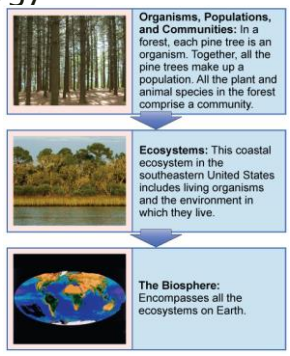
CLIMATE AND ECOSYSTEM DYNAMICS

Science 10
Ms. Hayduk

What is Ecology?

- **Ecology**: study of the interactions between living things and their environment
- **Biotic**: living
- **Abiotic**: non-living

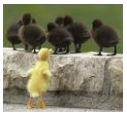


populations



not populations



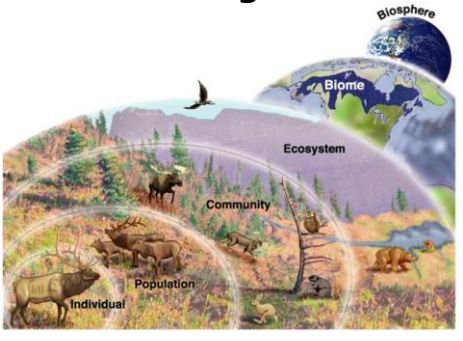


communities



ecosystem

Levels of Organization



Levels of Ecology

- Organism: study adaptations that let an organism survive in a specific habitat
- **Population**: study number of individuals of the same species in an area; how and why number changes over time
- **Community**: study of interactions between various species that live in the same area
- **Ecosystem**: study of how nutrients and energy are stored and move among organisms, soil, water and air

Quick Quiz…

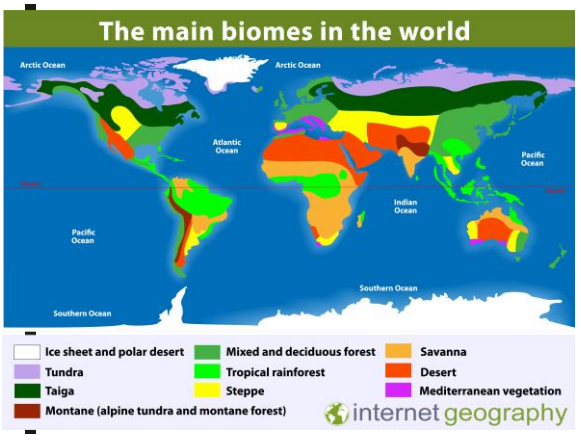
1. Which of these is a biotic factor?

Wind	Disease-causing bacteria
Temperature	Soil particle size

2. Studying the water cycle is an example of _____ ecology.

Biogeography

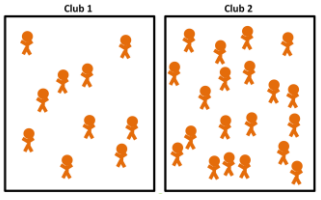
- Studies where different species are found on Earth, and the abiotic factors that affect their distribution
- Defined areas are called "biomes"; categorized by energy sources (access to sun, nutrients), temperature, water (how much, type), inorganic nutrients and soil
- In aquatic (water) systems: oxygen levels, salt levels, current and tide
- In terrestrial (land) systems: wind, fire



Population Dynamics

- **Population**: group of the <u>same</u> species that live in an area
- **Population size**: total number of individuals
- **Population density**: number of individuals in a specific area or volume

Example: Population Density



Example: Classroom Population

What is the population size of this classroom?

What is the population density of this classroom, if its size is about 500 ft^2?

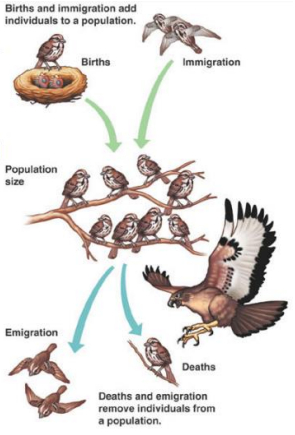
Population Density

- **Quadrat sampling**
  - Used for slow-moving, small or immobile organisms (like plants)
  - Mark a square area and count organisms in that area; repeated in multiple random spots can give an estimate of a population
- **Mark and recapture**
  - Catching and tagging animals, then releasing them back into the environment
  - Larger populations have fewer "recaptures"

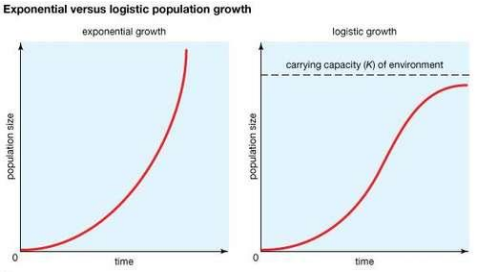
Dispersal Patterns

Population Growth

- Explains how population size changes over time
- **Birth/death rate**: number of births/deaths in a population in a certain amount of time
- **Immigration**: new individuals move <u>in</u> to a population
- **Emigration**: individuals move <u>out</u> of a population

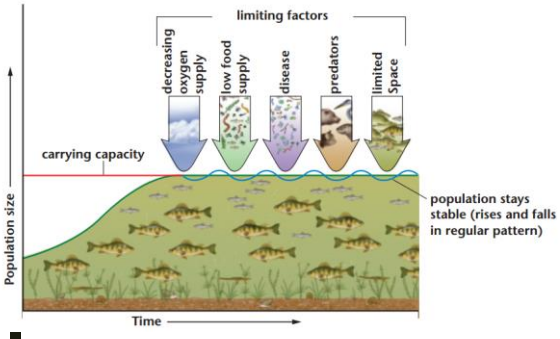


Growth Types



Carrying Capacity

- Largest population an area can support
- Depends on limiting factors, which prevent populations from growing larger
- Density-dependent factors (affected by how many individuals there are):
  - Disease
  - Competition
  - Predators
- Density-independent factors are generally environmental (food, weather, nutrients, etc.)



Community Ecology

- Based on interactions between different species in an area
- **Niche**: role of an organism its habitat (e.g. what it eats or is eaten by, how or when it reproduces, where it lives, etc.)
- Two organisms cannot occupy the same niche in an area – competition affects both populations

Interactions

1. **Competition**: struggle between organisms who use the same resource (e.g. same food)
   - *INVASIVE SPECIES*
2. **Predation**: one organism kills another for food
   - Predators have adaptations to help them catch prey
   - Prey have adaptations to avoid being caught

Invasive Species

- **Invasive species**: organism that grows and spreads quickly, often non-native, and lacks predators
- Competes in a different way than native species, since it does not have a niche (no role in the ecosystem)
- Can be aggressive and overwhelm native species (lowers biodiversity – more on this later)

Saskatchewan Invasive Species

Example: Purple Loosestrife

- Wetland plant introduced in the 1800s from Europe
- Has now spread through nearly every US state and at least six Canadian provinces
- Crowds out native plants and reduces food, shelter and nesting sites for wildlife, birds, turtles and frogs

Interactions

3. **Symbiosis**: relationship between organisms that live closely together
   - Commensalism: one benefits, other is unharmed (e.g. bird living in a tree, burrs on animals)
   - Mutualism: both species benefit (e.g. plants and pollinators, clownfish and sea anemones)
   - Parasitism: one species benefits, the other is harmed (e.g. ticks, tapeworms)

Ecosystems

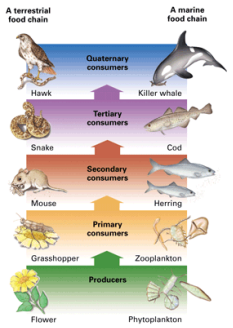
- Saltwater: in the ocean or salt seas; shallow, deep ocean water and deep ocean surfaces
  - Most common on Earth
- Freshwater: in lakes, rivers, streams and springs
  - Rarest on Earth
- Terrestrial: on land; grouped into biomes, but significant differences between different areas categories as the same biome

Balance in Ecosystems

- **Equilibrium**: all organisms are in balance with the environment and each other (populations are relatively constant, resources are available)
- **Resistance**: how well an ecosystem can stay balanced despite disturbances
- **Resilience**: how quickly an ecosystem recovers after being disturbed

Food Chains

- **Food chain**: linear sequence of organisms through which nutrients and energy pass (who eats whom?)
- Food chain levels →

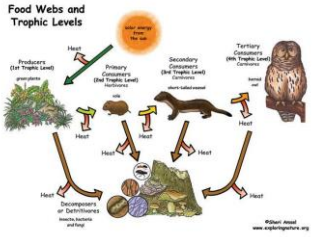


Trophic Levels

- Position in food chain is called trophic level
- **Producers** use photosynthesis to get energy
- **Primary consumers** eat producers
- **Secondary consumers** eat primary consumers
- **Tertiary consumers** eat other carnivores
- The top organism is the **apex consumer**
- **Decomposers** break down waste and dead organisms to return nutrients to soil

Food Webs

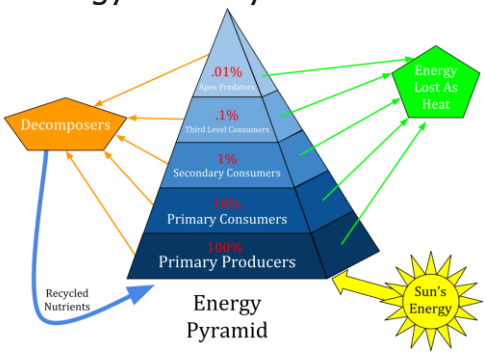
- Non-linear web of organisms within an ecosystem through which energy is transferred



Energy in Ecosystems

- Energy moves through living things by: photosynthesis, chemosynthesis and consumption/digestion of other organisms
- Energy pyramid shows amount of energy available in each trophic level
- Most energy at producer level, and decreases up the chain

Energy in Ecosystems



Movement of Energy

- Energy is lost between transfers
- EXAMPLE:
  - Spruce trees get energy from the sun.
  - Deer eat the buds off spruce trees (not the whole tree). Not all that is eaten is digested (some is released as waste) and some energy is converted to waste heat during digestion.
  - Wolf eats deer, but not all parts. Again, energy is lost through waste and heat.

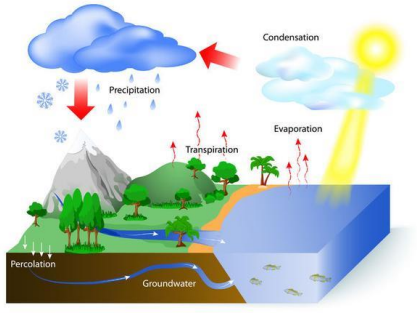
Biomagnification

- Occurs when toxic substances are introduced into the food web
- **Bioaccumulation**: build up of toxins in an organism because they are absorbed faster than they are released
- **Biomagnification**: higher amounts of toxic substances at each trophic level (e.g. pesticides)
- Small amount for each producer, lots for apex predators

Biogeochemical Cycles

- Nutrients also cycle through ecosystems
- Bio = life; geo = earth, so chemicals cycle through living and non-living things
- Cycles include:
  - Water
  - **Carbon**
  - **Nitrogen**
  - **Phosphorus**
  - Oxygen
  - Sulfur

Water Cycle



Biodiversity

- Amount of variation in the biosphere:
  - Genetic diversity (between organisms in a population to allow them to adapt)
  - Ecosystem diversity (number of different ecosystems on the planet, to encourage species interaction)
  - Species diversity (number of different organisms)

Why Does Biodiversity Matter?

- Medicine derived from compounds found in nature
- Crop diversity for food security (need wild crops to be able to make new varieties of domestic crops)
- Support for human agriculture through: pollination, nutrients, pest control, soil maintenance
- Access to wild food sources (e.g. fish)
- Psychological benefits

Threats to Biodiversity

- Habitat loss
- Overharvesting (**tragedy of the commons**), hunting
- Exotic or invasive species
- Climate change (extreme weather, changes in weather patterns, movement of habitat towards colder climes, change in breeding times and seasonal food resources)