



# Ecosystems

**6.L.2 Understand the flow of energy through ecosystems and the responses of populations to the biotic and abiotic factors in their environment.**

6.L.2.1 Summarize how energy derived from the sun is used by plants to produce sugars (photosynthesis) and is transferred within a food chain or food web (terrestrial and aquatic) from producers to consumers to decomposers.

6.L.2.2 Explain how plants respond to external stimuli (including dormancy and forms of tropism) to enhance survival in an environment.

6.L.2.3 Summarize how the abiotic factors (such as temperature, water, sunlight, and soil quality) of biomes (freshwater, marine, forest, grasslands, desert, Tundra) affect the ability of organisms to grow, survive and/or create their own food through photosynthesis.

# Soak Up the Sun

## How do organisms get energy and matter?

- **Energy** is the ability to do work.
- **Matter** is anything that has mass and takes up space.
- All organisms need energy and matter to live, grow, and reproduce.

# How do organisms get energy and matter?

- The sun is the original source of energy in most ecosystems.
- Organisms called *producers* make their own food.
- *Consumers* are organisms that cannot make their own food and eat producers or other consumers to get energy.



# How do organisms get energy and matter?

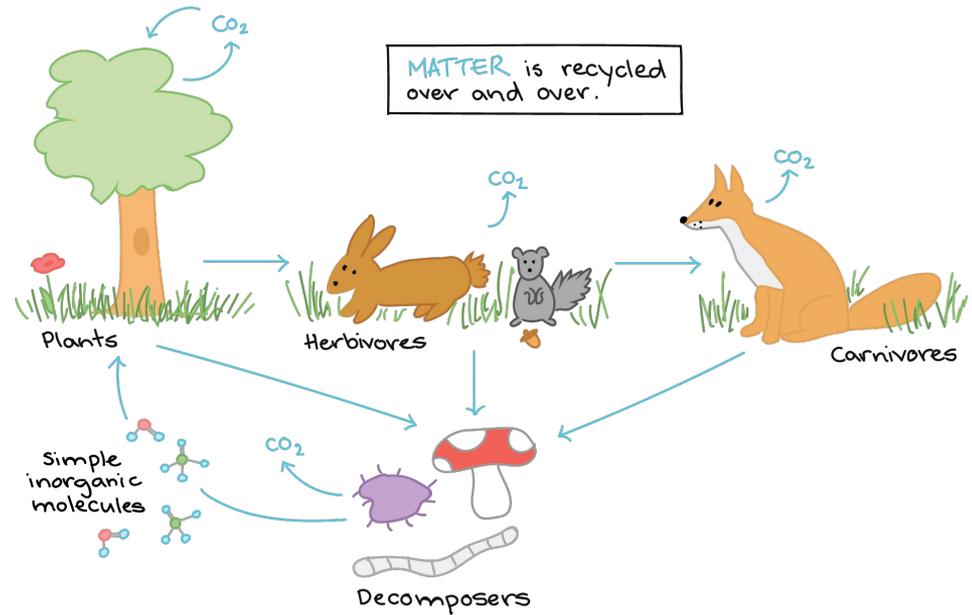
- Most producers get energy from the sun, but some use chemical energy instead of light energy to make food.
- Producers get matter from soil and air.
- Consumers get both energy and matter from the foods they eat.

# What happens to energy and matter in ecosystems?

- The **law of conservation of energy** states that energy cannot be created or destroyed; it only changes form.
- The **law of conservation of mass** states that mass cannot be created or destroyed.
- Matter moves through the environment in different forms.

# What happens to energy and matter in ecosystems?

- Matter and energy can leave an ecosystem when organisms move.
- Also, matter and energy can leave an ecosystem in moving water and air.
- Although matter and energy enter and leave an ecosystem, they are never destroyed.



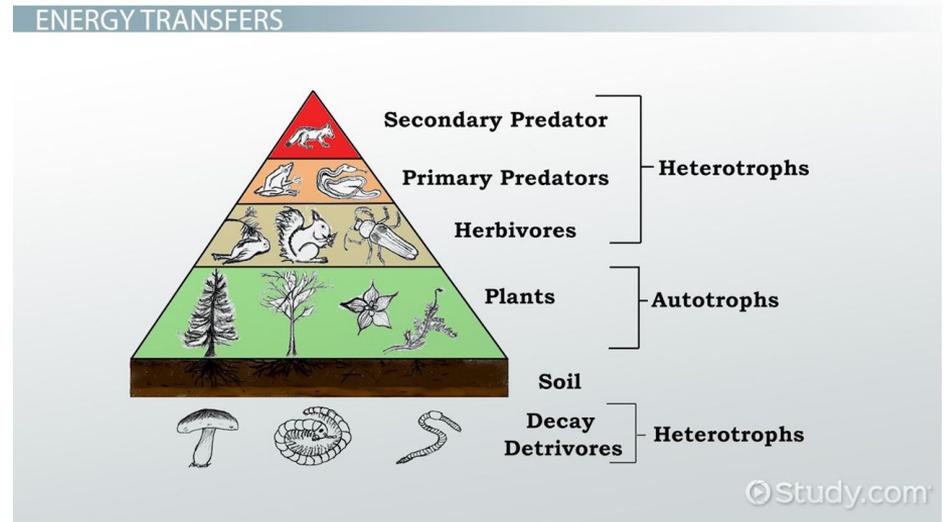
# Cycle and Flow

## How does energy move through an ecosystem?

- Energy enters most ecosystems as sunlight, which producers use to make food.
- Primary consumers get energy by eating producers. Secondary consumers get energy by eating primary consumers, and so on up the food chain.
- An organism uses most of the energy it takes in for life processes. Some energy is lost as heat, and some is stored in the organism's body.

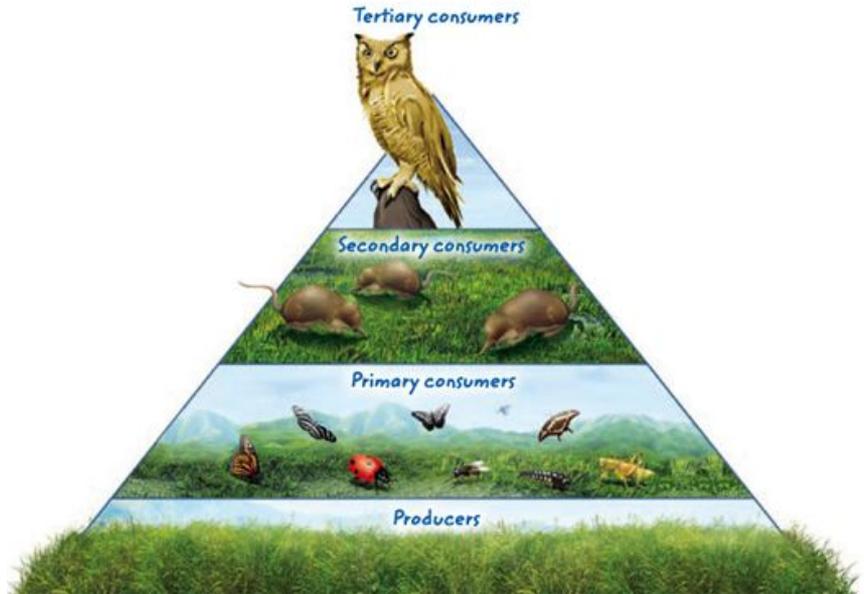
# How does energy move through an ecosystem?

- An **energy pyramid** is a tool that can be used to trace the flow of energy through an ecosystem.
- The bottom level, consisting of producers, has the largest population and the most energy. The other levels are consumers.
- Going up the pyramid, there is less energy and fewer organisms at each level. Consumers at the highest level have the smallest population.



# How does energy move through an ecosystem?

- How does the size of a population change at each step in an energy pyramid?

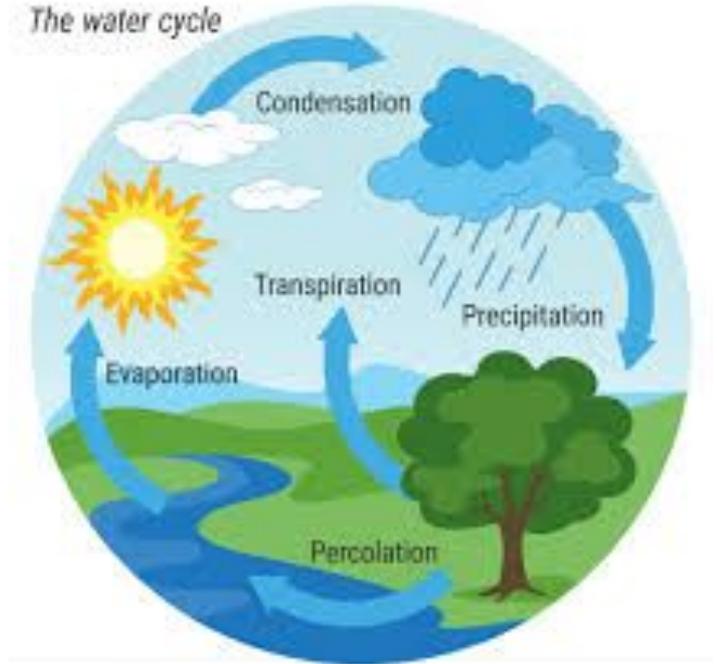


# How does matter move through an ecosystem?

- Water evaporates from Earth's surface, enters the atmosphere, becomes clouds, and falls back to Earth's surface.
- Likewise, carbon and nitrogen cycle through an ecosystem, going from producers to consumers to decomposers and back to producers.
- Matter leaves some ecosystems and enters other ecosystems. Because matter can enter and leave an ecosystem, it is called an *open system*.

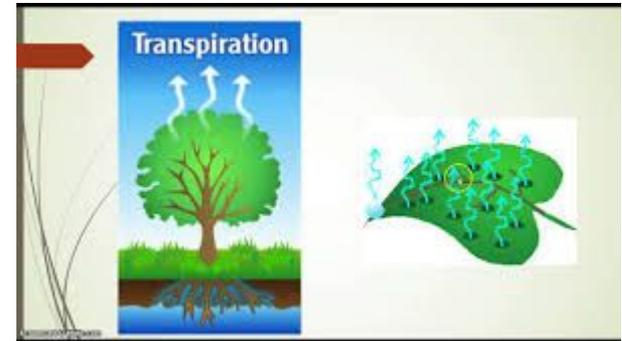
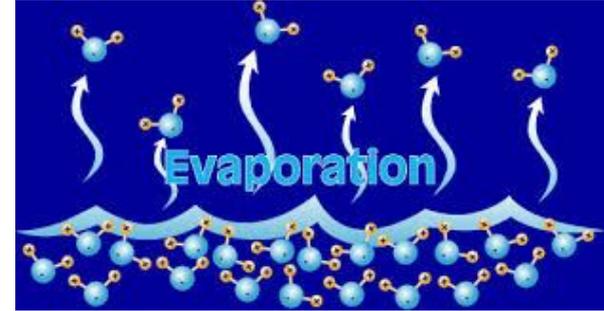
# What is the water cycle?

- The movement of water between the oceans, atmosphere, land, and living things is known as the **water cycle**.
- Water can enter the atmosphere by evaporation, transpiration, and respiration.



# What is the water cycle?

- During *evaporation*, the sun's heat causes water to change from liquid to vapor.
- Plants release water vapor from their leaves in *transpiration*.
- Organisms release water as waste during *respiration*.



# What is the water cycle?

- In *condensation*, water vapor cools and returns to liquid. The water that falls from the atmosphere to the land and oceans is *precipitation*.
- The precipitation that falls on land and flows into streams and rivers is called *runoff*.
- The water that seeps into the ground and is stored underground is called *groundwater*. It will flow back into the soil, streams, rivers, and oceans.

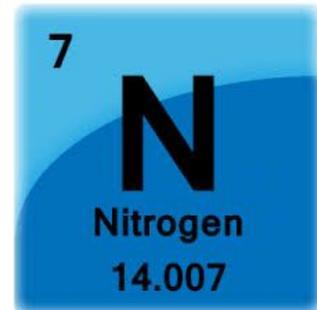


Precipitation



# What is the nitrogen cycle?

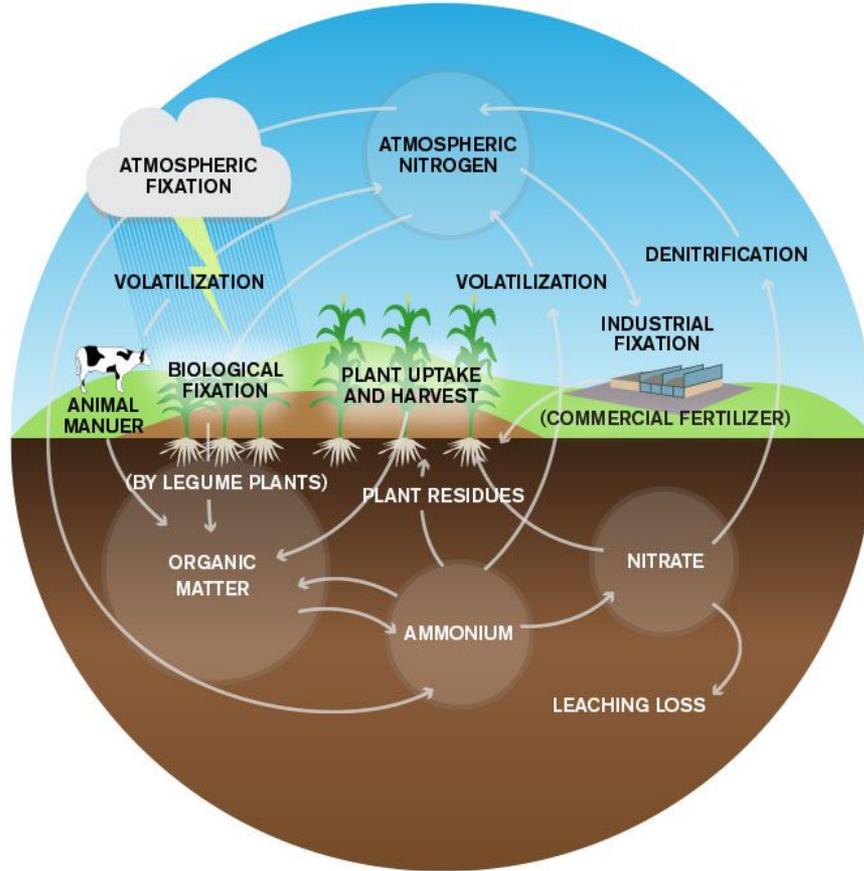
- The movement of nitrogen between the environment and living things is called the **nitrogen cycle**.
- Bacteria in the soil can change nitrogen gas from the air into forms that plants can use. This process is called *nitrogen fixation*.
- Plants take in and use fixed nitrogen. Consumers then get the nitrogen they need by eating plants or other organisms.

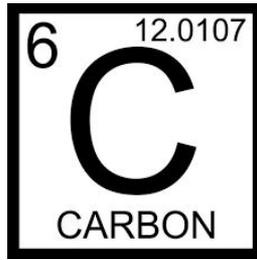


# What is the nitrogen cycle?

- When organisms die, decomposers break down their remains and release a form of nitrogen into the soil that plants can use.
- Finally, certain types of bacteria in the soil can convert nitrogen into a gas, which is returned to the atmosphere.

# NITROGEN CYCLE



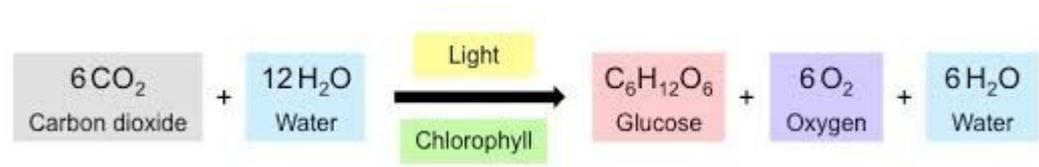


## What is the carbon cycle?

- Carbon is an important building block of organisms.
- Carbon is found in food, the atmosphere, water, rocks, soils, organisms, and fossil fuels.
- Carbon moves through organisms and between organisms and the physical environment in the **carbon cycle**.

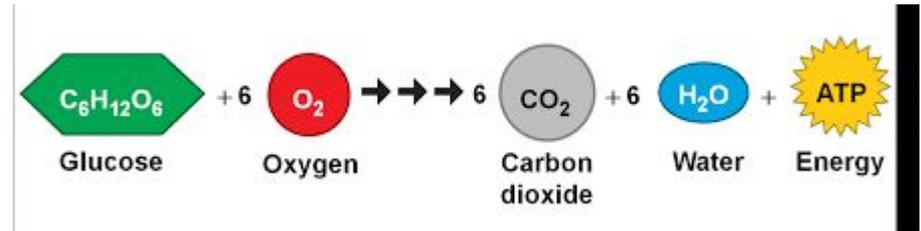
# What is the carbon cycle?

- During photosynthesis, producers make sugars that contain carbon.



**Photosynthesis**

- During cellular respiration, sugars are broken down to release energy, carbon dioxide, and water.



**Cellular Respiration**

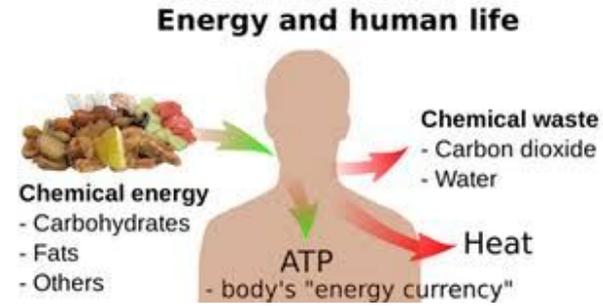
# What is the carbon cycle?

- Combustion is the burning of materials. The burning of once-living materials releases carbon dioxide, water, heat, and other materials.
- Decomposition breaks down dead organisms and waste. Decomposers get energy from this material by respiration.
- Decomposition returns carbon dioxide, water, and other nutrients to the environment.

# Get Energized!

## How do organisms get energy?

- All living things need a source of chemical energy to survive.
- Chemical energy is stored in the bonds of molecules and holds molecules together.
- The energy from food is the chemical energy in the bonds of food molecules.



# How do organisms get energy?

- A **producer**, also called an autotroph, uses energy to make food.
- The food made by producers supplies the energy for other living things in an ecosystem.
- Most producers use sunlight to make food through photosynthesis.
- All green plants, algae, and some bacteria are producers.

## Producers

- Most are plants



## Other Types of Producers

### Algae



### Some Bacteria



# How do organisms get energy?

- An organism that gets energy and nutrients by breaking down the remains of other organisms is a **decomposer**.
- Decomposers are nature's recyclers. They move matter through the ecosystem.
- Decomposers make water and nutrients available to other organisms.



# How do organisms get energy?

- A **consumer** is an organism that eats other organisms.
- Consumers must eat other organisms for energy and nutrients.



# How do organisms get energy?

- A consumer that eats only plants is called an **herbivore**.
- A **carnivore** eats other animals.
- An **omnivore** eats both plants and animals.
- A *scavenger*, such as a turkey vulture, is a specialized consumer that feeds on dead organisms.



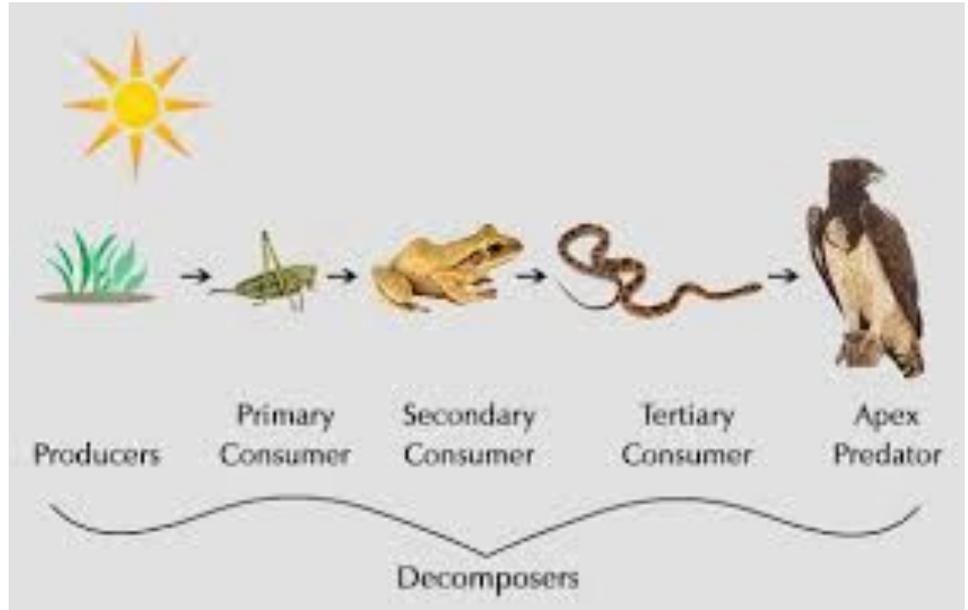
# Energy Transfer

## How is energy transferred among organisms?

- If an organism is eaten or decomposes, the consumer or decomposer takes in the energy stored in the original organism.
- Only chemical energy that an organism has stored in its tissues is available to consumers.
- In this way, energy is transferred from organism to organism.

# How is energy transferred among organisms?

- A **food chain** is the path of energy transfer from producers to consumers.
- The arrows in a food chain represent the flow of energy from the body of the consumed organism to the body of the consumer of that organism.
- Producers form the base of food chains.



# How is energy transferred among organisms?

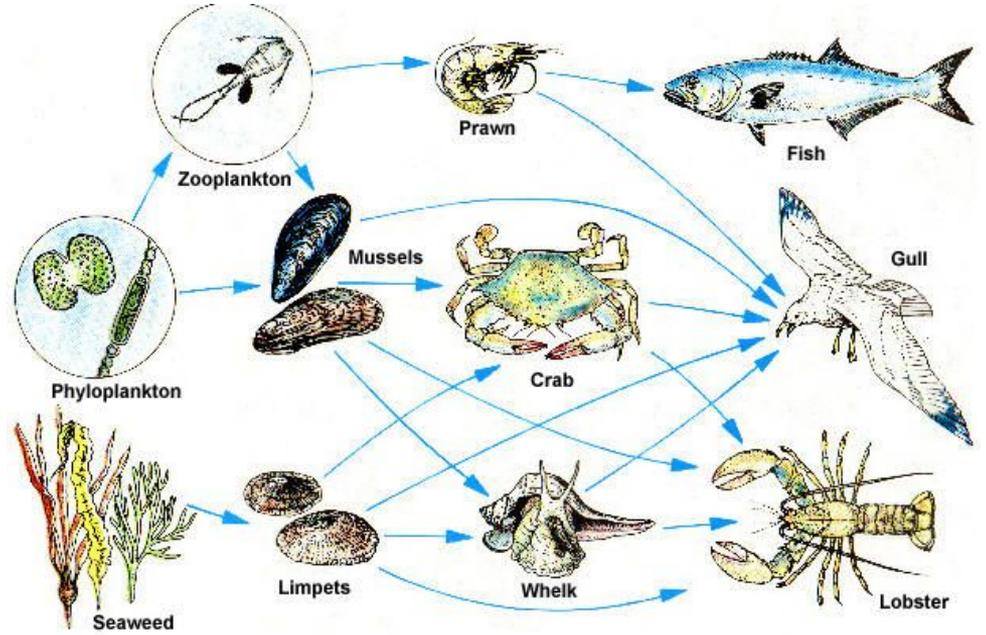
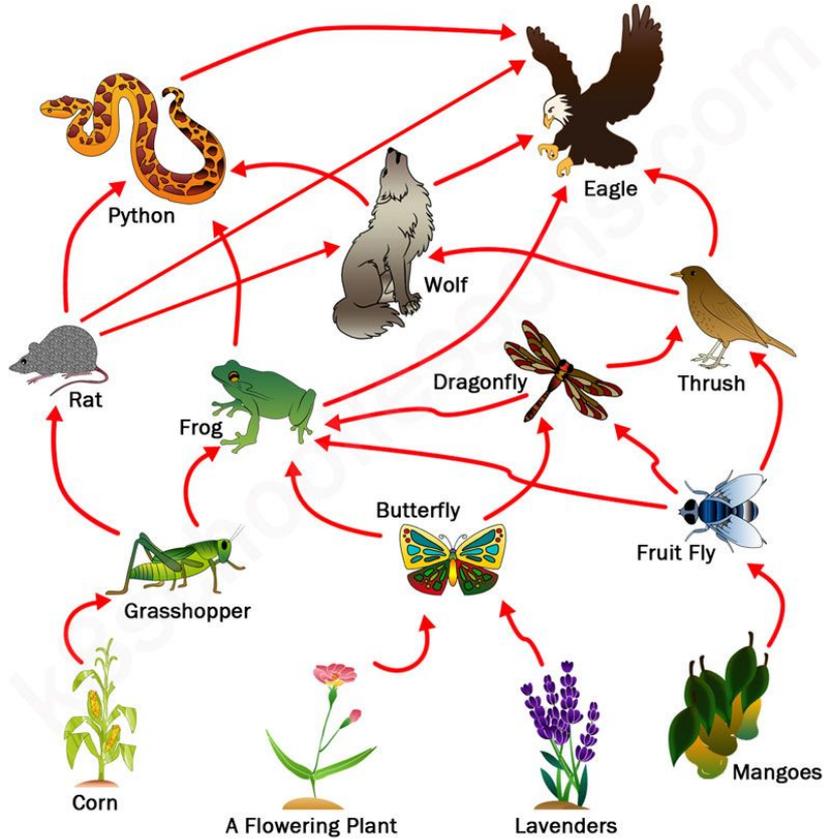
- Producers transfer energy to the first, or primary, consumer in the food chain.
- The secondary consumer consumes the primary consumer.
- A tertiary consumer eats the secondary consumer.
- 
- Finally, decomposers recycle matter back to the soil.

# World Wide Webs

## How do food webs show energy connections?

- In nature, energy and nutrient connections are more complicated than a simple food chain.
- A **food web** is the feeding relationships among organisms in an ecosystem. Food webs are made up of many food chains.
- Many different energy paths lead from the producers to the top predators.

# A Food Web



# How are organisms connected by food webs?

- All living organisms are connected by global food webs, which include webs that begin on land and webs that begin in the water.
- Many organisms have feeding relationships that connect the land- and water-based food webs.
- Because global food webs are connected, removing even one organism can affect many organisms in other ecosystems.

# Dangerous Competition

- Invasive species often compete with native species for energy resources.
- The invasive kudzu plant outgrows native plants and can completely cover houses and cars.
- The zebra mussel and walking catfish are so successful that they often leave little food for native species.



# The Web of Life

## How are all living things connected?

- Organisms need energy and matter to live.
- Interactions between organisms cause an exchange of energy and matter, creating a web of life.
- **Ecology** is the study of how organisms interact with one another and with the environment.

# How are all living things connected?

- Each individual organism has a role to play in the flow of energy and matter.
- In this way, organisms are connected to all other organisms, and their relationships affect each one's growth and survival.
- A **biotic factor** is an interaction between organisms in an area.

# How are all living things connected?

- All organisms rely on the nonliving environment for survival.
- An **abiotic factor** is a nonliving part of an environment, such as water, nutrients, soil, sunlight, rainfall, or temperature.
- Abiotic factors influence where organisms can survive.

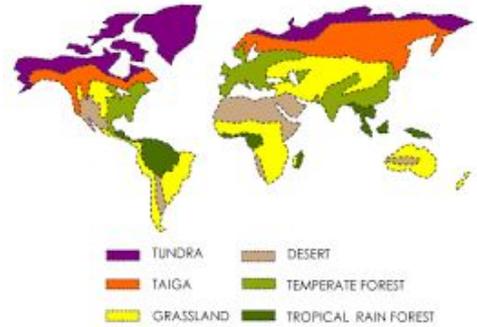
# What determines where a population can live?

- Abiotic and biotic factors influence whether a species can live in a certain place.
- In general, two populations cannot occupy exactly the same niche.
- Small differences in habitats, roles, and adaptations can allow similar species to live together in the same ecosystem.
- A population's **niche** is the role the population plays in the ecosystem, such as how it gets food and interacts with other populations.
- A **habitat** is the place where an organism usually lives and is part of an organism's niche.
- The habitat must provide all of the resources that an organism needs to grow and survive.

# Home Sweet Biome

## What is a biome?

- A **biome** is a region of Earth where the climate determines the types of plants that live there.
- The types of plants in a biome determine the types of animals that live there.
- Deserts, grasslands, tundra, taiga, temperate forests, and tropical forests are all types of biomes.

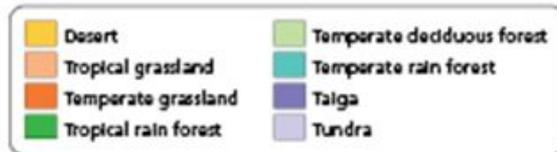
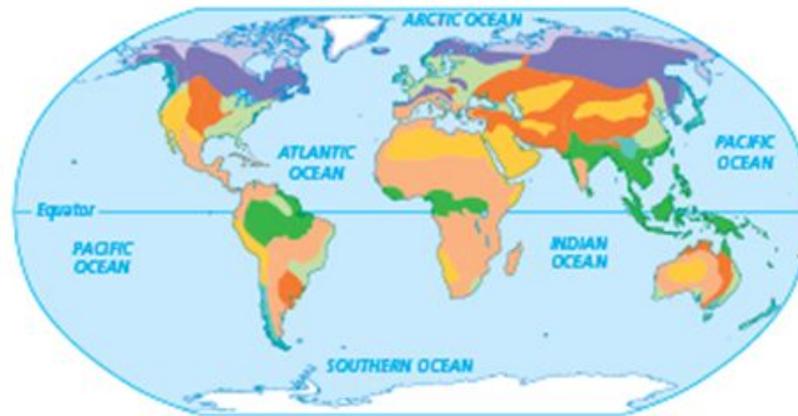


# What makes one biome different from another?

- Climate is the main abiotic factor that characterizes a biome.
- Climate describes the long-term patterns of temperature and precipitation in a region.
- The position of a biome on Earth affects its climate. For example, biomes closer to the poles have colder climates, those closer to the equator have warmer climates.

# What makes one biome different from another?

- Examine the distribution of Earth's major land biomes.



# What makes one biome different from another?

- Other abiotic factors that characterize a biome include soil type, amount of sunlight, and amount of water available.
- Abiotic factors affect which organisms can live in a biome.

# What makes one biome different from another?

- Adaptations are features that allow organisms to survive and reproduce.
- Plants and animals that live in a biome have adaptations to its unique conditions.
- For example, animals in biomes that are cold all year often grow thick fur coats. Plants in biomes with seasonal temperature changes lose their leaves and become inactive in winter.

# Life in a Biome



## How are ecosystems related to biomes?

- Most biomes stretch across huge areas of land. Within each biome are smaller areas called ecosystems.
- Each *ecosystem* includes a specific community of organisms and their physical environment.
- A temperate forest biome can contain pond or river ecosystems. A grassland biome can contain areas of small shrubs and trees.

# What are the major land biomes?

- **Tundra** has low average temperatures and very little precipitation. It is found in the Arctic and in high mountain regions.
- The ground contains permafrost, a thick layer of permanently frozen soil beneath the surface.
- The plants have shallow roots. Some animals develop thick fur, some migrate to warmer areas before winter, and some hibernate.



# What are the major land biomes?

- **Taiga**, also called boreal forest, has low average temperatures, as in the tundra biome, but more precipitation. Taiga biomes are found in Canada and northern Europe and Asia.

- Taiga plants include **coniferous trees**, which are trees that have evergreen, needlelike leaves.

- Migratory birds live in taiga in summer. Some animals live there year-round, and some undergo seasonal changes in fur color.



# What are the major land biomes?

- **Desert** biomes are very dry. Some receive less than 8 centimeters (3 inches) of precipitation each year. Desert soil is rocky or sandy.
- Many deserts are hot during the day and cold at night, although some have milder temperatures.
- Plants and animals in this biome have adaptations that let them conserve water and survive extreme temperatures.



# What are the major land biomes?

- A **grassland** is a biome that has grasses and few trees.
- Tropical grasslands, such as the African savanna, have high average temperatures throughout the year. They also have wet and dry seasons.
- Thin soils support grasses and some trees. Grazing animals feed on the grasses, and predators hunt the grazing animals.



# What are the major land biomes?

- Temperate grasslands, such as the North American prairie, have moderate precipitation, hot summers, and cold winters.
- These grasslands have deep, nutrient-rich soils. Periodic fires sweep through the grasslands, but grasses and other nonwoody plants are adapted to fire.
- Bison, antelopes, prairie dogs, and coyotes are common animals here.

# What are the major land biomes?

- Temperate deciduous forests have moderate precipitation, hot summers, and cold winters.
- This biome has **deciduous trees**, which are broadleaf trees that drop their leaves as winter approaches.
- During winter, some animals hibernate, but others are active year-round. Many birds migrate to warmer areas before winter.



# What are the major land biomes?

- Temperate rainforests have a long, cool wet season and a relatively dry summer.
- There are many coniferous trees, and the forest floor is covered with mosses and ferns. The soil is nutrient-rich and plants grow throughout the year.
- Animals include spotted owls, shrews, elk, and cougars.



# What are the major land biomes?

- Tropical rainforests are located near Earth's equator. This biome is warm throughout the year, and it receives more rain than any other biome.
- The soil is acidic and nutrient-poor. Yet, these forests sustain dense layers of plants and some of the highest biological diversity on Earth.
- Birds, monkeys, and sloths live in the upper layers of the rainforest. Leafcutter ants, jaguars, snakes, and anteaters live in the lower layers.



# Splish Splash

## What are the major types of aquatic ecosystems?

- An *aquatic ecosystem* includes any water environment and the community of organisms that live there.
- The three main types of aquatic ecosystems are freshwater ecosystems, estuaries, and marine ecosystems.

# What abiotic factors affect aquatic ecosystems?

- Abiotic factors are the nonliving things in an environment.
- The major abiotic factors that affect aquatic ecosystems include water temperature, water depth, amount of light, oxygen level, water pH, salinity, and rate of water flow.
- An aquatic ecosystem may be influenced by some of these factors but not by others.

# Where are examples of freshwater ecosystems found?

- Freshwater ecosystems contain water that has very little salt in it. They are found in lakes, ponds, wetlands, rivers, and streams.
- Lakes and ponds are bodies of water surrounded by land.
- Some plants grow at the edges of lakes and ponds. Others live underwater or grow leaves that float on the surface.

# Where are examples of freshwater ecosystems found?

- Lakes and ponds contain protists, such as algae and amoebas, and the eggs and young of frogs and some insects.
- Clams, bacteria, and worms live on the bottom of lakes and ponds and break down dead materials for food.
- Frogs, turtles, fish, and ducks have adaptations that let them swim in lakes and ponds.

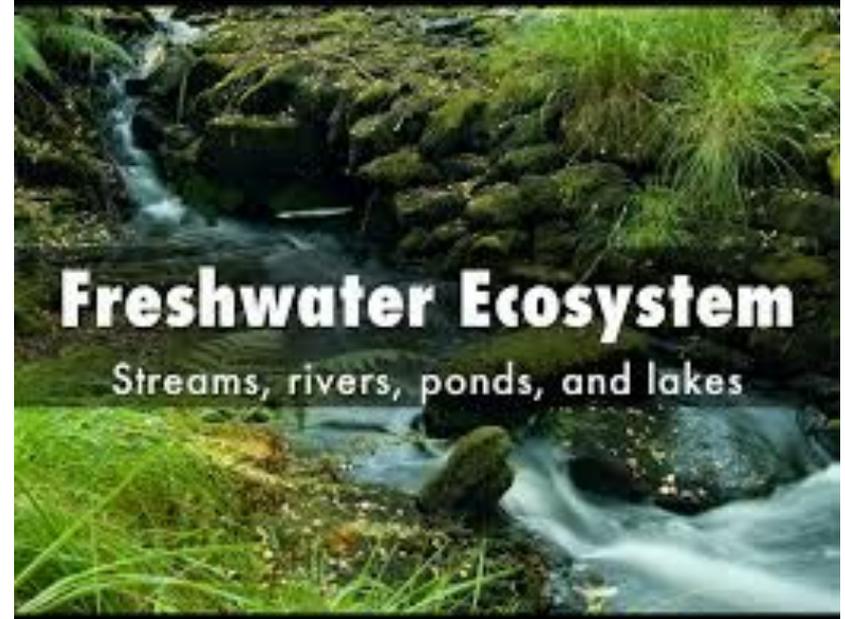
# Where are examples of freshwater ecosystems found?



- A **wetland** is an area of land that is saturated, or soaked, with water for at least part of the year. Bogs, marshes, and swamps are types of wetlands.
- Wetlands have high species diversity. Plants in wetlands can live in wet soil. Animals include ducks, frogs, shrews, herons, and alligators.
- Wetlands collect and filter water, removing some pollutants. They protect nearby land and shore from floods and erosion.

# Where are examples of freshwater ecosystems found?

- Rivers and streams are home to many organisms, including fish, aquatic insects, and mosses.
- As the water moves, it interacts with air and absorbs oxygen.
- Freshwater ecosystems in streams can have areas of fast-moving and slow-moving water, with organisms adapted to each area.





# Where River Meets the Sea

## What is an estuary?

- An **estuary** is a partially enclosed body of water formed where a river flows into an ocean.
- Because estuaries have a mixture of fresh water and salt water, they support ecosystems that have a unique and diverse community of organisms.
- Seagrasses, mangrove trees, fish, oysters, mussels, and water birds all live in estuaries.

