

Chapter 04

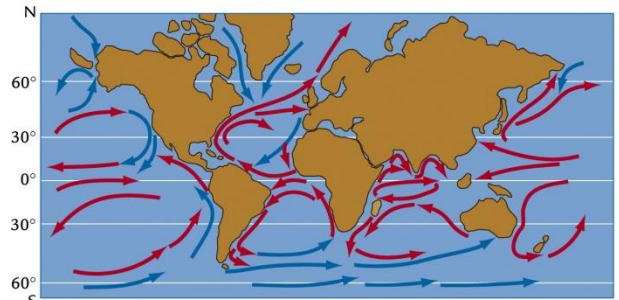
Ecosystems and Communities

4.1 Climate

- Weather and Climate
 - **Weather** = The day to day conditions of the Earth's atmosphere
 - **Climate** = The average conditions of the Earth's atmosphere over a long period of time
 - **Key** = A regions climate is the year after year patterns of temperature and precipitation
 - **Microclimates** = Small regions of a climate that have different weather than the large climate
- Factors That Affect Climate
 - **Key** = Global climate is shaped by solar energy trapped in the biosphere, latitude, and the transport of heat by winds and ocean currents
 - Solar Energy and the Greenhouse Effect
 - **Greenhouse Effect** = The trapping of heat from the sun by the Earth's atmosphere
 - Latitude and Solar Energy
 - Near the equator, almost all of the sunlight is absorbed because it shines directly down
 - As you move away from the equator, the sun shines less directly which makes less get absorbed
 - Near the poles, almost no heat/light shines directly on the Earth, making almost none get absorbed
 - Heat Transport in the Biosphere
 - Wind is caused by the warm air rising and cold air sinking
 - As the sunlight warms the air near the surface, it rises and expands from the equator
 - Water currents are caused by the same mechanism of warm air rising and cold water sinking
 - Cold water sinks near the poles and moves along the bottom of the ocean until it moves upward as the warmer water on top is moved by winds.



Latitude and Solar Energy



Ocean Currents

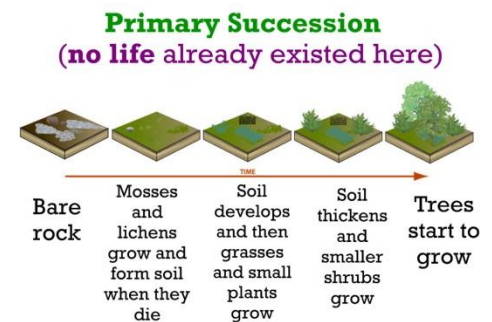
4.2 Niches and Community Interactions

- The Niche
 - Tolerance
 - **Tolerance** = Range of environmental circumstances in which an organism can survive and reproduce
 - **Habitat** = The general place where an organism lives
 - Defining the Niche
 - **Niche** = How an organism interacts with its biotic and abiotic factors of its environment
 - **Key** = A niche is the range of physical and biological conditions in which a species lives and the way the species obtains what it needs to survive and reproduce
 - Resources and the Niche
 - **Resource** = any necessity of life
 - Plants need sunlight, water, nutrients from the soil, etc...
 - Animals need nesting space, shelter, types of food, etc...
 - Physical Aspects of the Niche
 - The abiotic factors an organism requires to survive
 - Biological Aspects of the Niche
 - The biotic factors an organism requires to survive

- Competition
 - **Competitive Exclusion Principle** = No two species can occupy exactly the same niche in exactly the same habitat at exactly the same time
 - Dividing Resources
 - Instead of competing for the same resources, organisms will divide them
 - Three different types of Warblers live within a single spruce tree in different locations of the tree and feeding on different organisms they find there
 - **Key** = By causing species to divide resources, competition helps determine the number and kinds of species in a community and the niche each species occupies
- Predation, Herbivory, and Keystone Species
 - Predator-Prey Relationships
 - **Predation** = Where one animal captures and feeds on another animal
 - **Key** = Predators can affect the size of prey populations in a community and determine the places prey can live and feed
 - Herbivore-Plant Relationships
 - **Herbivory** = Where an animal feeds on a plant
 - **Key** = Herbivores can affect both the size and distribution of plant populations in a community and determine the places that certain plants can survive and grow
 - Keystone Species
 - **Keystone Species** = A species that when disturbed, can cause dramatic changes to the structure of a community
- Symbioses
 - **Symbiosis** = Any relationship where two species live closely together
 - **Key** = Biologists recognize three main classes of symbiotic relationships in nature:
 - **Mutualism** = Relationship where both organisms benefit from one another
 - **Parasitism** = Relationship where one organism benefits and the other is harmed
 - **Commensalism** = Relationship where one organism benefits and the other is not harmed

4.3 Succession

- Primary and Secondary Succession
 - **Ecological Succession** = A series of predictable changes that occur in a community over time
 - **Key** = Ecosystems change over time, especially after disturbances, as some species die out and new species move in
 - **Primary Succession** = Occurs in an area with no remnants of an older community
 - **Pioneer Species** = The first species to colonize barren areas
 - **Secondary Succession** = Occurs in an area with remnants of an older community
 - It is faster than primary succession because it doesn't have to start over
 - Why Succession Occurs
 - Every organism changes the environment it lives in
 - Lichens add organic matter and form soil
 - Mosses and other plants use the soil to grow
 - As plants grow, more species can then move in as a niche opens up
- Climax Communities
 - Succession After Natural Disturbances
 - **Key** = Secondary succession in healthy ecosystems following natural disturbances often reproduce the original climax community
 - Succession After Human-Caused Disturbances
 - **Key** = Ecosystems may or may not rec over from extensive human-caused disturbances
 - Studying Patterns of Succession
 - Usually plants with seeds or spores that can travel over long distances grow back first



4.4 Biomes

- The Major Biomes
 - Regional Climates
 - Some natural features can change the climate from other areas of similar latitudes
 - The rocky mountains make areas on the upwind side more wet and cooler than the downwind side which is hotter and dryer due to air going over mountains
 - Defining Biomes
 - **Key** = Biomes are described in terms of abiotic factors like climate and soil type, and biotic factors like plant and animal life
 - 10 Major Biomes
 1. Tropical Rain Forest – Home to more species than all other biomes combined, it receives at least 2 meters of precipitation a year
 - **Canopy** = Dense leafy covering made from the tall trees about 50 to 80 meters above the ground
 - **Understory** = Shorter trees and vines that grow underneath the canopy
 - Abiotic Factors
 - Hot and wet year-round, thin and nutrient poor soil subject to erosion
 - Biotic Factors
 - Plant Life
 - Understory plants compete for light so they have big leaves
 - The trees grow in poor shallow soil have buttress roots
 - Epiphytic plants grow on the branches of the tall plants
 - Animal Life
 - Animals are active all year
 - Many use camouflage to hide from predators
 - Animals in canopy are good climbers, jumpers, and/or fly
 2. Tropical Dry Forest – Grow in areas where rainy seasons alternate with dry seasons
 - Abiotic Factors
 - Warm year-round, wet/dry seasons, rich soils subject to erosion
 - Biotic Factors
 - Plant Life
 - Adaptations to survive the dry season includes loss of leaves
 - **Deciduous** = Plant that sheds its leaves during a particular season of the year
 - Some plants have thick waxy layer on leaves to reduce water loss and store water in their tissues
 - Animal Life
 - Many animals reduce their need for water by entering long periods of inactivity called estivation
 - Estivation is similar to hibernation, but typically takes place during a dry season
 - Birds and primates move to water during dry season
 3. Tropical Grassland/Savanna/Shrubland – Has more seasonal rainfall than deserts but less than dry forests. Spotted with isolated trees and small groves of trees and shrubs. Compact soil, frequent fires, and large animals prevent areas from turning into dry forest
 - Abiotic Factors
 - Warm, seasonal rainfall, compact soil, lightning started fires often
 - Biotic Factors
 - Plant Life
 - Similar to tropical dry forest including waxy leaf coverings and seasonal leaf loss.
 - Some grasses have high silica content that makes them less appetizing to grazing herbivores
 - Unlike most places, grasses grow from their bases not their tips so they can grow after being grazed

- Animal Life
 - Most migrate during dry season in search of water
 - Small animals burrow and remain dormant during dry season
4. Desert – Areas with less than 25 cm of precipitation annually, but otherwise vary greatly depending on elevation and latitude. Go through extreme hot/cold temperature changes
- Abiotic Factors
 - Low precipitation, variable temperatures, soils rich in minerals but poor in organic material
 - Biotic Factors
 - Plant Life
 - Store water in their tissues and minimize leaf surface to cut down on water loss
 - Cactus spines are actually modified leaves
 - Special photosynthesis allowing for them to open their pores only at night to conserve moisture
 - Animal Life
 - Get the water they need from the food they eat
 - Almost all are nocturnal so they sleep during hot days
 - Large ears and other extremities with blood vessels close to the skin to radiate heat better to maintain body temperature
5. Temperate Grassland – Plains and prairies contain very fertile soils. Periodic fires and heavy grazing by herbivores maintained plant communities dominated by grasses. Today, most have been converted for agriculture
- Abiotic Factors
 - Warm, hot summers and cold winters. Moderate seasonal precipitation, fertile soils, and occasional fires
 - Biotic Factors
 - Plant Life
 - Grassland plants, especially grasses that grow from their base are resistant to grazing and fire
 - Dispersal of seeds by wind is common
 - Animal Life
 - Predation is a threat for smaller animals so burrowing and camouflage are common
6. Temperate Woodland and Shrubland – Large areas of grasses and wildflowers with oak and other trees. If it is more shrubland than forest it is called chaparral. Dense low plants that contain flammable oils make fire a constant threat
- Abiotic Factors
 - Hot dry summers, cool moist winters, thin nutrient-poor soils and fires
 - Biotic Factors
 - Plant Life
 - Plants adapted to drought
 - Woody chaparral plants have tough waxy leaves to save water
 - Fire resistance is also important but many seeds need fire to germinate
 - Animal Life
 - Tend to be browsers that eat varied diets of grasses, leaves, shrubs, and other vegetation
 - Camouflage is common
7. Temperate Forest – Areas made up of deciduous and coniferous trees with cold winters and very fertile soils
- **Coniferous** = Trees that produce seed-bearing cones, and most have leaves shaped like needles coated in a waxy substance that helps reduce water loss
 - **Humus** = Material formed from decaying leaves and other organic matter

- Abiotic Factors
 - Cold to moderate winters, warm summers, year-round precipitation, fertile soils
 - Biotic Factors
 - Plant Life – Deciduous and Coniferous trees
 - Animal Life
 - Must cope with changing weather. Some hibernate while others migrate to warmer climates
 - Animals that don't hibernate or migrate may be camouflaged to escape predation in the winter when no leaves on trees
8. Northwestern Coniferous Forest – Mild moist air from the Pacific Ocean influenced by the Rocky Mountains provides abundant rainfall. Moss covers tree trunks and the forest floor. Also called the “temperate rain forest”
- Abiotic Factors
 - Mild temperatures, abundant precipitation in fall, winter, and spring with cool dry summers and rocky & acidic soil
 - Biotic Factors
 - Plant Life
 - Lots of plant life... tallest trees in the world due to trying to reach up and gather sunlight.
 - Lots of conifers and dense plant growth
 - Animal Life
 - Camouflage helps insects and ground-dwelling mammals
 - Mostly browsers
9. Boreal Forest – Dense forests of coniferous evergreens along the northern edge of the temperate zone are called Boreal Forests. Winters are bitterly cold, summers are mild and long enough to allow the ground to thaw. Boreal comes from the greek word for “north”
- **Taiga** = Another name for Boreal Forest
 - Abiotic Factors
 - Long, cold winters, short mild summers
 - Biotic Factors
 - Plant Life
 - Conifers are well suited for the environment
 - Conical shape sheds snow and wax-covered needlelike leaves prevent excess water loss
 - Dark green color absorbs maximum sunlight possible
 - Animal Life
 - Staying warm is major challenge for most animals
 - Most have small extremities and extra insulation in the form of fat or downy fathers
 - Many migrate to warmer areas during the winter
10. Tundra – Contains a permanently frozen layer of ground under the soil. In winter, the top layer of soil freezes then thaws in the summer. Freezing and thawing rips and crushes plant roots and only allows short, small, and stunted plants. Cold temperature, high winds, and humus-poor soil
- **Permafrost** = Permanently frozen ground under the top layer of soil
 - Abiotic Factors
 - Strong Wind
 - Low precipitation
 - Short and soggy summer with long, cold and dark winters
 - Biotic Factors
 - Plant Life
 - Mosses and low growing plants adapted to poor soil
 - Seed dispersal by wind is common
 - Legumes, with nitrogen-fixing bacteria

- Animal Life
 - Migration to warm areas for most of the year
 - Year-round animals have adaptations of natural antifreeze, small extremities, and a varied diet
- Other Land Areas
 - **Key** = Because they are not easily defined in terms of a typical community of plants and animals, mountain ranges and polar ice caps are not usually classified into biomes
 - Mountain Ranges
 - Exist on all continents and in many biomes
 - Conditions vary with elevation, from river valley to summit, temperature, precipitation, exposure to wind, and soil types all change and so do organisms
 - Polar Ice Caps
 - Polar regions border the tundra and are cold year-round
 - Plants are few, with exception to algae on snow and ice or rocks with moss and lichens
 - Marine mammals, insects, and mites are the typical animals

4.5 Aquatic Ecosystems

- Conditions Underwater
 - **Key** = Aquatic organisms are affected primarily by the water's depth, temperature, flow, and amount of dissolved nutrients
 - Water Depth
 - **Photic Zone** = The sunlit region near the surface in which photosynthesis can occur
 - Top 200 meters of tropical seas
 - Photosynthetic algae called phytoplankton live here and are eaten by zooplankton as the first step in almost all aquatic food webs
 - **Aphotic Zone** = Below the photic zone where photosynthesis cannot occur
 - Deeper than 200 meters in tropical seas
 - **Benthos** = Aquatic organisms that live on or in rocks and sediments on the bottom of lakes, streams, and oceans
 - If benthos is in the photic zone, algae and rooted aquatic plants can grow
 - If benthos is in a aphotic zone, chemosynthetic autotrophs are the only producers
 - Temperature and Currents
 - Aquatic habitats are warmer near the equator and colder near the poles
 - Temperature also varies with depth
 - Deepest parts of lakes and oceans are colder than the surface waters
 - Currents can dramatically affect water temperature because it can carry hot/cold water large distances making it warmer or cooler than normal for that latitude
 - Nutrient Availability
 - The availability of the nutrients necessary for life varies greatly within and between bodies of water making the types of organisms that can survive just as varied
- Freshwater Ecosystems
 - **Key** = Freshwater ecosystems can be divided into three main categories:
 - Rivers and Streams
 - Usually originate from underground water sources in mountains or hills
 - Near a source, water has plenty of dissolved oxygen but little plant life
 - Downstream, sediments build up and plants establish themselves
 - Even further downstream, water will meander slowly through flat areas, animals in many rivers and streams depend on terrestrial plants and animals along shores
 - Lakes and Ponds
 - Food webs in lakes and ponds are based on a combination of plankton and algae
 - **Plankton** = The general term that includes both phytoplankton and zooplankton
 - Freshwater Wetlands
 - **Wetland** = An ecosystem in which water covers the soil or is present at or near the surface for at least part of the year

- Water may flow through or stay in place of a wetland
 - Generally highly productive with lots of nutrients
 - They purify water by filtering pollutants and help to prevent flooding by absorbing large amounts of water and slowly releasing it
 - There are three types of wetlands
 - Freshwater bogs, freshwater marshes, and freshwater swamps
 - Saltwater wetlands are called estuaries
- Estuaries
 - **Estuary** = is a special kind of wetland formed where a river meets the sea
 - **Key** = Estuaries serve as spawning and nursery grounds for many ecologically and commercially important fish and shellfish species including bluefish, striped bass, shrimp, and crabs
 - Many salt-tolerant grasses above the sea-line and seagrasses below water are main plant life
- Marine Ecosystems
 - **Key** = Ecologists typically divide the ocean into zones based on depth and distance from shore
 - Intertidal Zone
 - Area submerged under water during low-tide, but above water during low-tide
 - Coastal Ocean
 - Extends from the low-tide mark to the outer edge of the continental shelf
 - Water is brightly lit and is supplied with nutrients by freshwater runoff
 - Open Ocean
 - Begins at the edge of the continental shelf and extends outwards
 - More than 90% of the world's ocean area is considered open ocean
 - Depth ranges from about 500 meters along continental slopes to over 10,000 meters in deep ocean trenches
 - The Open Ocean Photic Zone
 - Low nutrient levels and only supports only the smallest species of phytoplankton, yet has enough area to make up almost all of the photosynthesis that exists on earth within the top 100 meters
 - The Open Ocean Aphotic Zone
 - Permanently dark aphotic zone includes the deepest parts of the ocean
 - Food webs here are based on organisms that fall from the photic zone above, or chemosynthetic organisms