Biology Unit 9 Ecology

9:1 Populations

SPECIES: organisms of the same kind which are able to interbreed and reproduce

Example: Horse + Donkey→ Mule (64 + 62→63 chromosomes and cannot produce offspring)

ECOLOGY: the scientific study of interactions of organisms with each other and with their environment

BIOSPHERE: the surface of the Earth (air, land, water) where living things exist.

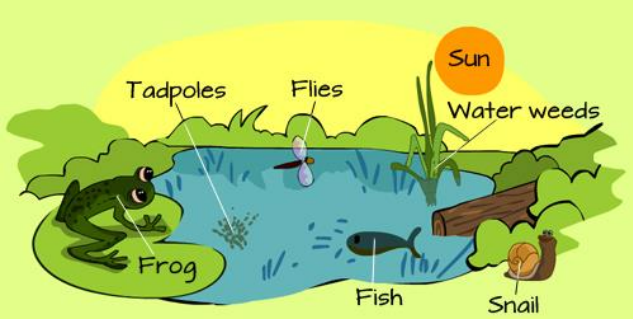
The biosphere includes land, water, and atmosphere. It extends from 8 km above the Earth's surface to 11 km below the ocean's surface.

BIOMASS: organic material in an ecosystem

Example: Plant matter, forest residues (dead, trees, branches, tree stumps), yard clippings, wood chips and even municipal solid waste

ECOSYSTEM: the interactions among the living populations of a community and the nonliving elements in their environment

Includes organisms, soil, weather,



water, weather, and energy.

BIODIVERSITY: the variety of life forms within a given ecosystem, biome, or for the entire Earth
It is used to measure the health of an ecosystem. Beneficial to humans for food, timber, medicines, etc.

BIOTIC FACTORS: living elements in an ecosystem, organisms
Example: Animals, Plants, and Fungi

ABIOTIC FACTORS: nonliving elements in an ecosystem
Example: soil, temperature, water, noise

HABITAT: the physical space in which an organism lives
Would be considered the organism's address
Example: Bee→ Bee hive in a forest or field.

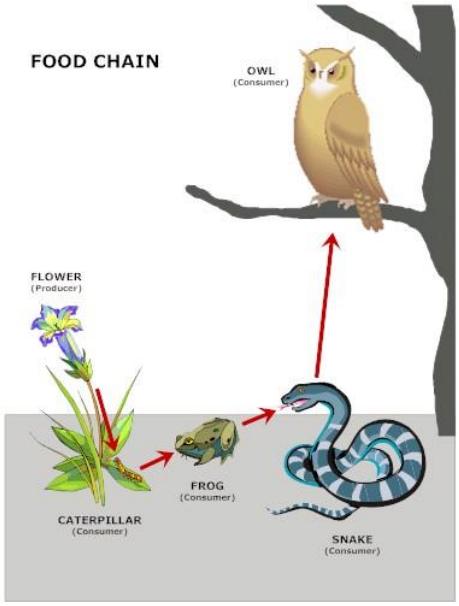
NICHE: a species way of life or the role the species plays in the community
Would be the organism's occupation
Example: Bees→ making honey, pollinating flowers, and drinking nectar

POPULATION: individuals of the same species that live in the same place

COMMUNITY: individuals of all the different species in a given area

9:2 Energy for Life

FOOD: an organic compound that living things may break down and use for energy



FOOD CHAIN: diagram showing the relationship between organisms and their food supply

- Energy flows in ONE direction from producers to various levels of consumers
- flower→caterpillar→frog→snake→owl

PRODUCER/AUTOTROPH: an organism that produces its own food through photosynthesis and brings energy from nonliving sources into the community

e.g. green plants, algae

Two niches of producers:

- PHOTOAUTOTROPHS: using light energy (plants)
- CHEMOAUTOTROPHS: using chemical energy (cyanobacteria)

CHEMOSYNTHESIS: process where autotrophs can make own food in the absence of light where they use energy stored in chemical bonds of inorganic molecules to produce carbohydrates

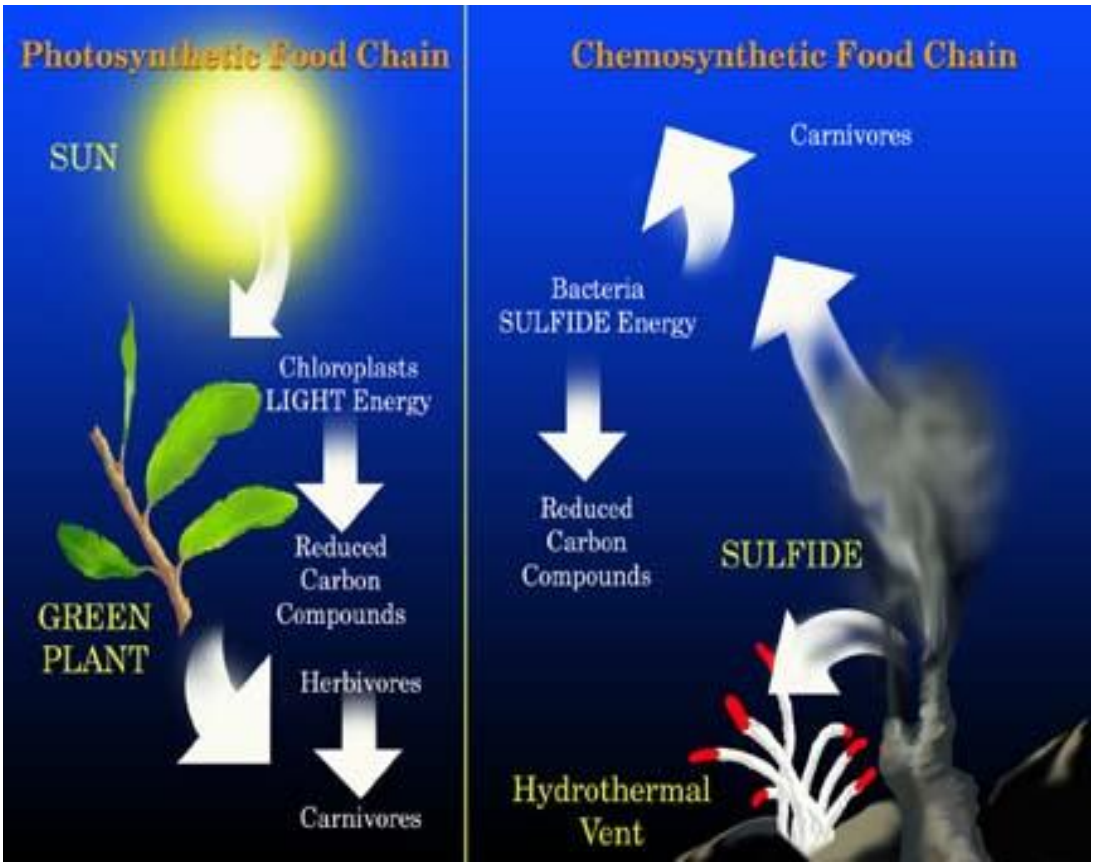
Example: Bacteria that live in HOSTILE places such as deep sea vents, volcano vents, hot springs, and marshes

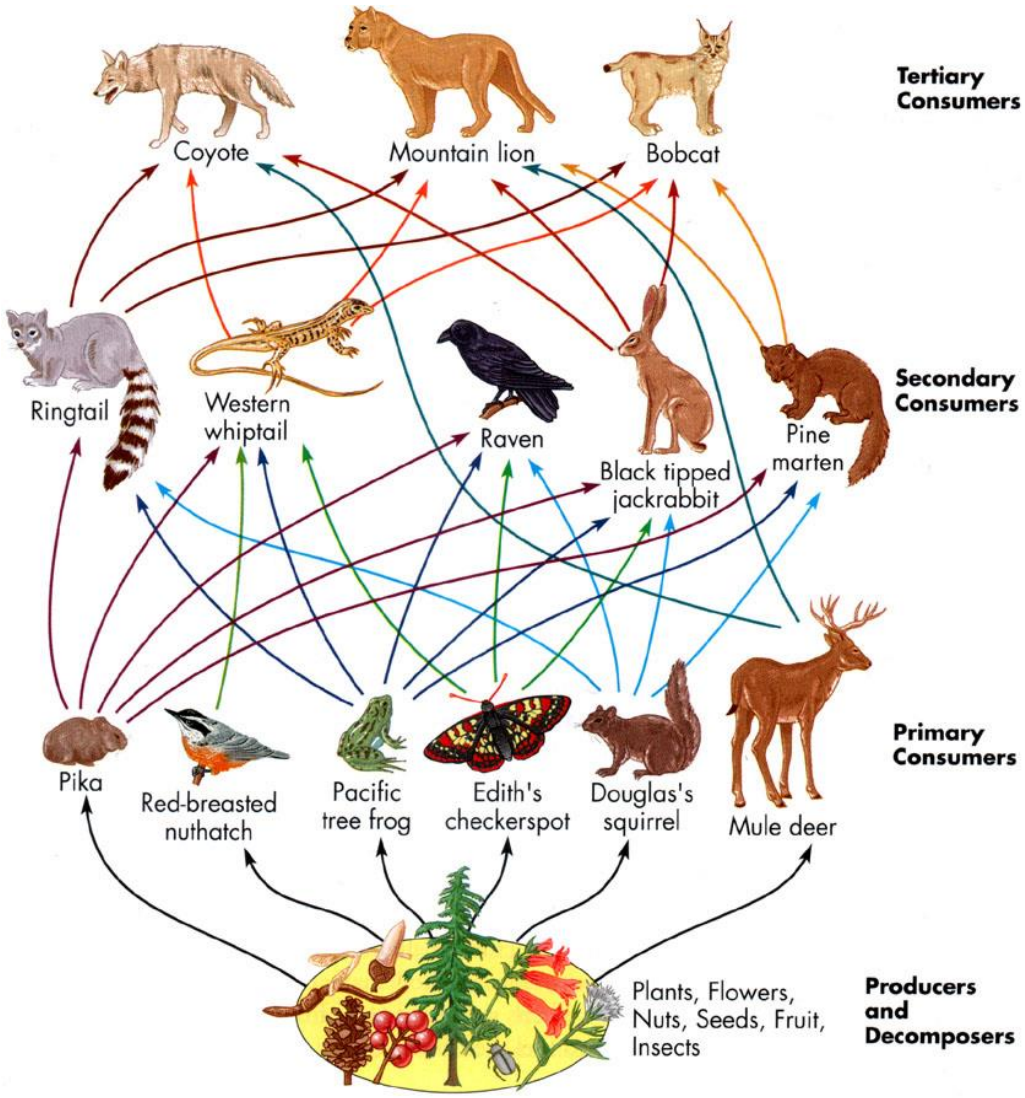
CONSUMER/HETEROTRPH: an organism that depends on others for its food e.g. animal, bacteria, fungi

HERBIVORE: (1st order consumer) organism that eats plants

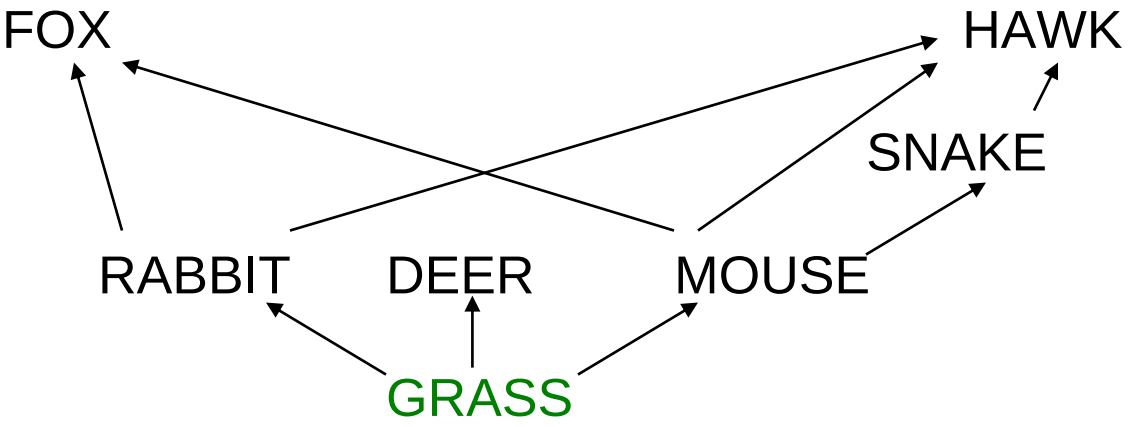
CARNIVORE: (2nd, 3rd or higher order consumer) organism that eats animals

OMNIVORE: organism that eats both plants and animals
e.g. human





<u>FOOD WEB</u>: diagram showing a group of food chains that are related



DECOMPOSER: small organisms that break down dead matter into CO_2 and minerals (inorganic material) for plant use

e.g. bacteria, molds

DETRITIVORES: small organisms that feed on plant and animal remains

e.g. mites, earthworms, snails, and crabs

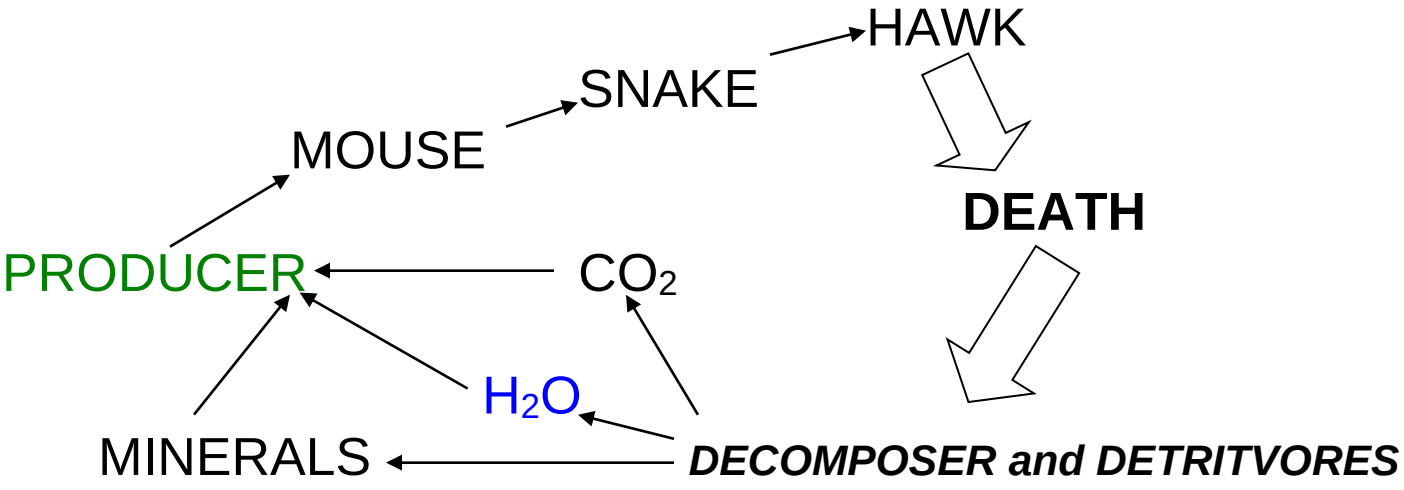
SCAVENGER: animals that feed on dead matter

e.g. buzzard

PREY: animal that is hunted for food

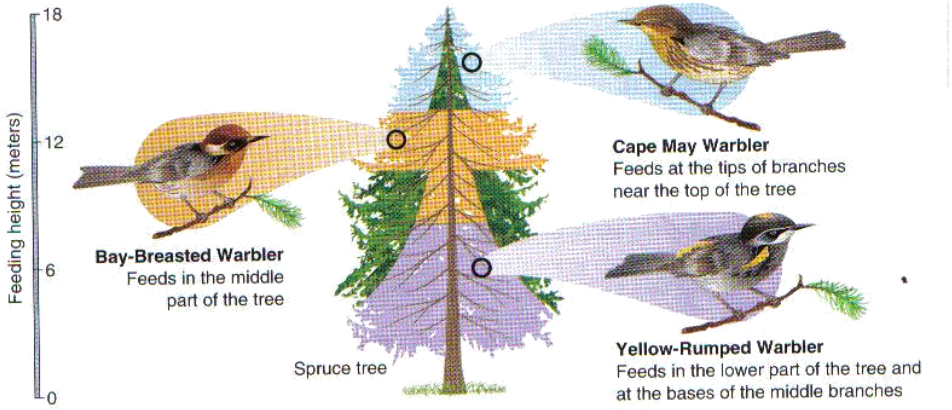
FOOD CYCLE: diagram showing how matter travels from producer to consumer and back to producer

- The consumer at the top will die and bacteria in the group will decompose to return nutrients to the soil
- Producers absorb the nutrients and it is recycled



9:3 Ways Organisms Interact

COMPETITIVE EXCLUSION PRINCIPLE: no two species can share the same niche; a species will be eliminated by a community because of competition.



RESOURCE: anything needed by an organism for life
Example: Nutrients, Water, Light, Space

LIMITING FACTOR: when a nutrient is in short supply or cycles slowly, it will limit the growth of the population
Example: During a drought, not enough food available and many kangaroos starved

COMPETITION: when organisms (different or same species) compete with each other for available resources
Example: compete for food, shelter, mates, space/territory, light

PREDATOR: animal that hunts another animal for food

COOPERATION: between the SAME species where they live together and help each other
Example: Share foods, childcare responsibilities, groom each other, and take care of sick, hunt in packs, provide protection

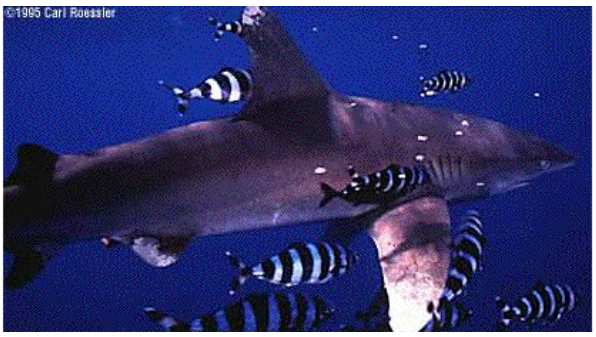
SYMBIOSIS: between DIFFERENT species where they live in close association with another kind of organism

Three kinds of Symbiosis:

- MUTUALISM: both organisms benefit
  - Insects transfer pollen between plants as they gather nectar for food
  - Birds eat parasites living on the hides of giraffes and rhinos, while enjoying protection from predators

- Clown fish receive protection from enemies by hiding in sea anemones, sea anemone gets scraps of leftover food dropped by fish

- COMMENSALISM: one organism benefits; while the other is neither harmed nor helped



  - Pilot fish receive scraps of food dropped by shark; Shark is neither harmed nor helped
  - Hermit crabs make homes in shells abandoned by snails; snail is not harmed by crab

- PARASITISM: one organism benefits; other is harmed in some way

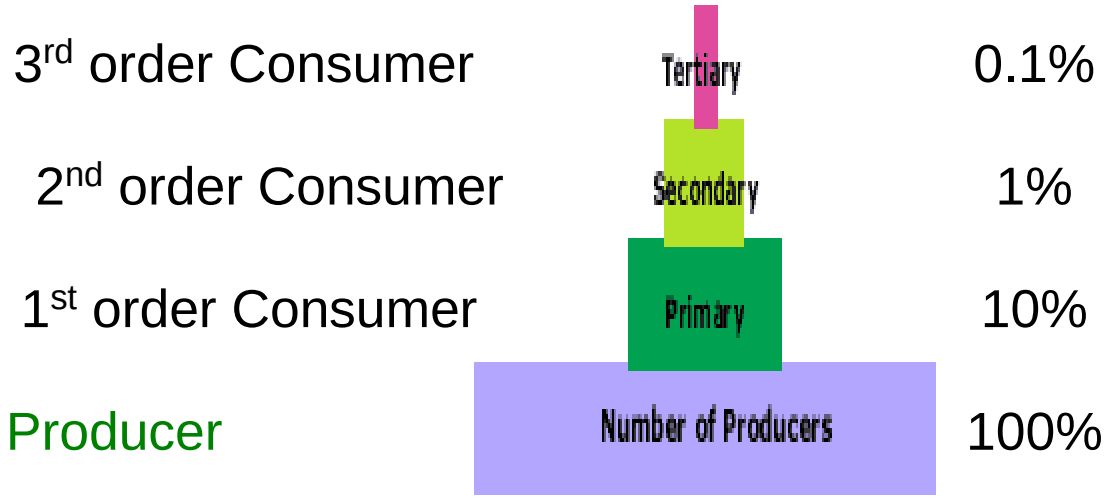
  - Tick feeds on dog's blood; dog has discomfort and can get diseases/infection
  - Barnacles are crustaceans that attach to the surface of whales and feed on their skin and fluids; Whale is harmed

9:4 Energy Pyramids

PYRAMID OF ENERGY (aka Pyramid of Numbers):

quantitative relationship between organisms in a food chain

- Each higher feeding level receives only 1/10 the energy available to the previous level. 90% of the energy is:
  - It is used for life processes such as growth, development, movement, metabolism, transport, and reproduction
  - Or lost as HEAT
- Each higher feeding level has 1/10 of the number of organisms at the previous level. This 90% decrease in numbers occurs because of the energy losses when one organism feeds on another.



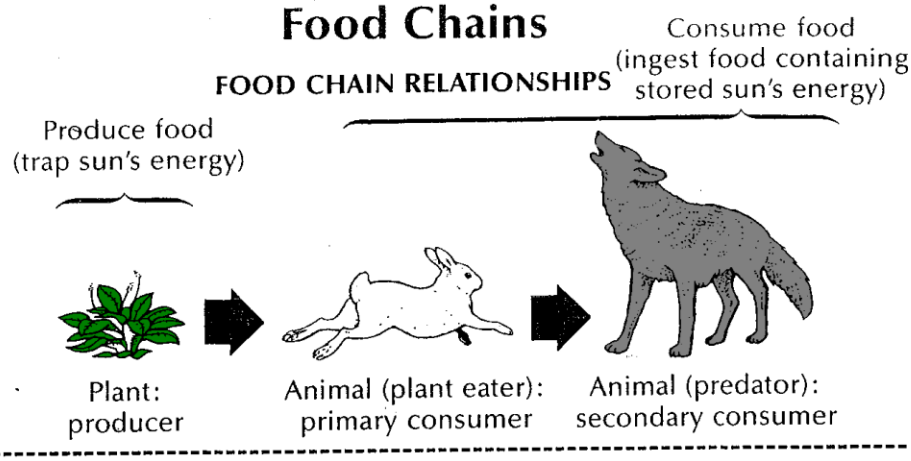
TROPHIC LEVEL: each level in a food chain

- Producers: always the first trophic level
- Herbivores: second trophic level
- Carnivores/Omnivores: make up the remaining trophic levels

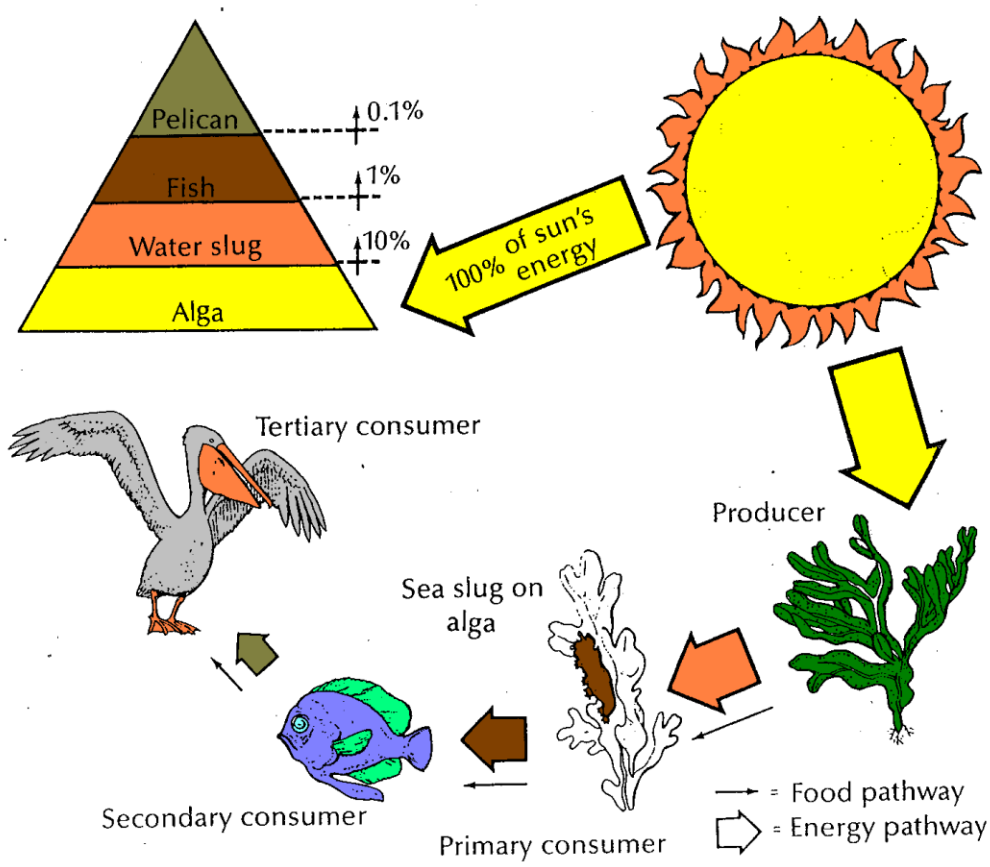
Energy is always "lost" as heat energy at each trophic level.
Matter is always recycled.

Food Chains

FOOD CHAIN RELATIONSHIPS



CONSTRUCTING A FOOD CHAIN AND ENERGY PYRAMID



9:5 Succession

SUCCESSION: the series of ecological changes that every community undergoes over long periods of time.

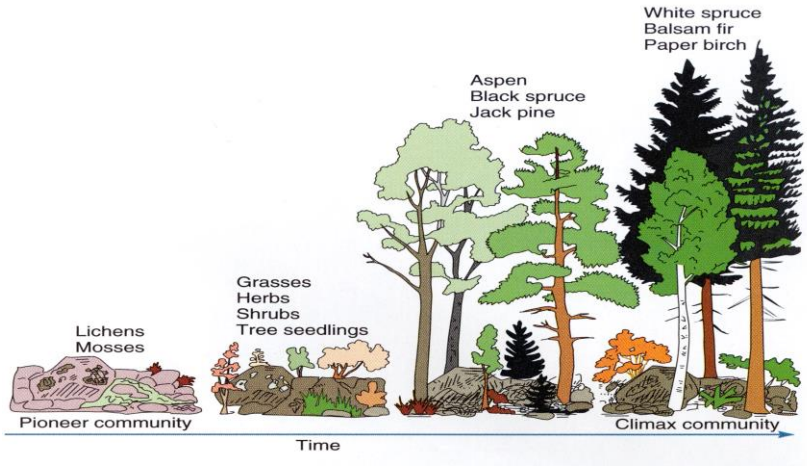
PRIMARY SUCCESSION: colonization of new sites by communities of organisms; takes place on bare rock

Will develop from three sources:

1. Volcanic lava flow cools and forms rock
2. Glaciers retreat and expose rock
3. Landslides

PIONEER ORGANISM: the first organisms to colonize a new site

Example: lichens and algae are the first to colonize



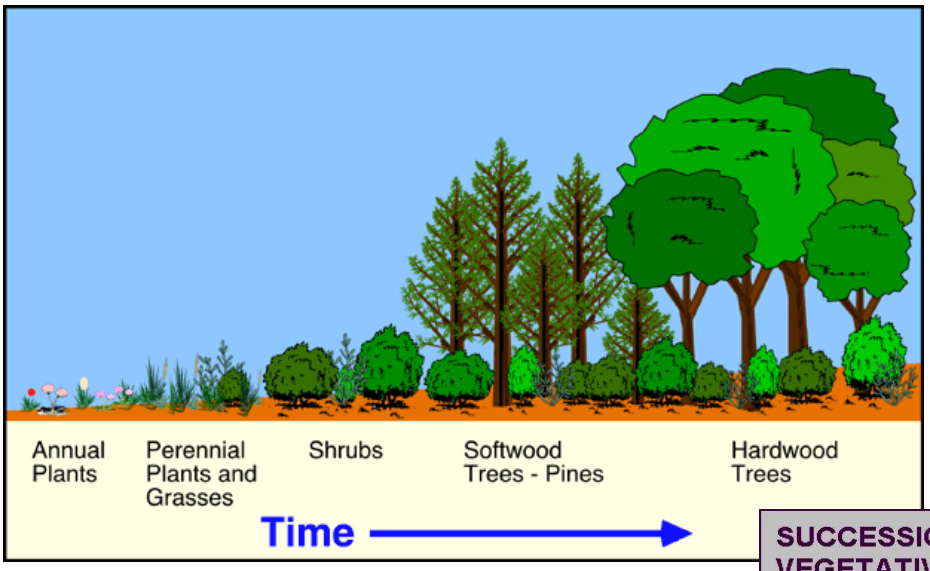
The Process of Primary Succession

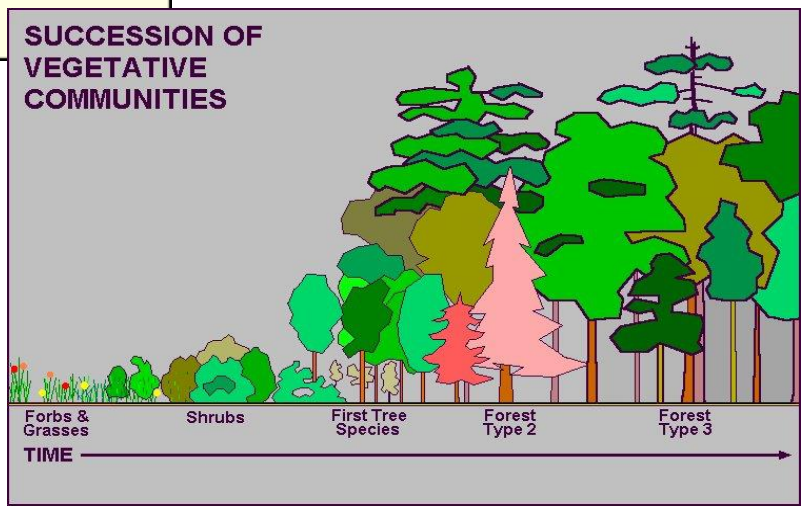
1. Small hardy plants such as lichens will gradually break down the surface of rock and soil will start to form.
2. As plants grow and die they add organic material from their bodies to the soil that is forming. Worms and insects will start to move in to the community.
3. As a thin soil forms, other small plants such as grass and small shrubs will begin to grow. This adds to the soil as they grow and die.

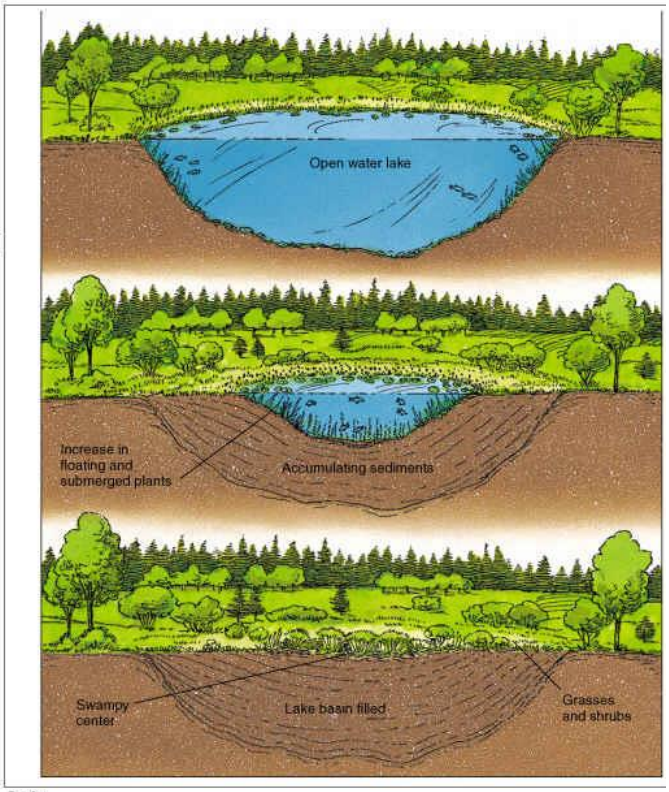
4. Small animals such as mice and rabbits will move into area as more plants grow to provide food and shelter.
5. Over time, as the soil becomes rich and deeper, more large plants will grow such as large shrubs.
6. Climax community forms if the abiotic conditions are favorable, trees will grow and a forest will form where once there was only bare rock.

SECONDARY SUCCESSION: sequence of community changes that takes place when a community is disrupted by natural disaster or human actions; takes place on existing soil and is a replacement

Example: Farmer plowing land, a fire levels portions of the forest







Caption
(a) What begins as a lake gradually fills with organic and inorganic sediments, which successively shrink the area of the pond. A bog forms, then a marshy area, and finally a meadow completes the successional stages. (b) Aquatic succession in a mountain lake. [Photo by Bobbé Christopherson.]

CLIMAX COMMUNITY: the stage in succession where the community has become relatively stable through successful adjustment to its environment

9:6 Properties of Populations

POPULATION DENSITY: a measure of how crowded a population is, expressed as the number of individuals per unit of area

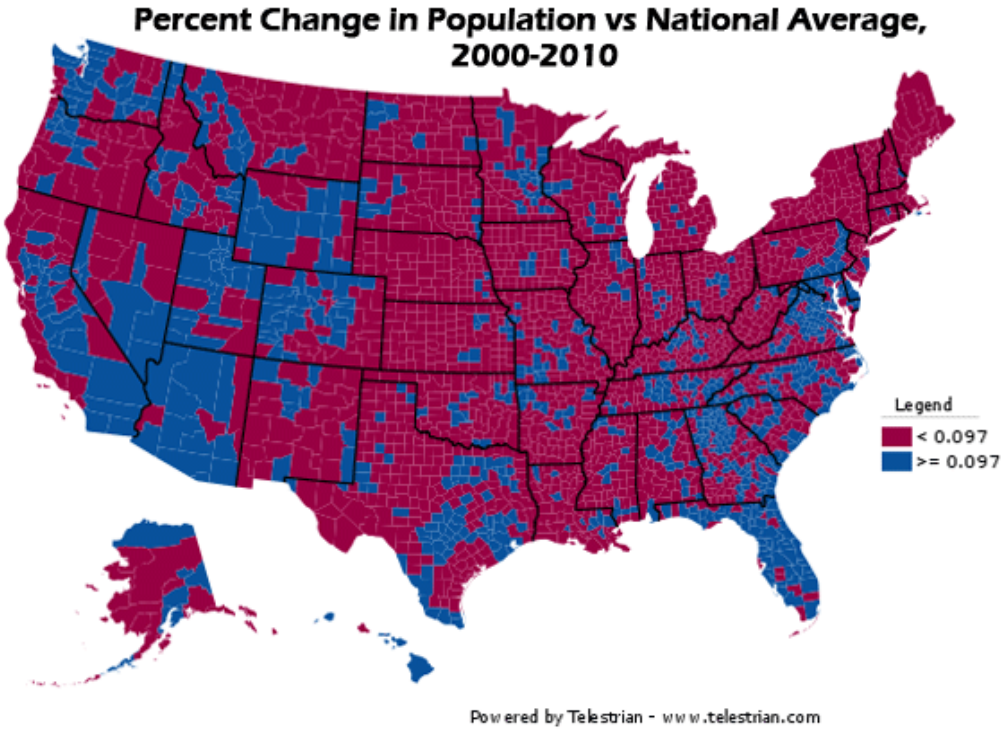
GROWTH RATE: the amount by which a population's size changes in a given time

Populations are dynamic or constantly changing.

Population sizes are increased by:

BIRTH: new organisms born into the population

IMMIGRATION: organisms moving into the population
Population sizes are decreased by:
DEATH: organisms leaving the population when they die
EMIGRATION: organisms moving away from the population



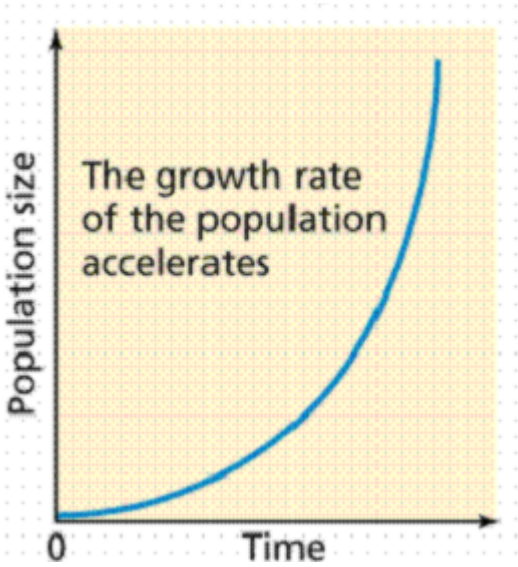
Populations cannot grow indefinitely because:
1. Resources they depend on become scarce
2. Wastes accumulate

LIMITING FACTOR: a factor that restrains the growth of a population

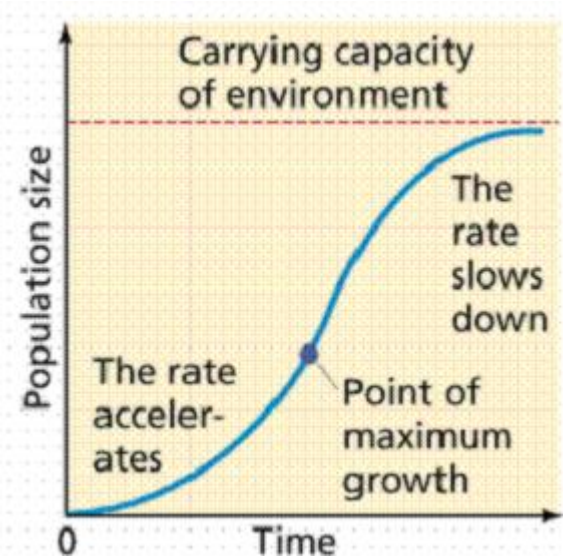
Two Kinds of Limiting Factors:
DENSITY DEPENDENT: triggered by increasing population density, so population size determines the effect the factor has on the population. Examples: food or habitat shortages

DENSITY INDEPENDENT: reduce the population regardless of the population's size; population size does not determine the effect the factor has on the population.
Examples: weather, floods, fires

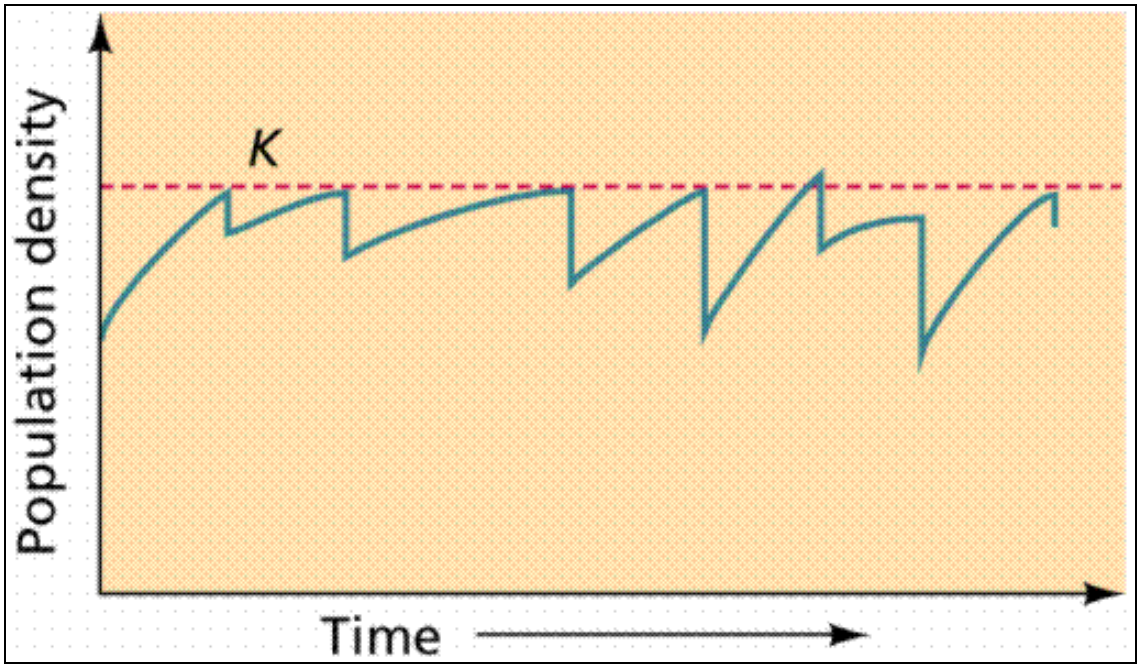
Two Modes of Population Growth:
EXPONENTIAL GROWTH: (J-curve) unlimited growth that occurs when there is no limit to population size



LOGISTIC GROWTH: (S-curve) population growth slows down or stops due to the effect of a limiting factor, such as the carrying capacity of the environment



CARRYING CAPACITY: (K) the maximum number of individuals of a species that an ecosystem is capable of supporting on a sustained basis

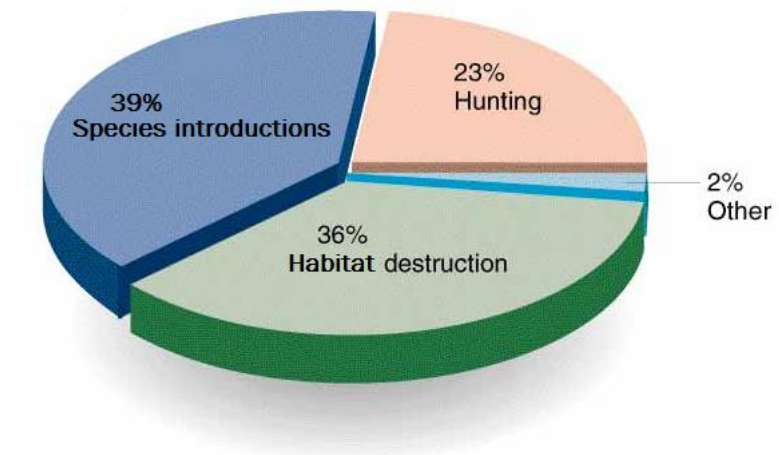


When a population reaches the carrying capacity of the environment, organisms will start to die due to lack of resources or accumulation of waste.

9:7 Extinction

EXTINCTION: when a species disappears from Earth

Known Causes of Animal Extinctions since 1600

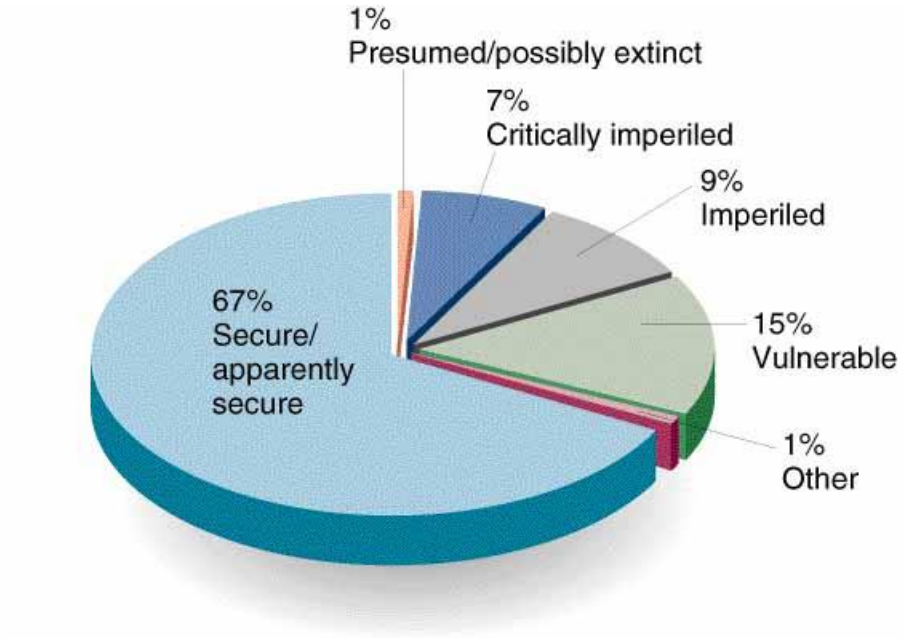


- Small populations are vulnerable to extinction

- Small populations→more likely to INBREED→causes a decreases in genetic variability and less likely to adapt to environmental changes

ENDANGERED SPECIES: species whose population is in danger of extinction

Species at Risk of Extinction



- Species are now disappearing faster than at any time since the last mass extinction, when the Dinosaurs disappeared 65 million years ago.
- Scientists estimate that about 1/5 of the species in the world may disappear in just the next century.

What are the greatest threats to Biodiversity?

1. HABITAT DESTRUCTION

   More than ½ the world's Tropical Rain Forests have been destroyed and the other ½ is likely to be gone by 2020. Tropical Rain forests contain 20% of all species on Earth.

2. SPECIES INTRODUCTION

   INVASIVE SPECIES: organisms that are not indigenous or native to a given area, may adversely affect the habitats they invade

   - Many invasive species have been accidentally or deliberately introduced to a new location by human activity
   - Native species may not be able to compete with invasive species, causing extinction of native species


Kudzu overtaking shrubs

African Honeybee (very aggressive)


Japanese Beetle


Honeysuckle