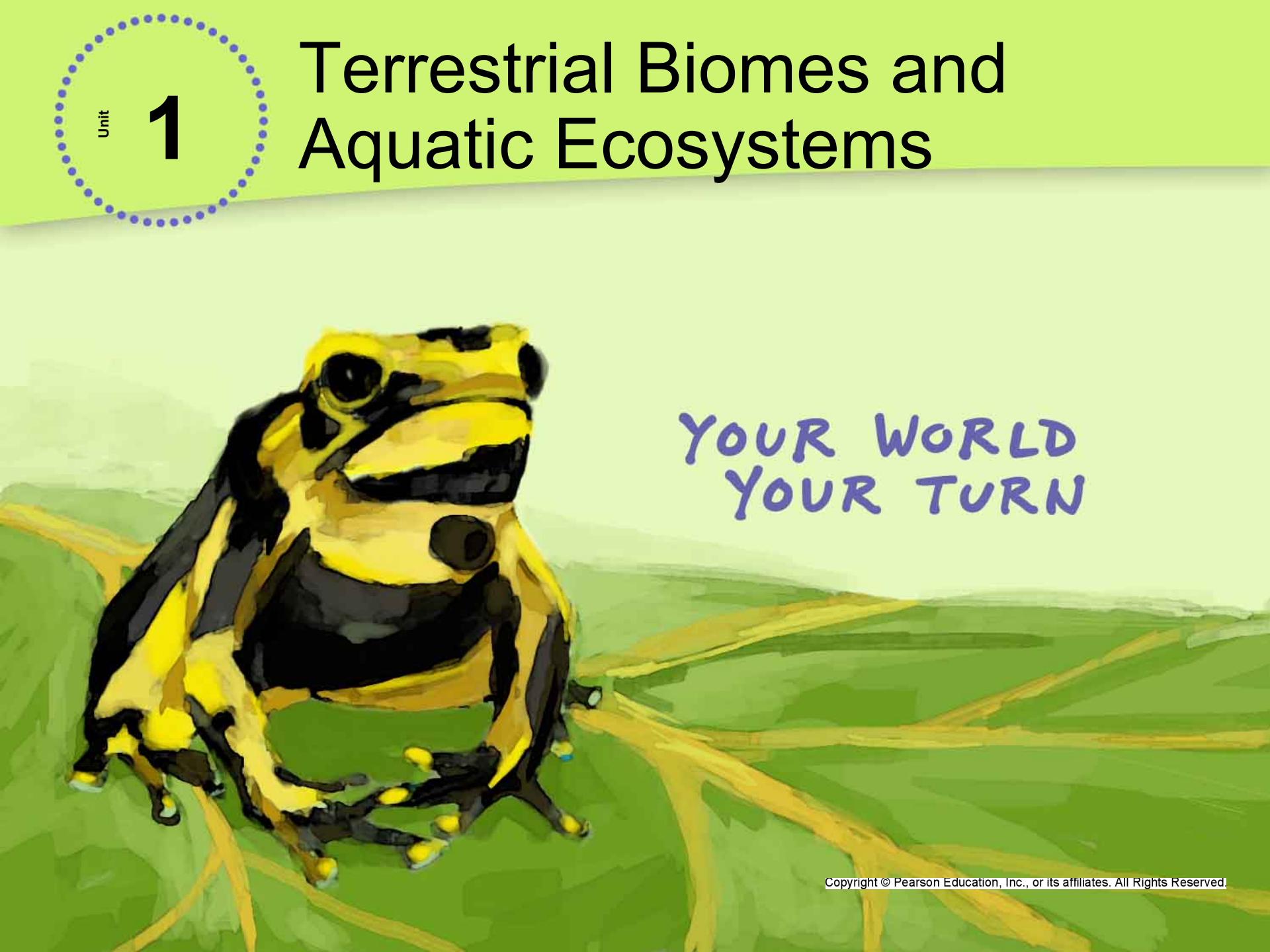
Unit 1

Terrestrial Biomes and Aquatic Ecosystems



Lesson 1.4 Defining Biomes

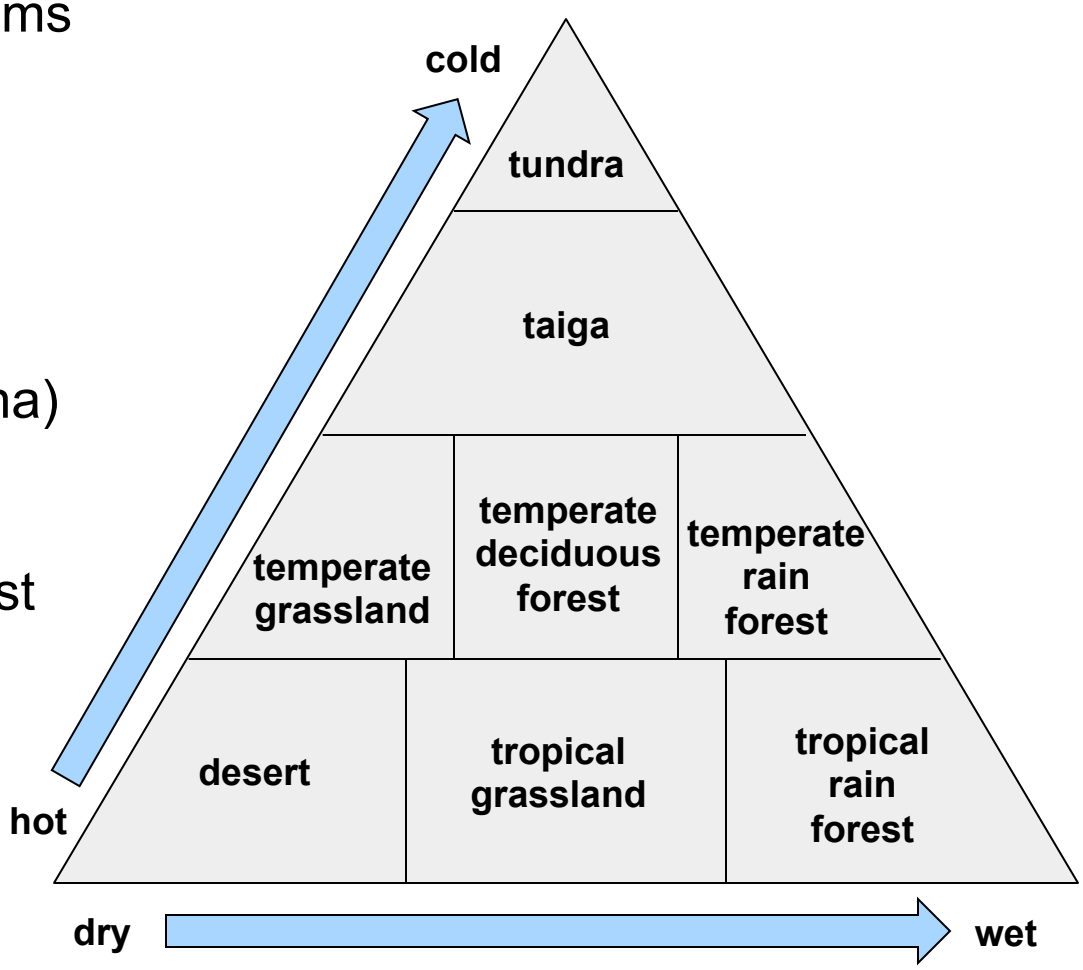
Today's Objective: Describe characteristic biotic and abiotic components of aquatic and terrestrial ecosystems.

Fossil evidence suggests that the frozen continent of Antarctica was once covered in temperate forest.

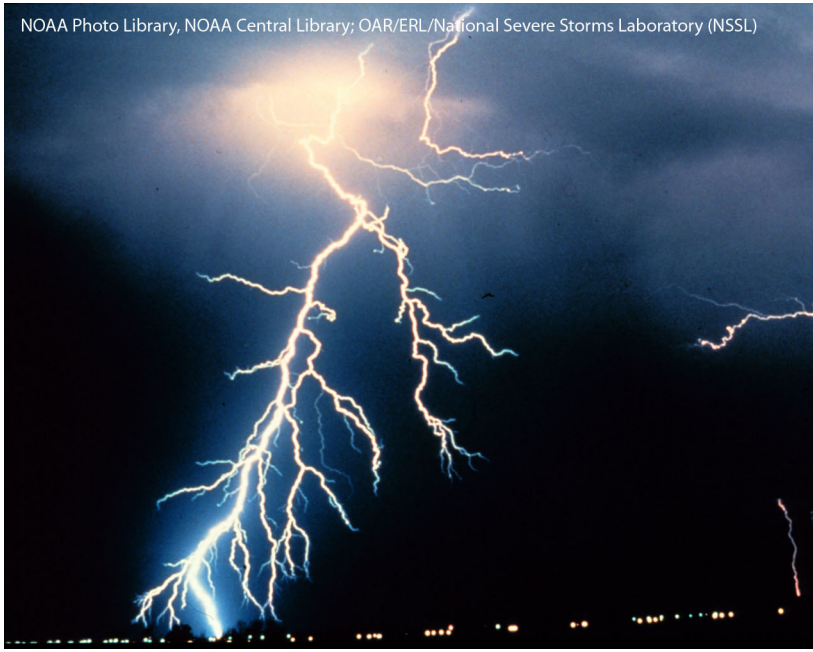
Ben Holt Sr/GRACE team/DLR/NASA

Earth's Major Biomes

- Groups of terrestrial ecosystems that share biotic and abiotic conditions
- **10 primary biomes:**
  - tropical rain forest
  - tropical grassland (savanna)
  - desert
  - temperate rain forest
  - temperate deciduous forest
  - temperate grassland
  - taiga (boreal forest)
  - tundra
  - freshwater
  - marine



Climate and Climatographs

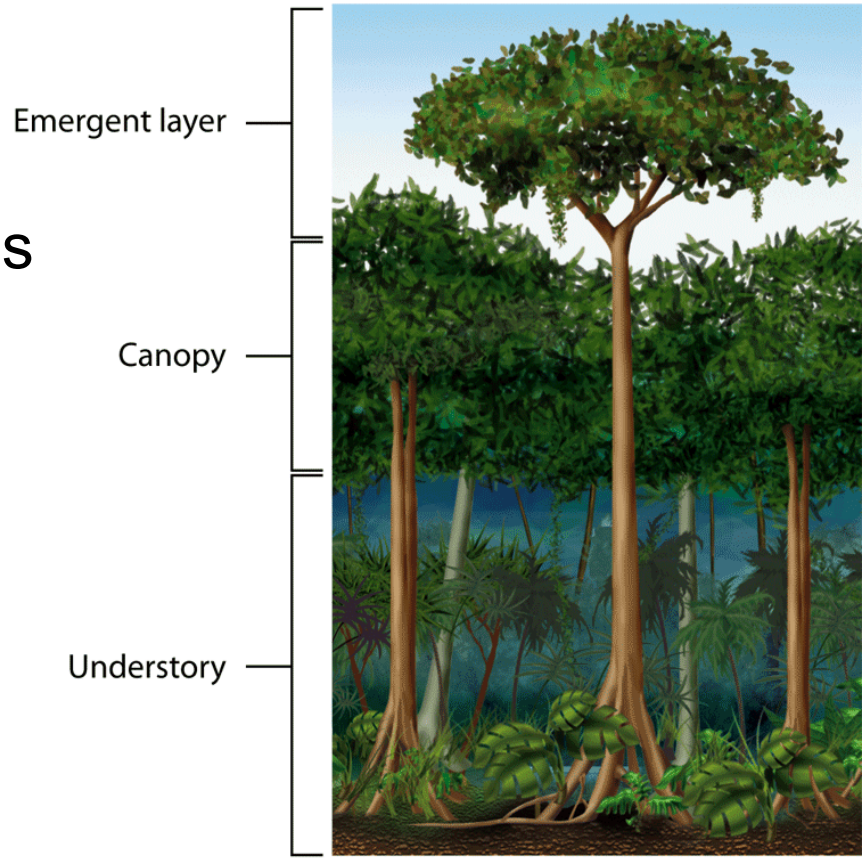


- **climate:** average conditions, including temperature and precipitation, over long periods of time in a given area
- **weather:** day-to-day conditions in Earth's atmosphere
- **climatographs:** Diagrams that summarize an area's average monthly temperature and precipitation
- Each biome has a set of characteristic organisms adapted to its particular climate conditions.

Tropical Rain Forest

- Year-round warm temperatures and at least 2 m (6.6 ft) precipitation a year
- Soil generally nutrient-poor
- Forest canopy, emergent layer, and understory support enormous variety of plants.
- Plants tend to have large, flat leaves and shallow roots.
- Supports more animal species than any other biome; animals tend to be highly specialized.

Did You Know? *Some tropical plants (epiphytes) grow high on other plants to access sunlight and do not touch the soil.*



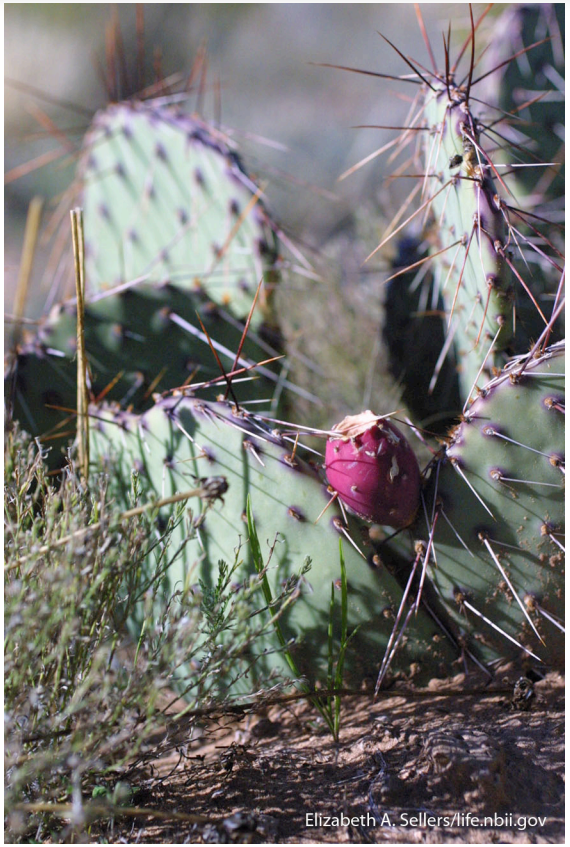
Tropical Grassland (Savanna)

- Receives less precipitation than tropical dry forests, but more than deserts; usually has a distinct rainy season
- Grasses interspersed with groups of trees
- Tree growth limited by frequent fires and strong winds
- Plants are adapted to dry conditions; tend to be deciduous with deep roots, thick bark, and waxy coatings on leaves.
- Many animals migrate to find water, or burrow when water is scarce.

Desert

- Receives less than 25 cm (9.8 in.) of precipitation per year
- Temperatures vary widely from day to night.
- Plants tend to have thick, leathery leaves, store water in their tissues, and have shallow roots.
- Animals get most of their water from the food they eat, and they tend to be nocturnal. Mammals have exaggerated appendages to help regulate body temperature.

Did You Know? *Cactus spines are modified leaves that protect the plant from thirsty animals. Photosynthesis occurs within the green stems and trunks.*



Temperate Rain Forest

- Year-round moderate temperatures and heavy rainfall
- Largest extent found in Pacific Northwest of United States
- Characterized by tall evergreen trees, such as cedars and hemlocks, that don't lose leaves annually; many are conifers (produce seed-bearing cones)
- Forest floor is shaded, damp, covered in moss.
- Animals that require moisture, such as amphibians, thrive here.

Olympic Peninsula, Hoh River rain forest

Temperate Deciduous Forest

- Precipitation evenly spread throughout the year
- Varied temperatures (hot summers, cold winters)
- Plants tend to be broad-leafed and deciduous.
- Soil is enriched with nutrients from annual leaf drop.
- Animals may migrate, hibernate, or store food to survive cold conditions.

Temperate Grassland (Prairie)

- Moderate seasonal precipitation and fairly extreme seasonal temperatures; droughts and fires common
- Not enough precipitation to support large trees; grasses, which grow from their base, thrive despite droughts, fires, animals grazing
- Animals are adapted to deal with lack of cover.
- Soil tends to be rich in nutrients; most of world's grasslands have been converted to farmland.

Taiga (Boreal Forest)

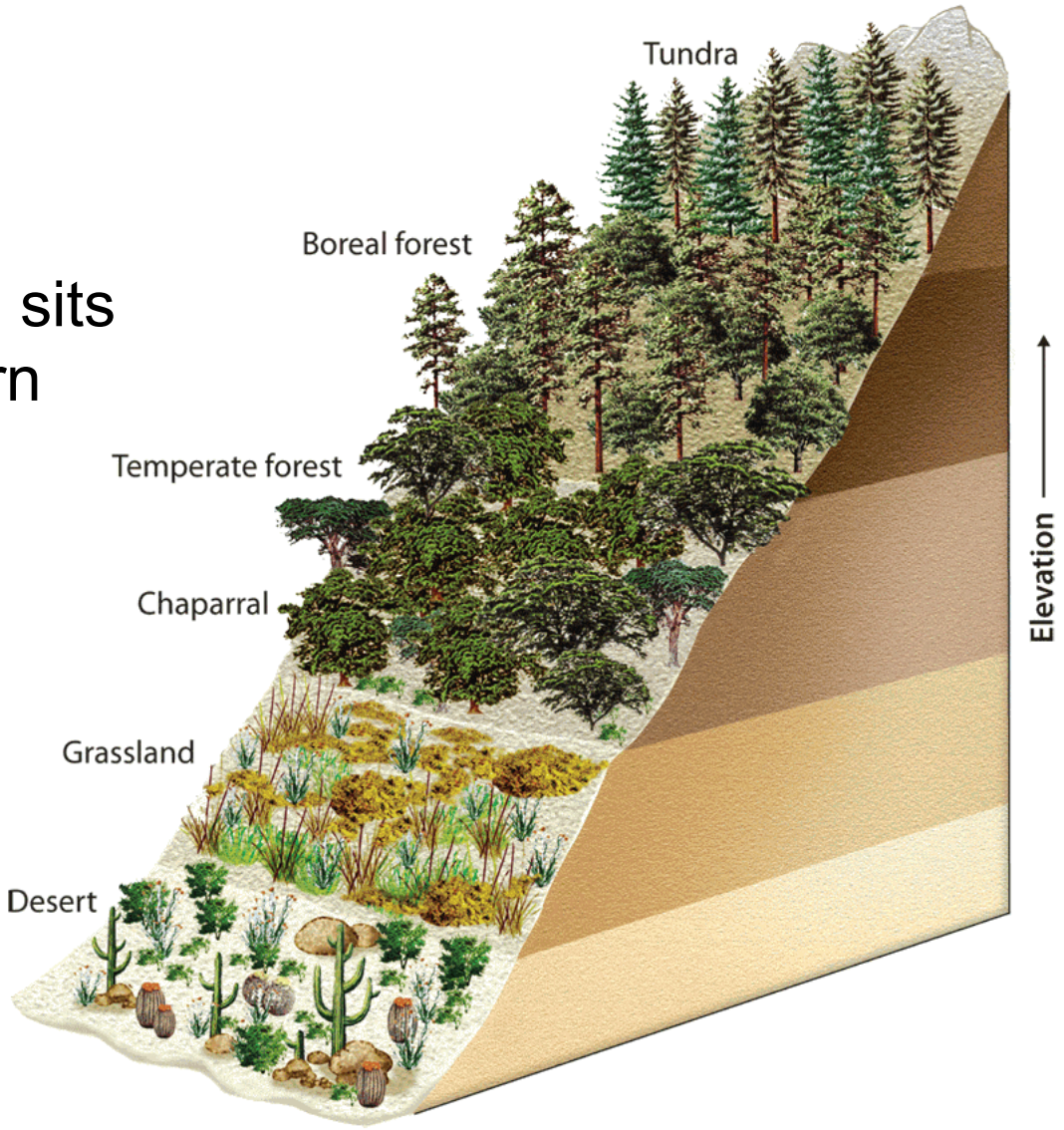
- Long, cold winters; short, cool summers
- Nutrient-poor, slightly acidic soils
- Low species diversity
- Coniferous trees with waxy needles and conical shape, adapted to harsh, snowy conditions are common.
- Animals feed, breed, and care for young mostly during short warm season; year-round residents tend to have thick insulation and small extremities that maintain heat.

Tundra

- Extremely cold, dark winters; relatively sunny and cool summers
- Found at very high latitudes in the Northern Hemisphere
- Harsh winds, nutrient-poor soil, and freezing temperatures limit plant growth; no tall trees; mosses and lichens common
- Characterized by permafrost (underground soil that is frozen year-round)
- Birds and caribou migrate to the tundra during the mild summer to feed on insects and lichens; only a few species live here year-round.

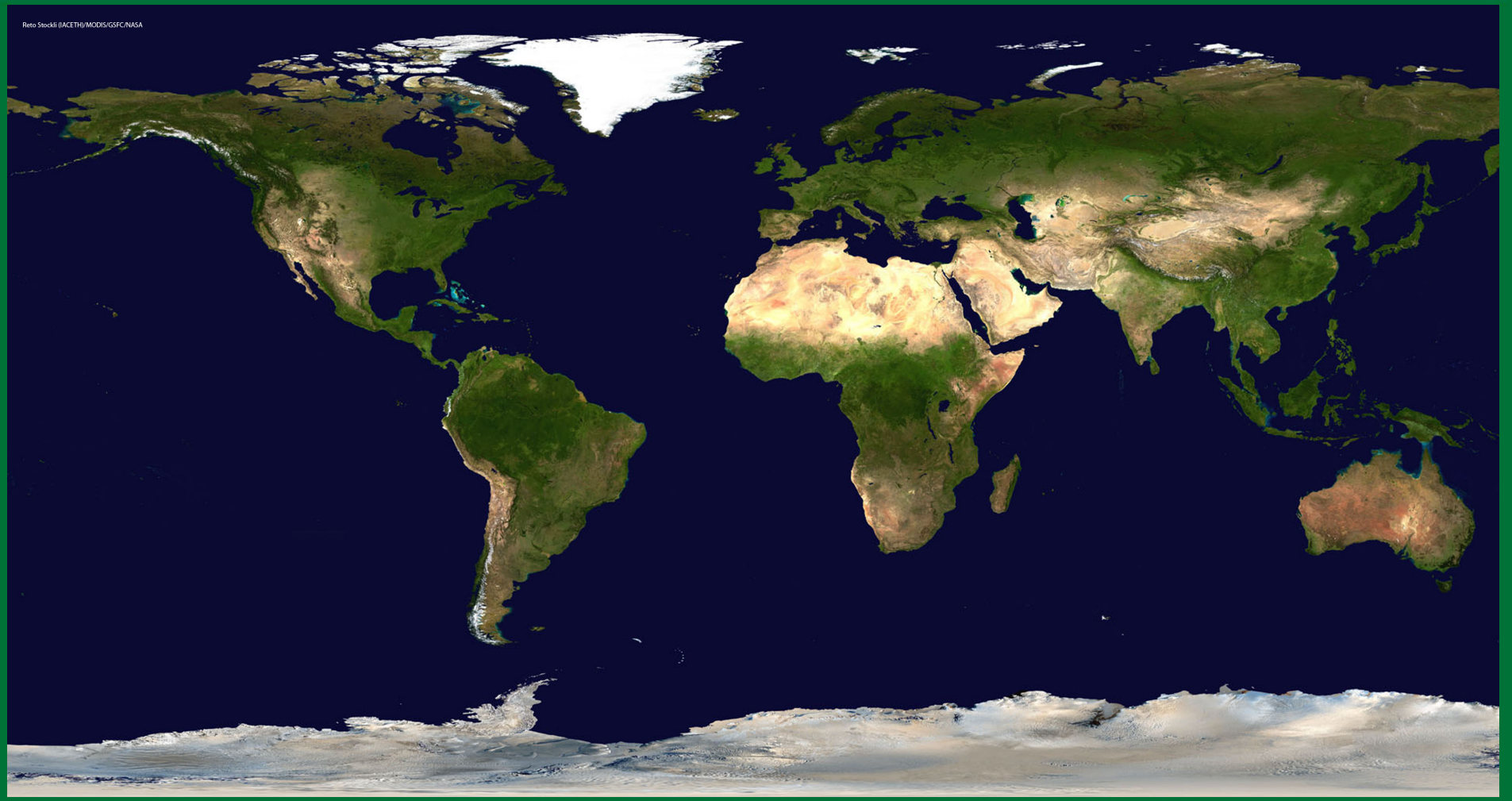
Polar Ice and Mountains

- Not classified as biomes
- No land under polar ice in Northern Hemisphere; ice sits atop Antarctica in Southern Hemisphere
- Very few plants; most life is in surrounding ocean
- Mountain communities change with elevation, similar to how biome communities change with latitude.



Lesson 1.4 Defining Biomes

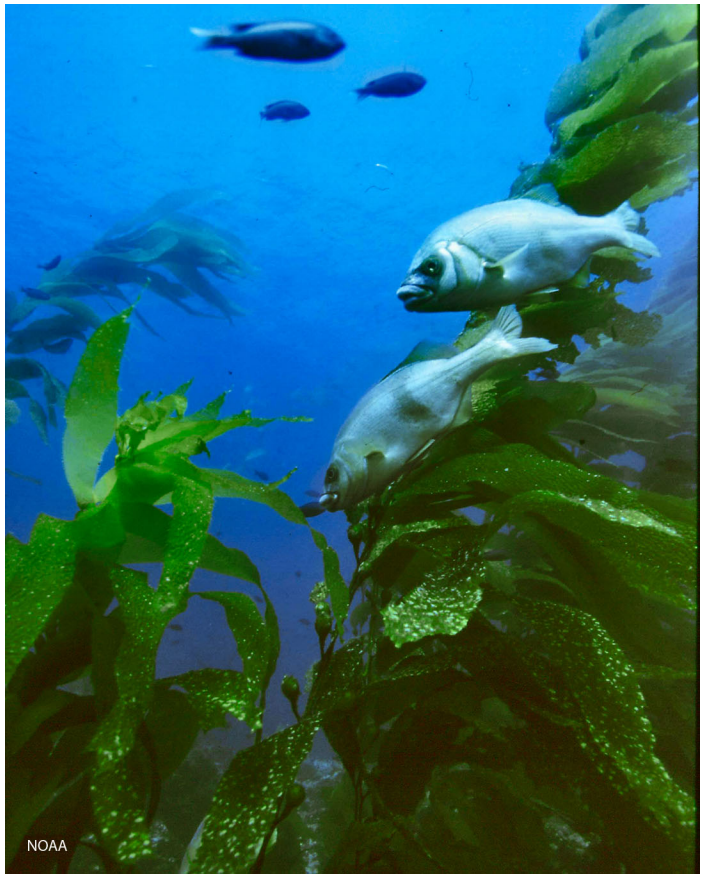
75% of Earth's surface is covered by water.



Today's Objective: Describe characteristic biotic and abiotic components of aquatic and terrestrial ecosystems.

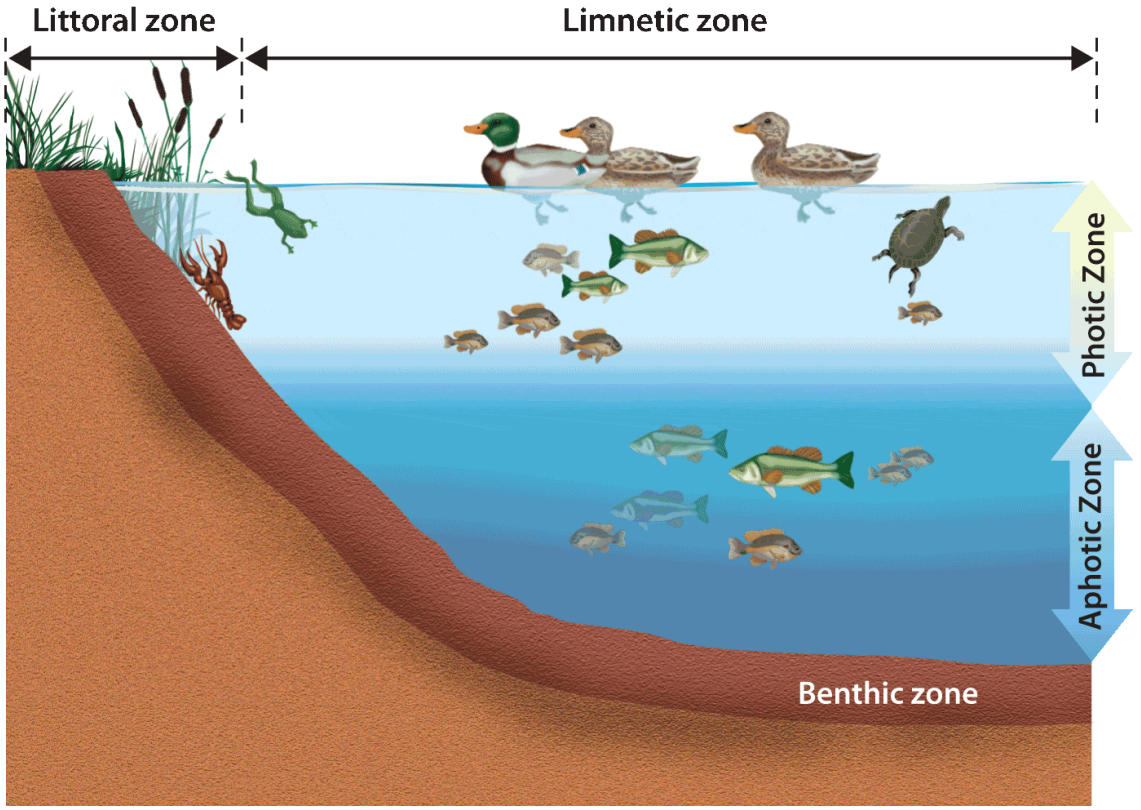
Describing Aquatic Ecosystems

- **salinity:** the amount of dissolved salt present in water
- Ecosystems are classified as salt water (marine), fresh water, or brackish depending on salinity.
- Photosynthesis tends to be limited by light availability, which is a function of depth and water clarity.
- Aquatic ecosystems are either flowing or standing.
- **aquatic ecosystem zones:** photic, aphotic, benthic



Freshwater Ecosystems: Ponds, Lakes, Inland Seas

- Salinity is less than 0.5 ppt (parts per thousand)
- Ponds and lakes are similar, except in size, but inland seas contain organisms adapted for open water.
- Ponds and lakes are divided horizontally into zones: littoral and limnetic

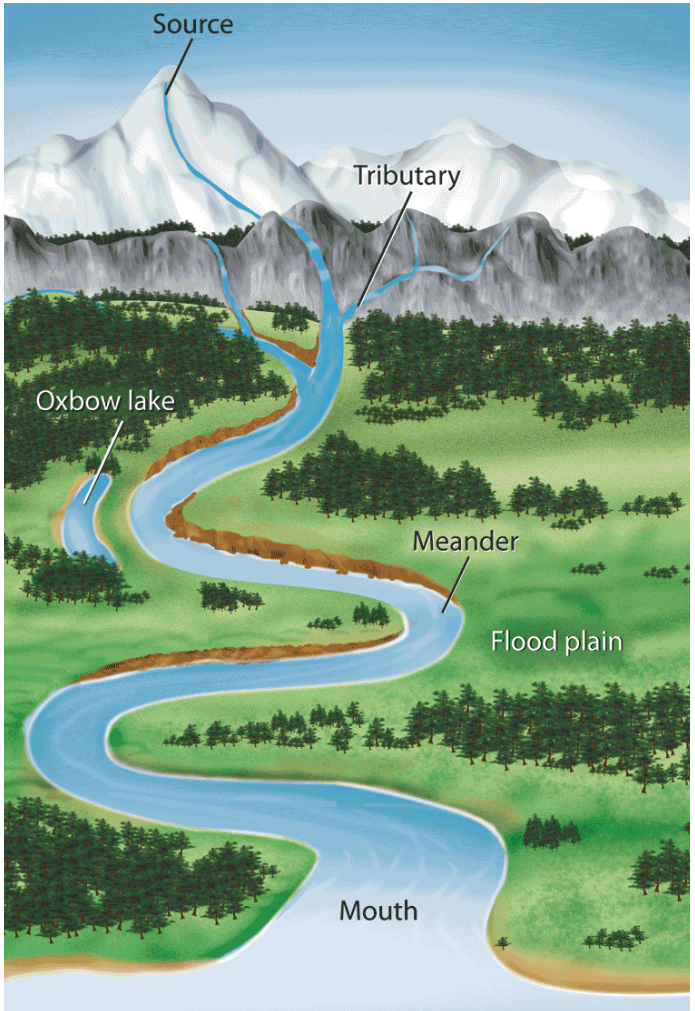


Freshwater Ecosystems: Wetlands

- **wetlands** - areas of land flooded with water at least part of the year
- Include freshwater marshes, swamps, bogs, and fens
- Wetlands prevent flooding, recharge aquifers, filter pollutants, and provide habitats.

Freshwater Ecosystems: Rivers and Streams

- Bodies of surface water that flow downhill, eventually reaching an ocean or inland sea
- **watershed:** the area of land drained by a river and its tributaries
- Characteristics, such as dissolved oxygen, temperature, water speed, organisms, and others, change from source to mouth.



Estuaries

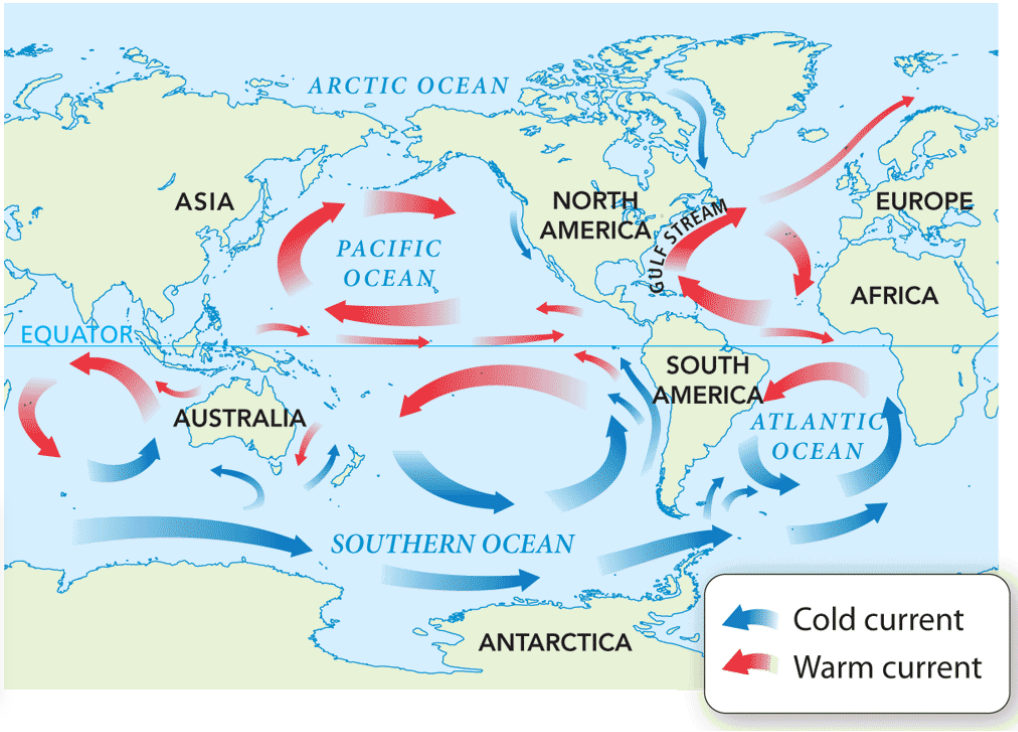
- **estuary** - occurs where a river flows into the ocean or an inland sea
- Coastal estuaries are brackish ecosystems; organisms must tolerate wide salinity and temperature ranges.
- Coastal estuaries are home to salt marshes and mangrove forests.
- Like wetlands, estuaries help prevent flooding and soil erosion as well as provide habitats.

Everglades, Florida, wetlands

Did You Know? *Salt marshes and mangrove forests are two of the most productive ecosystems on Earth.*

Marine - Oceans

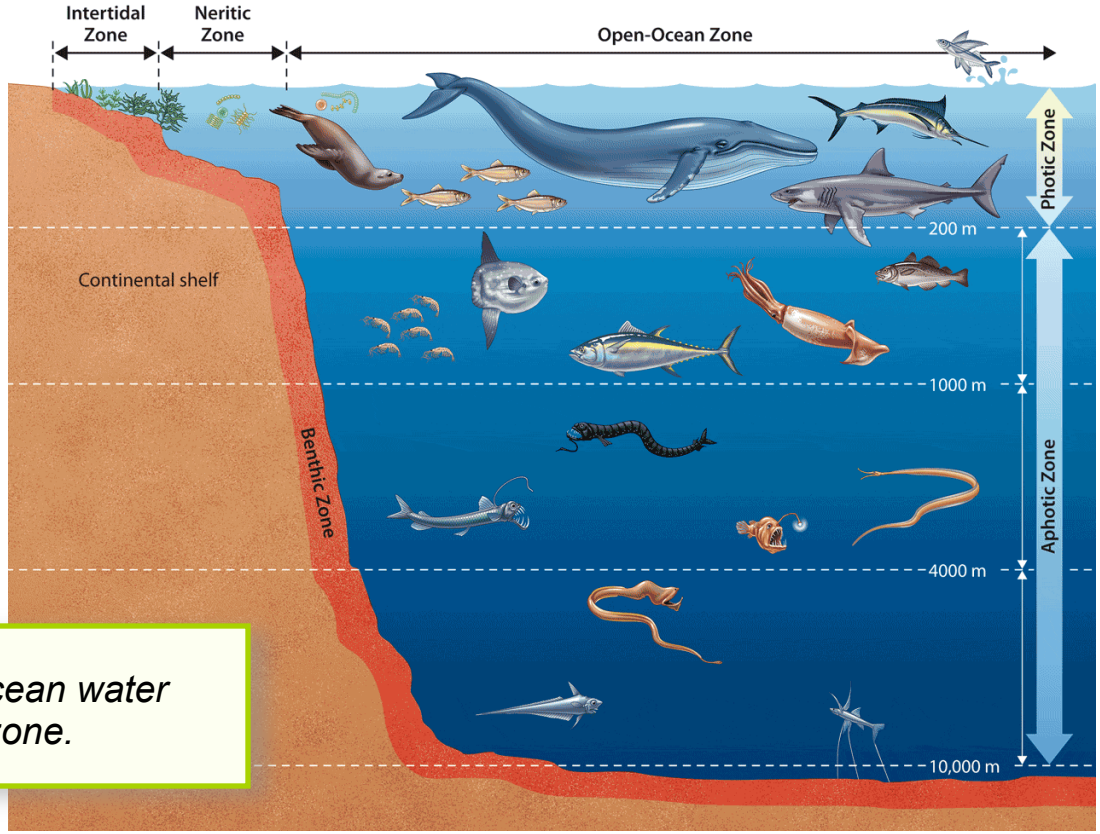
- Currents are driven by water temperature and density differences, wind, and gravity.
- Surface winds and heating generate vertical currents that transport nutrients and oxygen.
- **horizontal ocean zones:** intertidal, neritic, open ocean
- **vertical ocean zones:** photic, aphotic, benthic



Did You Know? *If the water in the oceans evaporated, a 60 m (200 ft) deep layer of salt would be left behind.*

Ocean Ecosystems

- **intertidal:** highly diverse; extreme range of temperature, moisture, and salinity
- **neritic:** productive kelp forests and coral reefs provide habitats and help protect shorelines from erosion.
- **open ocean:** low productivity due to low light penetration; phytoplankton base of food chain; deep sea organisms and hydrothermal vent communities



Did You Know? *Over 90% of ocean water on Earth is in the open ocean zone.*

Lesson 1.4 Defining Biomes

Assignment: Answer the following questions about terrestrial and aquatic ecosystems on a separate piece of paper.

1) **List some examples of biotic components of ecosystems.**

2) **List some examples of abiotic components of ecosystems.**

3) **Explain the difference between climate and weather.**

4) **Describe how the biotic components of terrestrial ecosystems are suited for their environments.**

5) **Describe how the biotic components of aquatic ecosystems are suited for their environments.**

6) **Describe how the abiotic components of an ecosystem determine the type of biome it is classified as.**

Lesson 1.5 Species Interactions

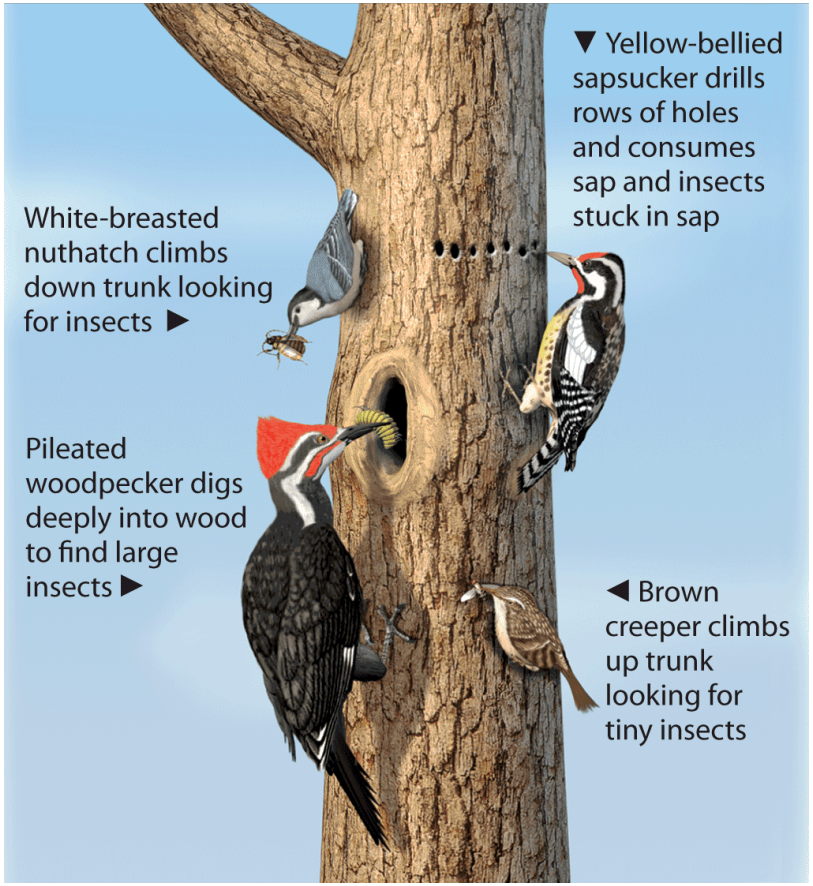
Warm Up: Discuss why there are more producers in the food chain than consumers.

Today's Objective: Describe how energy flows through an ecosystem.

The sun provides the energy for almost all of the ecological communities and species interactions on Earth.

Competition

- Organisms compete when they seek the same limited resources.
- In rare cases, one species can entirely exclude another from using resources.
- To reduce competition, species often partition resources, which can lead to character displacement.



Resource Partitioning

Predation (+/–)

- **predation** - the process by which a predator hunts, kills, and consumes prey
- Causes cycles in predatory and prey population sizes
- Defensive traits such as camouflage, mimicry, and warning coloration have evolved in response to predator-prey interactions.
- Some predator-prey relationships are examples of coevolution, the process by which two species evolve in response to changes in each other.

Rough-Skinned Newt

Did You Know? *A single rough-skinned newt contains enough poison to kill 100 people. Unfortunately for the newt, its predator, the common garter snake, has coevolved resistance to the toxin.*

Parasitism and Herbivory (+/–)

Hookworm (a parasite)

- **parasitism** - one organism (the parasite) relies on another (the host) for nourishment or for some other benefit
- **herbivory** - an animal feeding on a plant

Did You Know? *One study of Pacific estuaries suggests that parasites play an important role in keeping these ecosystems healthy by controlling host populations.*

Mutualism (+/+) and Commensalism (+/0)

Lichen: a symbiotic relationship between a fungus and a photosynthetic partner, such as an alga

- **mutualism -** a relationship in which two or more species benefit
- **commensalism -** a relationship in which one species benefits while the other is unaffected

Did You Know? *Symbiosis describes a long-lasting and physically close relationship between species in which at least one species benefits.*

Primary Producers (Autotrophs)

- Capture energy from the sun or from chemicals and store it in the bonds of sugars, making it available to the rest of the community
- Energy from the sun is captured by plants, algae, or bacteria through photosynthesis.
- Energy from chemicals is captured by some bacteria through chemosynthesis.

Did You Know? *Deep-sea vents, far from sunlight, support entire communities of fish, clams, and other sea animals, which depend on energy converted through chemosynthesis.*

Consumers (Heterotrophs)

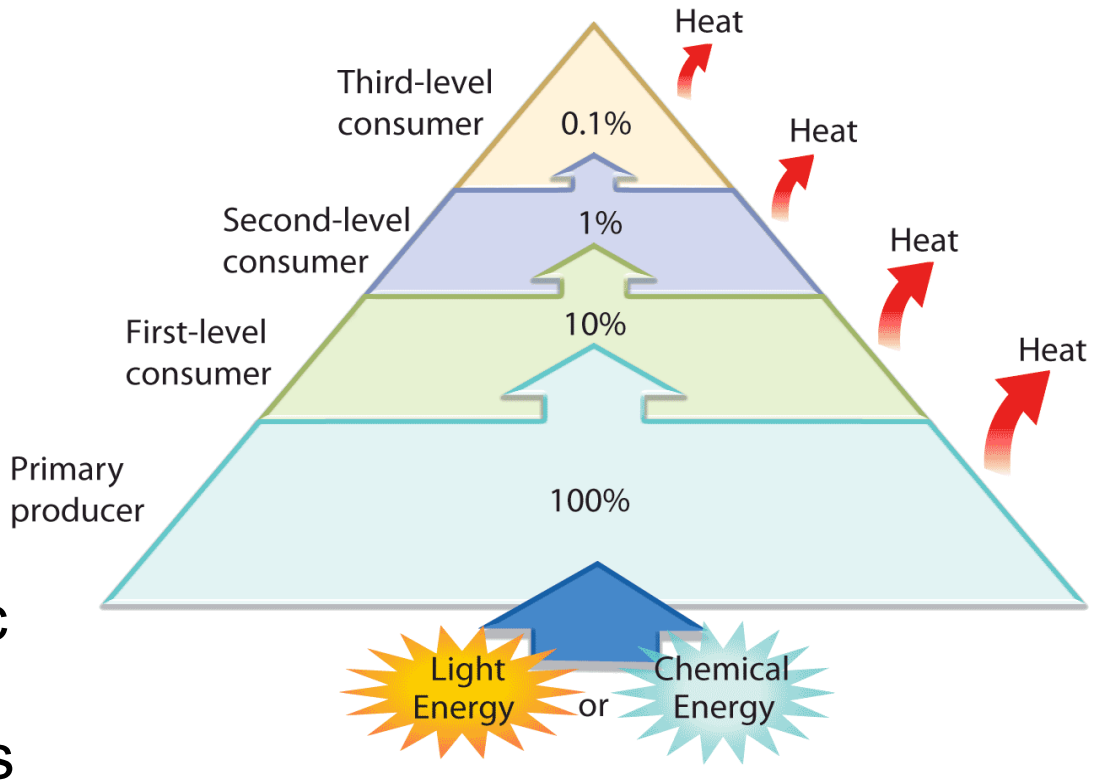
- Rely on other organisms for energy and nutrients
  - **herbivores** - plant-eaters
  - **carnivores** - meat-eaters
  - **omnivores** - combination-eaters
  - **detritivores** and **decomposers** - recycle nutrients within the ecosystem by breaking down nonliving organic matter
- Use oxygen to break bonds in sugar and release its energy through cellular respiration (primary producers do this, too)

California Condor

Did You Know? *Scavengers, such as vultures and condors, are just large detritivores.*

Energy in Communities

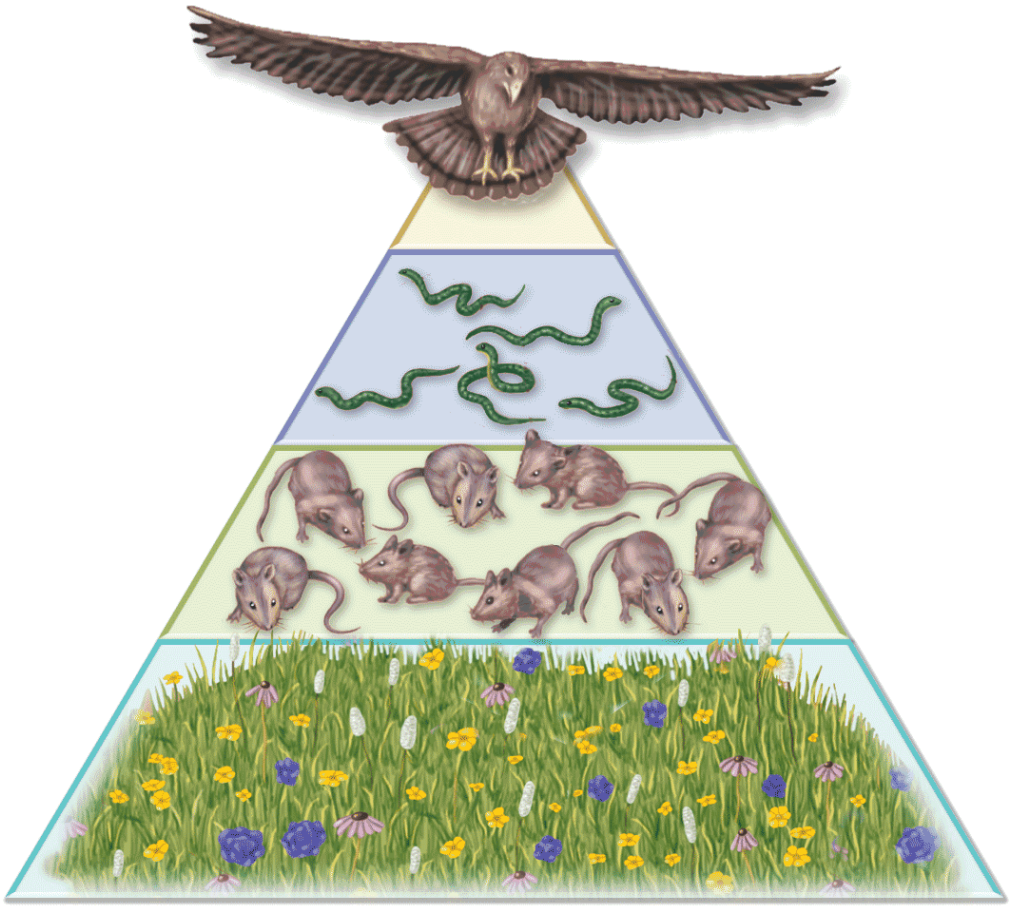
- **trophic level** - an organism's rank in a feeding hierarchy
- Primary producers always occupy the first trophic level of any community.
- In general, only about 10% of the energy available at any trophic level is passed to the next; most of the rest is lost to the environment as heat.



Pyramid of Energy

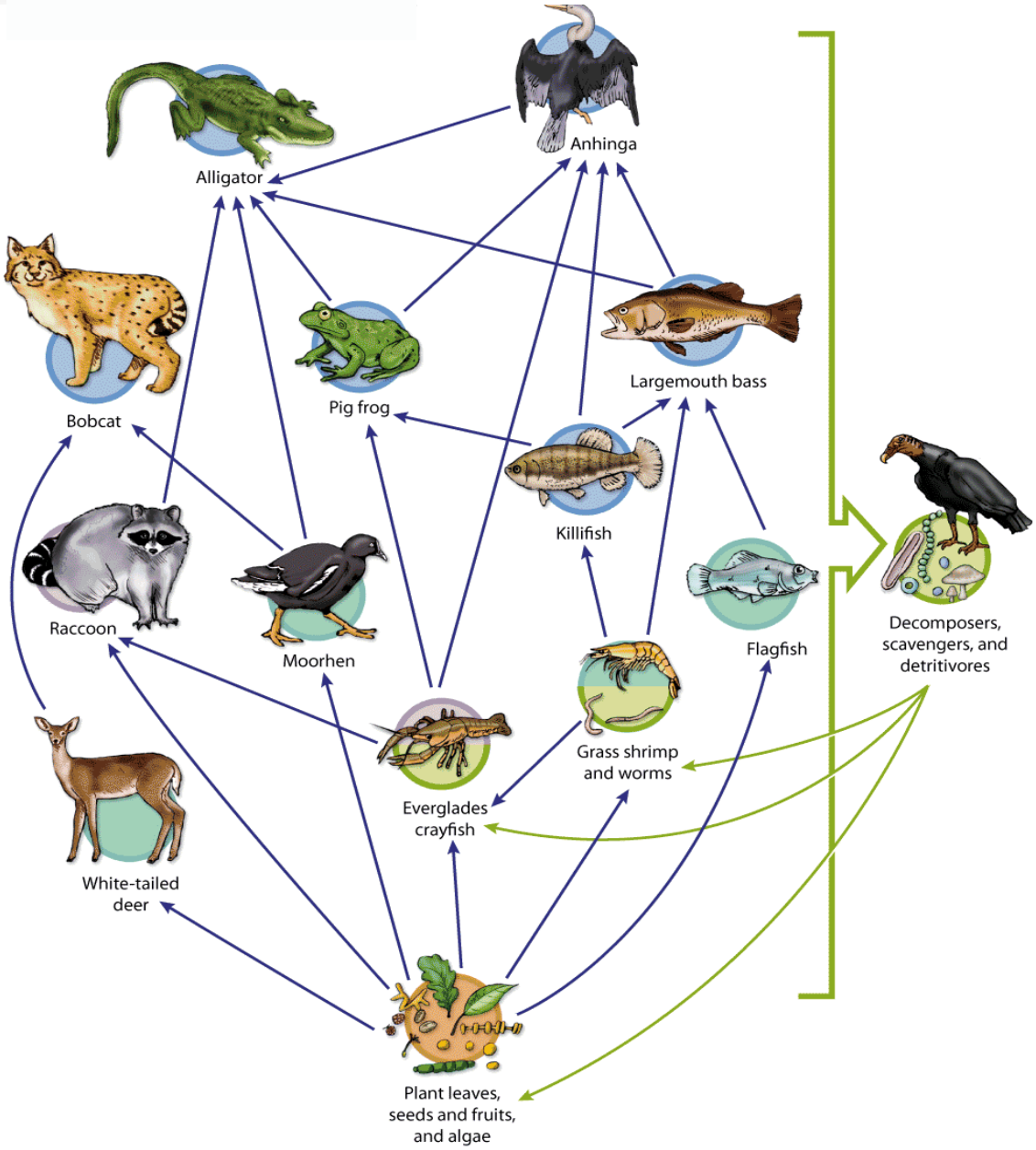
Numbers and Biomass in Communities

- A trophic level's biomass is the mass of living tissue it contains.
- In general, there are more organisms and greater biomass at lower trophic levels than at higher ones.

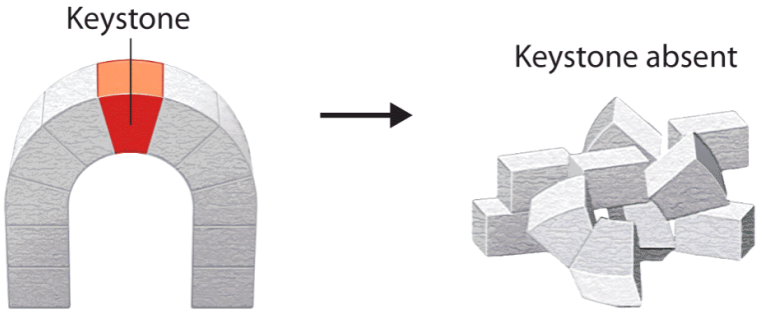


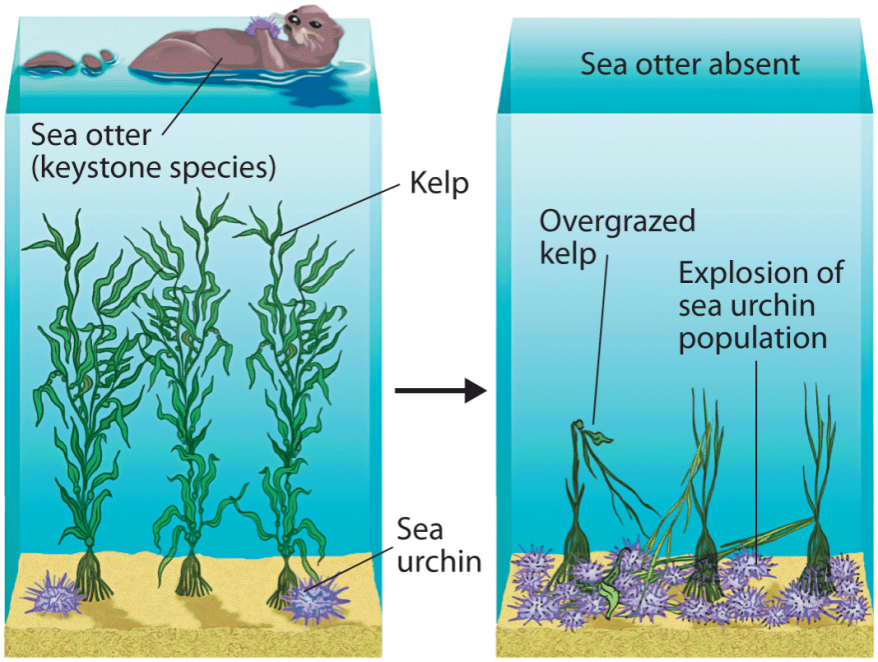
Food Chains and Webs

- **food chain -** linear series of feeding relationships
- **food web** - shows the overlapping and interconnected food chains present in a community



Keystone Species





- Species that have strong and/or wide-reaching effects on a community
- Removal of a keystone species can significantly alter the structure of a community.

Invasive Species

- Nonnative organisms that spread widely in a community
- A lack of limiting factors such as predators, parasites, or competitors enables their population to grow unchecked.
- Not all invasive species are harmful.

Did You Know? *Although the European honeybee is invasive to North America, it is beneficial because it pollinates our agricultural crops.*

Ticket Out: Complete the Quizdom Check on energy flow through an ecosystem.

Quizdom Check

1) About _____ percent of energy makes it on to the next trophic level.

A) 5 B) 10 C) 50 D) 100

2) In mutualism, **ALL** species benefit. ***True or False***

3) _____ are linear feeding relationships.

A) Food chains B) Food webs

4) Most of the organisms at the lowest trophic level are **consumers**. ***True or False***

5) Invasive species will experience exponential growth because there are no limiting factors for them.

True or False