

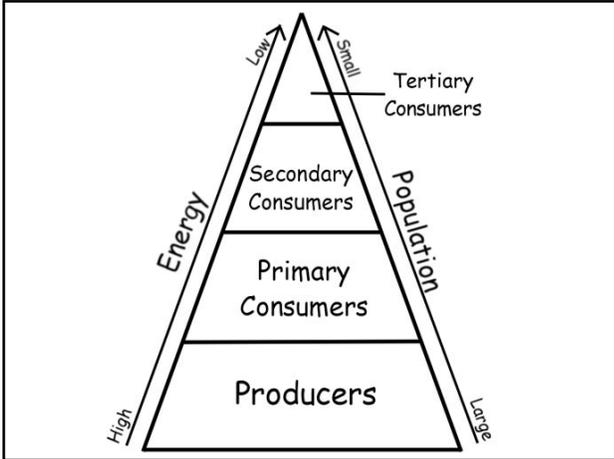


Carrying Capacity

- The largest population of a species that an environment can support is called the **carrying capacity**.
- Four main factors affect carrying capacity:
 - Materials and energy
 - Food chains
 - Competition
 - Density

Materials and Energy

- All populations of organisms are ultimately limited by amount of usable energy from the sun, as well as the supply of water, carbon, and other essential materials
- Energy flows from the sun to producers, to primary consumers, to secondary consumers, and so on
- Energy is lost between trophic levels in the form of heat from cellular respiration



- Approximately 10-20% of the energy at each trophic level is lost as heat
- This limits the size of a food chain
 - The more energy a producer can capture, the longer the food chain

Food Chains

- The population size at any trophic level is limited by the population (or biomass) in all the levels below it.
- Populations are limited by food.
- Populations are also limited by organisms in the trophic levels above them.
- Animal populations are limited by predators.
- Plant populations are limited by herbivores.

Competition

- Each organism has the same needs as other organisms.
 - Food, water, mates, space
- This demand results in competition.
 - Foxes in an area may eat rabbits for lunch. A rabbit population is low and the fox population is high, competition for food among foxes increases.

- Competition among members of the same species is called **intraspecific competition**.
 - Foxes in an area may also compete with wolves and coyotes for rabbits.
- Competition between species is called **interspecific competition**.
 - All of the herbivores in an area compete for the same food.
- Both intraspecific and interspecific competition can limit population growth.

Density

- Different species have different needs for space depending on their size, environment and way of life.
 - Grizzly bears space themselves out
 - Penguins live together in large groups
- This need for space determines an organism's **population density**.
 - How many individuals can live in an area at one time.

- If a population density increases beyond a suitable level for a particular species, conditions are produced that tend to limit growth.
 - Overcrowding may increase the spread of disease or parasites
 - Overcrowding in some species increases aggression and neglect of offspring (increases death rate and lowers birth rate)
- Factors that increase in significance as a population grows are called **density-dependent factors**.

- Other factors can limit a population, regardless of its size.
 - A forest fire may kill most of the snakes in the forest, whether there are 10 or 10 000 of them.
- Such factors are called **density-independent factors** because their effect on population size does not depend on how many individuals there are in the population.

Population Size

- Population can increase due to:
 - Natality
 - Offspring added to population
 - Immigration
 - Individuals moving into the area
- Population can decrease due to:
 - Mortality
 - Individual dies (eaten, sickness, old age)
 - Emigration
 - Individuals moving out of the area

Population Growth

- Population growth goes through three phases:
 - Exponential
 - Quick growing when there are very few limiting factors
 - Plants germinating in spring
 - Transitional
 - Slowing of growth rate as the population approaches the carrying capacity
 - Population plateau
 - The population remains constant or stable
 - Note: the plateau may have variations year to year around an average value

Population Growth Curve

