** (- ,-) species using the same resources.
- **Predation** (+,-) one organism kills another for food.
- **Parasitism** (-,+) a parasite benefits and a host is harmed.
- **Mutualism**(+,+) symbiosis where both species benefit.
- **Commensalism**(+, 0) - relationship where one species benefits and the other is neither harmed or helped.
- http://www.nearctica.com/ecology/pops/symbiote.htm

Biomes

- **Biome-** a large area with a type of climate and certain types of plants and animals.
- **Climate**- the physical conditions and average weather conditions of a particular area over a long period of time.
  - Moisture
  - Temperature

Terrestrial Biomes

- Tropical Rain Forest
- Savannas
- Chaparral
- Deserts
- Temperate Grassland
- Temperate Deciduous Forest
- Taiga-Temperate Coniferous Forest
- Tundra
  - http://www.mbgnet.net/index.html



Convection Cells

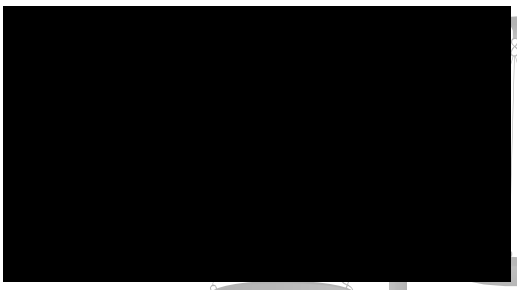
Location of the Worlds Biomes

- Tropical Rainforest will be located around the Equator due to hot, humid air from Hadley Cell.
- Deserts will be located around 30° N and 30° S due to cool dry air from the Hadley Cell and Ferrel Cell
- Taiga will be located around 60° N due to wet air from the Ferrel and Polar Cell

Mountain Effect

- On the windward side of a mountain, warm wet air from prevailing winds will rise, cool and condense causing precipitation.
- On the leeward side of a mountain, air that travels over the mountain will be cool and very dry.
- Dry biomes like deserts and grasslands can be created on the leeward side of the mountain.

Mountain Effect



Succession

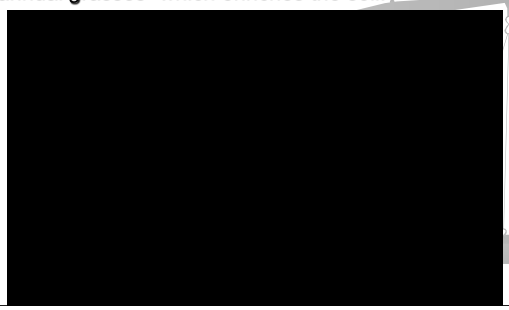
- Ecosystems change over time as species are introduced by natural means or abiotic factors.
- Pioneer species are organism that are first to live in an area.
- Climax Community- a stable, self perpetuating plant and animal community established by succession.

Primary Succession

- Ecosystems change over time as species are introduced by natural means or abiotic factors.
- Primary Succession occurs in an area with newly exposed rock, lava, or sand, where life has not lived before.
  - retreated glacier
  - lava cooling
  - new beach forms
  - Etc.

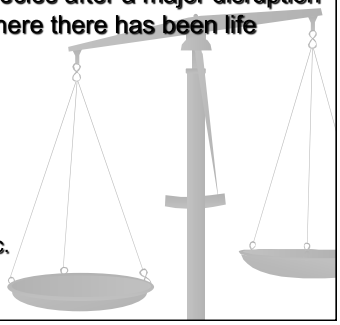
Primary Succession

- Primary Succession begins with bare rock, and pioneer species like lichen, mosses, and or small annual grasses- which enriches the soil.



Secondary Succession

- Secondary Succession- the sequential replacement of species after a major disruption in a community where there has been life before.
  - forest fire
  - flood
  - climate change
  - cultivation
  - plowed field
  - clearcut forest, etc.



Secondary Succession

- If fertile soil is present secondary succession replace established species as new species become more competitive.

Invasive Species

- Natural Selection favors organisms that can disperse and then colonize new territory.
- Plants use wind and animals for dispersal, animals can move great distances.
- Barriers like continents, mountains, and inhospitable conditions provide barriers for exotic species.
- Exotic (Invasive) Species that overcome natural barriers can damage ecosystems.
- The ecosystem has no checks on the exotic species- which upset balance.