Abiotic Components of Ecosystems

**Climate** is the average weather in a region over a long period of time. It includes the effects of temperature, wind, precipitation, and sunlight. Climate and soil composition help determine the plant community (flora). Climate and flora help determine the animal community (fauna).

**Temperature**
- contributes to erosion & creation of soil
- different organisms have different cellular tolerances for cold and heat

**Water**
- important component in erosion & generation of soils
- terrestrial and freshwater environments require animals and plants to conserve water and evolve ways to maintain water/salt balance.
- animals that have secondarily returned to marine environments face water/salt balance challenges, since the ocean is now saltier than when their ancestors left it.
- **Plants** can be categorized by their adaptations to conserve water:
  - *xerophyte* – evolutionary adaptations for dry (xeric) environments
  - *hydrophyte* – evolutionary adaptations for wet (hydric) environments
  - *mesophyte* – evolutionary adaptations for moderate conditions

**Sunlight**
- intensity affects living things
- daily duration affects living things
- angle of incidence of the sun (seasonal changes) affects climate
- photoperiodicity can be diurnal, seasonal, 24-hour (Circadian rhythms)
- competition for light is an important factor in many environments
- plants use blue & red light for photosynthesis
- under foliage and underwater habitats have varying levels of these wavelengths, with red light being screened out first, and blue light last

**Wind**
- contributes to erosion and generation of soils
- affects perceived temperature via evaporation & convection
- affects desiccation (drying out) rate of animals and plants
- affects growth form of plants
- affects the rate of photosynthesis

**Major Environmental Disturbances**
- fire
- severe storms (hurricanes, tornadoes, etc.)
- volcanic activity
Rocks and Soil

- provides topography (hills, valleys, caves, etc.) and creates habitat
- mineral (inorganic nutrient) content of rock affects flora
- pH (acid/base level, on the scale of 0 to 14) of rock/soil affects flora
- soil composition affects any water in contact with that soil

Soil is classified in layers called **horizons**. From bottom to top:

- **Bedrock** – Solid base layer that gives rise to the upper layers.
- **C Horizon (parent material)** – large rocks and gravel
- **B horizon (subsoil)** – smaller rocks, more gravel, sand
- **A Horizon (topsoil)** – sand, some gravel, organic material
- **O Horizon** (leaf litter and other organic detritus) – decaying organic matter

**Global Patterns of Climate**

- The ultimate source of climate is the sun, which provides not only most of earth's energy, but also creates climatic events when its energy interacts with the earth.
- Less than half of the solar radiation striking the earth's atmosphere successfully penetrates the atmosphere to reach earth.
- Terrestrial irradiance (solar radiation that strikes the earth's surface) ranges from about 250nm (ultraviolet) to 1500nm (near infrared). Shorter and longer wavelengths are absorbed or reflected by atmospheric ozone, water vapor.
  - (note: "nm" stands for nanometer, 10^{-9} meters, or 0.0000000001 meters. Teeny weeny!)
- Environmental conditions and angle of incidence affect both **intensity** and **spectral distribution** (wavelengths) of sunlight reaching an ecosystem.
Climatic Regions of the Globe

The **TROPICS** lie between the Tropic of Cancer (23.5° N) and the Tropic of Capricorn (23.5° S). These receive the highest annual input of solar energy, and are the only place on earth that the sun ever shines directly overhead (on the equinoxes, March 21 and September 21).

The **SUBTROPICS** lie between the Tropic of Cancer and 30°N in the northern hemisphere, and between the Tropic of Capricorn and 30°S in the southern hemisphere. (Miami is in the subtropics)

The **TEMPERATE** regions lie between 30°N and 60°N in the Northern Hemisphere and between 30°S and 60°S in the Southern Hemisphere.

The **POLAR REGIONS** lie above 60°N and S

Because the earth is tilted 23.5° on its axis (defining those tropical latitudes), there are seasonal changes solar irradiation in both hemispheres, and that's what creates the seasons.

- **tropics**: warm, high levels of precipitation
- **subtropics** and **lower temperate**: relatively warm, arid:
- **higher temperate**: cool, high levels of precipitation
- **polar**: cold, arid (Arctic and Antarctic)

Climate determines the boundaries of **biomes**, large, naturally occurring communities of flora and fauna occupying a major habitat.
Unequal solar warming of earth creates global air and water vapor movement.

**Result:** cells of wet, warm air rising and cool, dry air falling at latitudes shown:

The interaction of the rising and falling "tubes" of air surrounding the earth interact with land masses, water masses and the forces that turn the earth, resulting in a complex web of prevailing winds, as shown above.

Local climate can be affected locally by proximity to ocean, lakes, rivers and topography. This creates smaller, localized ecosystems within **biomes**.

**Water: Saving us from the Heat**  
Compared to most matter, water has relatively high **specific heat**. That means it takes a lot of energy to change the temperature of water. Thus, bodies of water are tremendous energy "sinks" that can absorb large amounts of solar energy without heating up as much as a similar area of land.