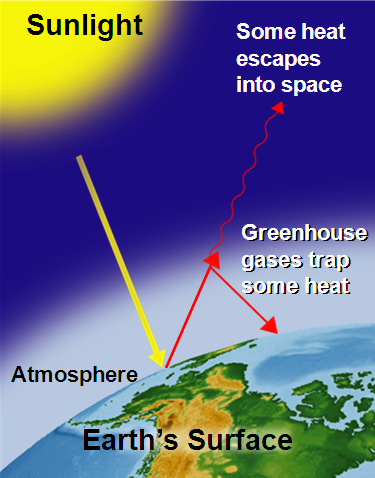
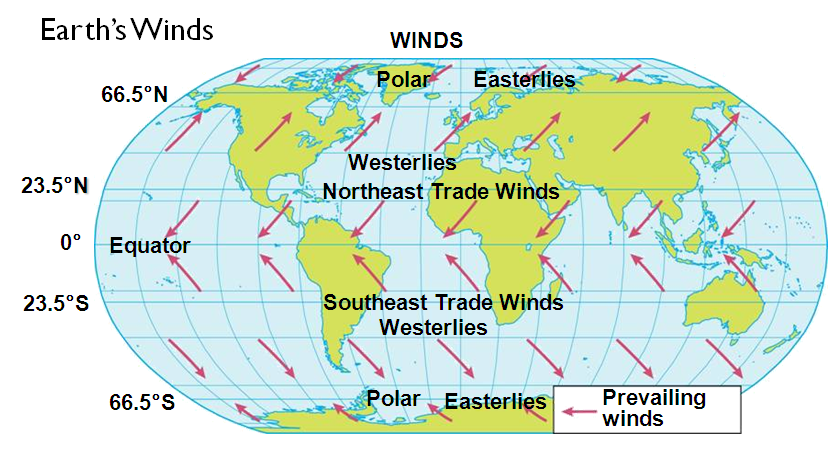
Chapter 4 – Ecosystems and Communities

Section 1 – The Role of Climate

* What Is Climate?
  + **\_\_\_\_\_\_\_\_\_\_\_\_\_\_** is the day-to-day condition of Earth's atmosphere at a particular time and place.
  + **Climate** refers to the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ year-after-year conditions of temperature and precipitation in a particular region.
* Climate is caused by:
  + trapping of heat by the atmosphere
  + latitude
  + transport of heat by winds and ocean currents
  + amount of precipitation
  + shape and elevation of landmasses
* The Greenhouse Effect
  + How does the greenhouse effect maintain the biosphere's temperature range?
  + Atmospheric gases that trap the heat energy of sunlight and maintain Earth's temperature range include:
    - **carbon \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
    - **methane**
    - **water vapor**
  + The natural situation in which heat is retained in Earth’s atmosphere by this layer of gases is called the **greenhouse \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**.



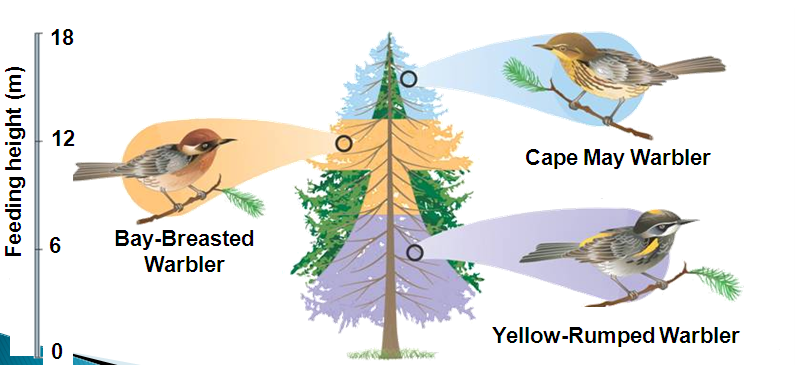
* + Solar radiation strikes different parts of Earth’s surface at an angle that varies throughout the year.
  + At the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, energy from the sun strikes Earth almost directly.
  + At the North and South Poles, the sun’s rays strike Earth’s surface at a lower angle.
* As a result of differences in latitude and thus the angle of heating, Earth has three main climate zones:
  + **polar,**
  + **temperate, and**
  + **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
* **Polar Zones** 
  + The **polar zones** are \_\_\_\_\_\_\_ areas where the sun's rays strike Earth at a very low angle.
  + Polar zones are located in the areas around the North and South poles, between 66.5° and 90° North and South latitudes.
* Temperate Zones
  + The **temperate zones** sit between the polar zones and the tropics.
  + Temperate zones are more affected by the changing \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the sun over the course of a year.
  + As a result, the climate in these zones ranges from hot to cold, depending on the season.
* Tropical Zones
  + The **tropical zone**, or tropics, is near the equator, between 23.5° North and 23.5° South latitudes.
  + The tropics receive direct or nearly direct sunlight year-round, making the climate almost always \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* Heat Transport in the Biosphere
  + Unequal heating of Earth’s surface drives winds and ocean currents, which transport \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ throughout the biosphere.
  + Warm air over the equator rises, while cooler air over the poles sinks toward the ground.
  + The upward and downward movement of air creates air currents, or \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, that move heat throughout the atmosphere.



* Similar patterns of heating and cooling occur in Earth’s oceans. Cold water near the poles sinks, then flows parallel to the ocean bottom, and rises in warmer regions.
* Water is also moved at the surface by winds.
* The movement of the water creates ocean \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, which transport heat energy throughout the biosphere.
* Surface ocean currents warm or cool the air above them, affecting the weather and climate of nearby \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Section 2 – What Shapes an Ecosystem? (Part 1)

* Biotic and Abiotic Factors
  + Ecosystems are influenced by a combination of biological and physical factors.
* The biological influences on organisms within an ecosystem are called **biotic factors**.
  + **Biotic** factors include all the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ things with which an organism might interact.
* Physical, or \_\_\_\_\_\_\_\_\_\_\_\_\_\_, factors that shape ecosystems are called **abiotic factors**.
  + Abiotic factors include:
    - temperature
    - precipitation
    - humidity
    - wind
    - nutrient availability
    - soil type
    - sunlight
* How do biotic and abiotic factors influence an ecosystem?
  + Biotic and abiotic factors determine the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and growth of an organism and the productivity of the ecosystem in which the organism lives.
  + The area where an organism lives is called its **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**. A habitat includes both biotic and abiotic factors.
* The Niche
  + A **niche** is the full range of physical and biological conditions in which an organism lives and the way in which the organism uses those conditions.
  + The range of temperatures that an organism needs to survive and its place in the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ web are part of its niche.
  + The combination of biotic and abiotic factors in an ecosystem often determines the number of different niches in that ecosystem.
  + No two species can \_\_\_\_\_\_\_\_\_\_\_\_\_\_ the same niche in the same habitat.
  + Different species can occupy niches that are very similar.
* Community Interactions
  + When organisms live together in ecological communities, they \_\_\_\_\_\_\_\_\_\_\_ constantly.
  + Community interactions, such as competition, predation, and various forms of symbiosis, can affect an ecosystem.
* Competition
  + Competition occurs when organisms of the same or different species attempt to use an ecological \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in the same place at the same time.
  + A **resource** is any necessity of \_\_\_\_\_\_\_\_\_, such as water, nutrients, light, food, or space.
  + Direct competition in nature often results in a winner and a loser—with the losing organism failing to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + The **competitive exclusion principle** states that no two species can occupy the same niche in the same habitat at the same time.
  + The distribution of these warblers avoids direct competition, because each species feeds in a different \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the tree.



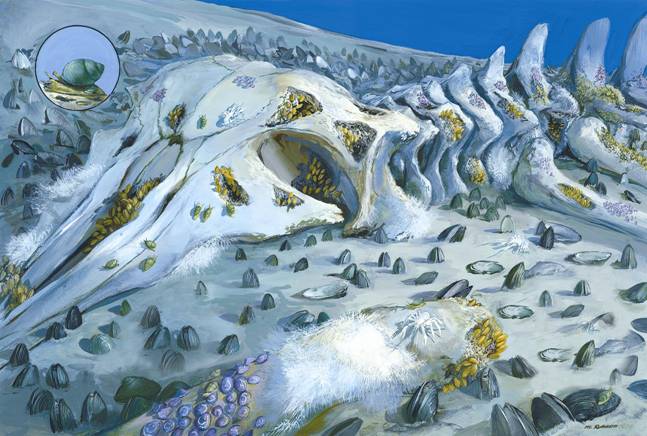
* Predation
  + An interaction in which one organism captures and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ on another organism is called **predation**.
  + The organism that does the killing and eating is called the predator, and the food organism is the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* Symbiosis
  + Any relationship in which two species live closely together is called **symbiosis**.
  + Symbiotic relationships include:
    - mutualism
    - commensalism
    - parasitism
  + **Mutualism**: both species \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ from the relationship.
  + **Commensalism**: one member of the association benefits and the other is neither helped nor \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + **Parasitism**: one organism lives on or inside another organism and \_\_\_\_\_\_\_\_\_\_\_\_\_\_ it.

Section 2 – What Shapes an Ecosystem (Part 2)

* Ecological Succession
  + Ecosystems are constantly changing in response to natural and human disturbances.
  + As an ecosystem changes, older inhabitants gradually \_\_\_\_\_\_\_\_\_\_\_\_\_\_ out and new organisms move in, causing further changes in the community.
  + This series of predictable changes that occurs in a community over time is called **ecological succession**.
  + Sometimes, an ecosystem changes in response to an **abrupt** disturbance.
  + At other times, change occurs as a more gradual response to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ fluctuations in the environment.
* Primary Succession
  + On land, succession that occurs on surfaces where no soil exists is called **primary succession**. For example, primary succession occurs on rock surfaces formed after volcanoes erupt.
  + The first species to populate the area are called **\_\_\_\_\_\_\_\_\_\_\_\_\_\_ species**.
  + In this example, a volcanic eruption has destroyed the previous ecosystem.
  + The first organisms to appear are lichens.
  + Mosses soon appear, and grasses take root in the thin layer of soil.
  + Eventually, tree seedlings and shrubs sprout among the plant \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* Secondary Succession
  + Components of an ecosystem can be changed by natural events, such as fires.
  + When the disturbance is over, community interactions tend to restore the ecosystem to its original condition through **\_\_\_\_\_\_\_\_\_\_\_\_\_\_ succession**.
  + Healthy ecosystems usually recover from natural disturbances, but may not recover from long-term, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_-caused disturbances.
* Succession in a Marine Ecosystem
  + Succession can occur in any ecosystem, even in the permanently dark, deep ocean.
  + In 1987, scientists documented an unusual community of organisms living on the remains of a dead \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + The community illustrates the stages in the succession of a whale-fall community.
  + Succession begins when a whale dies and sinks to the ocean floor.

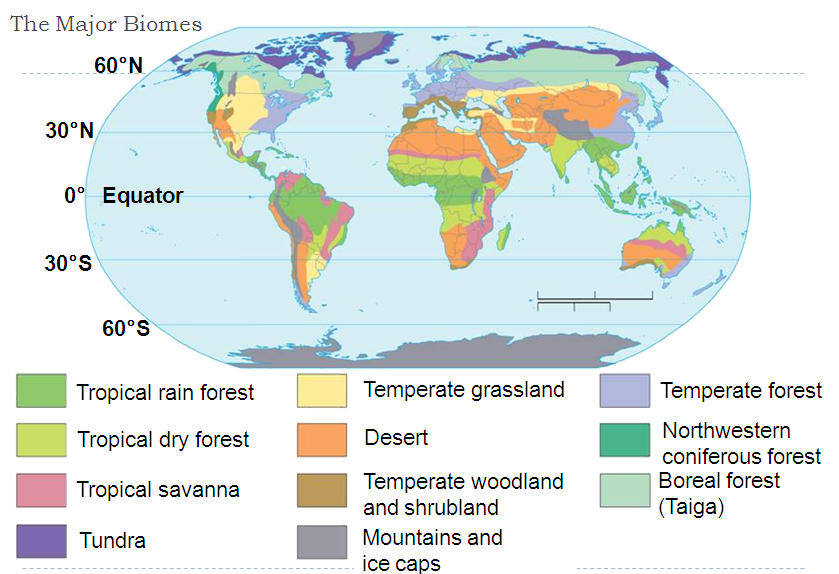


* + Within a year, most of the whale’s tissues have been eaten by scavengers and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.



* The decomposition of the whale’s body enriches the surrounding sediments with nutrients.
* When only the skeleton remains, heterotrophic bacteria decompose oils in the whale bones.
* This releases compounds that serve as \_\_\_\_\_\_\_\_\_\_\_\_\_ sources for chemosynthetic autotrophs.
* The chemosynthetic bacteria support a diverse community of organisms.

Section 3 – Biomes (Part 1)

* A **biome** is a complex of terrestrial communities that covers a large area and is characterized by certain soil and \_\_\_\_\_\_\_\_\_\_\_\_ conditions and particular assemblages of plants and animals.
  + Variations in plants and animals help different species survive under different conditions in different biomes.
  + Plants and animals exhibit variations in **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**, or the ability to survive and reproduce under conditions that differ from their optimal conditions.
  + The climate of a region is an important factor in determining which organisms can survive there.
  + Within a biome, temperature and precipitation can vary over small distances.
  + The climate in a small area that differs from the climate around it is called a **\_\_\_\_\_\_\_\_\_climate**.
* The Major Biomes
  + The world's major biomes include:
    - tropical rain forest
    - tropical dry forest
    - tropical savanna
    - desert
    - temperate grassland
    - temperate woodland and shrubland
    - temperate forest
    - northwestern coniferous forest
    - boreal forest
    - tundra
* Biomes are defined by a unique set of abiotic factors—particularly climate—and a characteristic assemblage of \_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* Tropical Rain Forest
  + Tropical rain forests are home to more species than all other biomes combined.
  + The tops of tall trees, extending from 50 to 80 meters above the forest floor, form a dense covering called a **\_\_\_\_\_\_\_\_\_\_\_\_\_**
  + In the shade below the canopy, a second layer of shorter trees and vines forms an **understory**.
  + Organic matter that falls to the forest floor quickly decomposes, and the nutrients are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
    - **Abiotic factors:** hot and high precipitation year-round; thin, nutrient-poor soils
    - **Dominant plants:** broad-leaved evergreen trees; ferns; large woody vines and \_\_\_\_\_\_\_\_\_\_\_\_\_ plants
    - **Dominant wildlife:** sloths, capybaras, jaguars, anteaters, monkeys, toucans, parrots, butterflies, beetles, piranhas, caymans, boa constrictors, and anacondas.
    - **Geographic distribution:** parts of South and Central America, Southeast Asia, parts of Africa, southern India, and northeastern Australia
* Tropical Dry Forest
  + Tropical dry forests grow in places where \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is highly seasonal rather than year-round.
  + During the dry season, nearly all the trees drop their \_\_\_\_\_\_\_\_\_\_\_\_ to conserve water.
  + A tree that sheds its leaves during a particular season each year is called **deciduous**.
    - **Abiotic factors:** generally warm year-round; alternating wet and dry seasons; rich soils subject to erosion
    - **Dominant plants:** tall, deciduous trees; drought-tolerant plants; aloes and other succulents
    - **Dominant wildlife:** tigers, monkeys, elephants, Indian rhinoceroses, hog deer, great pied hornbills, pied harriers, spot-billed pelicans, termites, snakes and monitor lizards
    - **Geographic distribution:** parts of Africa, South and Central America, Mexico, India, Australia, and tropical islands

Section 3 – Biomes (Part 2)

* Tropical Savanna
  + Tropical savannas, or grasslands, receive more rainfall than deserts but less than tropical dry forests.
  + They are covered with \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + Compact soils, fairly frequent \_\_\_\_\_\_\_\_\_\_\_\_\_, and the action of large animals prevent them from becoming dry forest.
    - **Abiotic factors:** warm temperatures; seasonal rainfall; compact soil; frequent fires set by lightning
    - **Dominant plants:** tall, perennial grasses; drought-tolerant and fire-resistant trees or shrubs
    - **Dominant wildlife:** lions, leopards, cheetahs, hyenas, jackals, aardvarks, elephants, giraffes, antelopes, zebras, baboons, eagles, ostriches, weaver birds, and storks
    - **Geographic distribution:** large parts of eastern Africa, southern Brazil, and northern Australia
* Desert
  + All deserts are dry, defined as having annual precipitation of less than \_\_\_\_ centimeters.
  + Deserts vary greatly, some undergoing extreme \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ changes during the course of a day.
  + The organisms in this biome can tolerate extreme conditions.
    - **Abiotic factors:** low precipitation; variable temperatures; soils rich in minerals but poor in organic material
    - **Dominant plants:** cacti and other succulents; plants with short growth cycles
    - **Dominant wildlife:** mountain lions, gray foxes, bobcats, mule deer, pronghorn antelopes, desert bighorn sheep, kangaroo rats, bats, owls, hawks, roadrunners, ants, beetles, butterflies, flies, wasps, tortoises, rattlesnakes, and lizards
    - **Geographic distribution:** Africa, Asia, the Middle East, United States, Mexico, South America, and Australia
* Temperate Grassland
  + Temperate grasslands are characterized by a rich mix of grasses and underlaid by fertile \_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + Periodic fires and heavy grazing by large \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ maintain the characteristic plant community.
    - **Abiotic factors:** warm to hot summers; cold winters; moderate, seasonal precipitation; fertile soils; occasional fires
    - **Dominant plants:** lush, perennial grasses and herbs; most are resistant to drought, fire, and cold
    - **Dominant wildlife:** coyotes, badgers, pronghorn antelopes, rabbits, prairie dogs, introduced cattle, hawks, owls, bobwhites, prairie chickens, mountain plovers, snakes, ants and grasshoppers
    - **Geographic distribution:** central Asia, North America, Australia, central Europe, and upland plateaus of South America
* Temperate Woodland and Shrubland
  + This biome is characterized by a semiarid climate and mix of shrub communities and open woodlands.
  + Large areas of grasses and wild\_\_\_\_\_\_\_\_\_\_\_\_\_ are interspersed with oak trees.
  + Communities that are dominated by shrubs are also known as chaparral.
  + The growth of dense, low plants that contain flammable oils makes \_\_\_\_\_\_\_\_\_\_\_\_\_ a constant threat.
    - **Abiotic factors:** hot, dry summers; cool, moist winters; thin, nutrient-poor soils; periodic fires
    - **Dominant plants:** woody evergreen shrubs; herbs that grow during winter and die in summer
    - **Dominant wildlife:** coyotes, foxes, bobcats, mountain lions, black-tailed deer, rabbits, squirrels, hawks, California quails, warblers, lizards, snakes, and butterflies
    - **Geographic distribution:** western coasts of North and South America, areas around the Mediterranean Sea, South Africa, and Australia

Section 3 – Biomes (Part 3)

* Temperate Forest
  + Temperate forests contain a mixture of deciduous and coniferous trees.
  + **Coniferous** trees, or conifers, produce \_\_\_\_\_\_\_\_\_\_\_\_-bearing cones and most have leaves shaped like needles.
  + These forests have cold \_\_\_\_\_\_\_\_\_\_\_\_\_\_ that halt plant growth for several months.
  + In autumn, the deciduous trees shed their leaves.
  + Soils of temperate forests are often rich in **humus**, a material formed from decaying leaves and other organic matter that makes \_\_\_\_\_\_\_\_\_\_\_\_\_ fertile.
    - **Abiotic factors:** cold to moderate winters; warm summers; year-round precipitation; fertile soils
    - **Dominant plants:** broadleaf deciduous trees; some conifers; flowering shrubs; herbs; a ground layer of mosses and ferns
    - **Dominant wildlife:** Deer, black bears, bobcats, squirrels, raccoons, skunks, numerous songbirds, turkeys
    - **Geographic distribution:** eastern United States; southeastern Canada; most of Europe; and parts of Japan, China, and Australia
* Northwestern Coniferous Forest
  + Mild, moist air from the Pacific Ocean provides abundant \_\_\_\_\_\_\_\_\_\_\_\_ to this biome.
  + The forest is made up of a variety of trees, including giant redwoods, spruce, fir, hemlock, and dogwood.
  + Because of its lush vegetation, the northwestern coniferous forest is sometimes called a “temperate rain forest.”
    - **Abiotic factors:** mild temperatures; abundant precipitation during fall, winter, and spring; relatively cool, dry summer; rocky, acidic soils
    - **Dominant plants:** Douglas fir, Sitka spruce, western hemlock, redwood
    - **Dominant wildlife:** bears, elk, deer, beavers, owls, bobcats, and members of the weasel family
    - **Geographic distribution:** Pacific coast of northwestern United States and Canada, from northern California to Alaska
* Boreal Forest
  + Dense evergreen forests of coniferous trees are found along the northern edge of the temperate zone.
  + These forests are called boreal forests, or **taiga**.
  + Winters are bitterly \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + Summers are mild and long enough to allow the ground to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + Boreal forests occur mostly in the Northern Hemisphere.
    - **Abiotic factors:** long, cold winters; short, mild summers; moderate precipitation; high humidity; acidic, nutrient-poor soils
    - **Dominant plants:** needleleaf coniferous trees; some broadleaf deciduous trees; small, berry-bearing shrubs
    - **Dominant wildlife:** lynxes, timber wolves, members of the weasel family, small herbivorous mammals, moose, beavers, songbirds, and migratory birds
    - **Geographic distribution:** North America, Asia, and northern Europe
* Tundra
  + The tundra is characterized by **\_\_\_\_\_\_\_\_\_\_\_\_\_**, a layer of permanently frozen subsoil.
  + During the short, cool summer, the ground thaws to a depth of a few centimeters and becomes soggy and wet. In winter, the topsoil freezes again.
  + \_\_\_\_\_\_\_\_\_\_\_\_\_ temperatures, high winds, the short growing season, and humus-poor soils also limit plant \_\_\_\_\_\_\_\_\_\_\_\_\_.
    - **Abiotic factors:** strong winds; low precipitation; short and soggy summers; long, cold, and dark winters; poorly developed soils; permafrost
    - **Dominant plants:** ground-hugging plants such as mosses, lichens, sedges, and short grasses
    - **Dominant wildlife:** birds, mammals that can withstand the harsh conditions, migratory waterfowl, shore birds, musk ox, Arctic foxes, caribou, lemmings and other small rodents
    - **Geographic distribution:** northern North America, Asia, and Europe
* Other Land Areas
  + Mountain ranges and polar icecaps do not fit neatly into any of Earth’s major biomes.
* Mountain Ranges
  + Abiotic and biotic conditions vary with \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + Temperatures become colder as you move from base to summit.
  + The amount of precipitation \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ as you move from base to summit.
  + Plants and animals also change, adapting to the changing environment.
* Polar Ice Caps
  + The polar regions are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ all year round.
  + In the north polar region, the Artic Ocean is covered with sea ice and a thick ice cap.
  + Dominant organisms include mosses, lichens, polar bears, seals, insects, and mites.
  + In the south polar region, Antarctica is covered by a layer of ice nearly 5 kilometers thick in some places.
  + The dominant wildlife includes \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and marine mammals.

Section 4 – Aquatic Ecosystems (Part 1)

* Nearly three-fourths of the Earth’s surface is covered with \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + Almost all bodies of water contain a wide variety of communities governed by biotic and abiotic factors including light, nutrient availability, and oxygen.
* What are the main factors that govern aquatic ecosystems?
  + Aquatic ecosystems are determined primarily by the depth, flow, temperature, and chemistry of the overlying water.
  + Aquatic ecosystems are often grouped according to the \_\_\_\_\_\_\_\_\_\_\_\_ factors that affect them.
  + The depth of water determines the amount of \_\_\_\_\_\_\_\_\_\_\_\_\_ that organisms receive.
  + Water chemistry refers to the amount of dissolved chemicals on which life depends.
  + Communities of organisms found in shallow water close to shore can be very different from the communities that occur away from shore in deep water.
  + Latitude is an important abiotic factor to both land biomes and aquatic ecosystems.
* What are the two types of freshwater ecosystems?
* Freshwater Ecosystems
* Freshwater ecosystems can be divided into two main types:
  + **flowing-water ecosystems**
  + **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_-water ecosystems**
* Flowing-Water Ecosystems
  + Rivers, streams, creeks, and brooks are freshwater ecosystems that flow over land.
  + Organisms that live there are well adapted to the rate of flow.
  + Flowing-water ecosystems originate in mountains or \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + Turbulent water near the source has little \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ life.
  + As the water flows downhill, sediments build up and enable plants to grow.
  + Downstream, water may meander slowly, where turtles, beavers, and river otters live.
* Standing-Water Ecosystems
  + Lakes and \_\_\_\_\_\_\_\_\_\_\_\_\_ are standing-water ecosystems.
  + In addition to the net flow of water in and out of these systems, there is usually water circulating within them.
  + This circulation helps to distribute heat, oxygen, and nutrients throughout the ecosystem.
  + Still waters provide habitats for organisms such as plankton.
  + **Plankton** is a general term for free-floating organisms that live in both freshwater and saltwater environments.
  + Unicellular algae, or **phytoplankton**, are supported by nutrients in the water and form the base of many aquatic food webs.
  + **Zooplankton** are unicellular \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ that feed on phytoplankton.
* Freshwater Wetlands
  + A **wetland** is an ecosystem in which water covers the soil or is present at or near the surface of the soil at least part of the year.
  + The water in wetlands may be flowing or standing and fresh, salty, or brackish.
  + Many wetlands are productive ecosystems that serve as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ grounds for many types of wildlife.
* The three main types of freshwater wetlands are bogs, marshes, and swamps.
  + \_\_\_\_\_\_\_\_\_\_\_ are wetlands that typically form in depressions where water collects.
  + Marshes are shallow wetlands along \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + In swamps, which often look like flooded \_\_\_\_\_\_\_\_\_\_\_\_, water flows slowly.

Section 4 – Aquatic Ecosystems (Part 2)

* Estuaries
  + **Estuaries** are wetlands formed where rivers meet the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + Estuaries contain a mixture of fresh and salt water, and are affected by the ocean tides.
  + Primary producers include plants, algae, and bacteria.
  + In estuary food webs, most primary production is not consumed by herbivores. Instead, much of that organic material enters the food web as detritus.
  + **Detritus** is made up of tiny pieces of organic material that provide food for organisms at the base of the estuary's food web.
* **Salt marshes** are temperate-zone estuaries dominated by salt-tolerant \_\_\_\_\_\_\_\_\_\_\_\_ above the low-tide line, and by seagrasses under water.
  + Salt marshes occur in estuaries along seacoasts in the temperate zone.
* **Mangrove swamps** are coastal wetlands that occur in bays and estuaries across \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ regions, including southern Florida and Hawaii.
  + The dominant plants are salt-tolerant trees, called mangroves, with seagrasses common below the low-tide line.
* Marine Ecosystems
  + The well-lit upper layer of the ocean is known as the **\_\_\_\_\_\_\_\_\_\_ zone**.
    - Algae and other producers can grow only in this thin surface layer.
  + Below the photic zone is the **\_\_\_\_\_\_\_\_\_\_\_\_\_ zone**, which is permanently dark.
    - Chemosynthetic autotrophs are the only producers that can survive in the aphotic zone.
* In addition to the division between photic and aphotic zones, marine biologists divide the ocean into zones based on the depth and distance from shore:
  + **the intertidal zone**
  + **the coastal ocean**
  + **the open ocean**
* Intertidal Zone
  + Organisms that live in the intertidal zone are exposed to regular and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ changes in their surroundings.
  + Competition among organisms in the rocky intertidal zone often leads to **zonation**, the prominent arrangement of organisms in a particular habitat in horizontal bands.
* Coastal Ocean
  + The **coastal ocean** extends from the low-tide mark to the outer edge of the continental shelf.
  + It falls within the photic zone, and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ occurs throughout its depth.
  + The coastal ocean is often rich in plankton and many other organisms.
* **\_\_\_\_\_\_\_\_\_\_ forests** are named for their dominant organism, a giant brown alga. Kelp forests are one of the most productive coastal ocean communities.
  + Kelp forests support a complex food web.
* Coral Reefs
  + **\_\_\_\_\_\_\_\_\_\_\_\_\_ reefs**, found in tropical coastal waters, are named for the coral animals whose calcium carbonate skeletons make up their primary structure.
  + An extraordinary diversity of organisms flourishes among coral reefs.
  + Reef-building corals grow with the help of algae that live symbiotically within their tissues.