

Unit 6: Ecology

Content Outline: Ecology Introduction (6.1) – Part 1

- I. **Ecology** – Is the study of the *interactions occurring between organisms and their environment* .(This is another level to the theme of open systems)
 - A. Ecology also studies *location* and *abundance of species*, either individually or collectively
 - B. **Abiotic** – environmental factors that are *without life* (temperature, light, water, nutrients, soil, and wind)
 - C. **Biotic** – environmental factors that *possess life* (bacteria, protists, fungi, plants, animals, competition, and symbiosis)

- II. Levels of Ecology
 - A. Organismal – looks at *morphology* (bodily structure), *behavior*, and *distribution* of organisms.
Point of bodily differences between aquatic, terrestrial, and flight organisms.
 - B. Population – looks at *abundance* within an area. (At the same time and showing signs of reproduction)
 - C. Community – looks at *species interacting*. (predation, competition, symbiosis)
Can use your own Community and discuss interactions between species as well as number of each species.
 - D. Ecosystem – looks at the *biotic factors interacting with the abiotic factors*. (E flow and cycling of nutrients)
 - E. Landscape - looks at the *arrangement of ecosystems* within a given area. (mountainscapes and seascapes)
Point out that landscape can change as you go up or down a mountain. Rocky Mountains are great example going from lush pastures to wooded (hard and pine), to pine, to snow cap as you go up.
 - F. Biosphere – looks at *global interactions* between biotic and abiotic factors.

- III. **Biogeography** – the distribution of *species* and distribution patterns seen *within an area* as well as the **species richness** (*number of different species* within that area)
 - A. **Normal species** – species that evolved in the defined area. (Also referred to as indigenous or native species)
 - B. **Transplant species** - species from another area living in a foreign environment.
 1. Accidental transplant species – Zebra Mussels and Fire Ants
 2. Human purposeful transplant species – African “killer” honeybees and Kudzu
 - C. Abiotic Factors
 1. Temperature
 2. Water availability (Please point out that water is important to all organisms.
 3. Sunlight amount (Photosynthesis rates and photoperiods indicates the amount of energy for a system)
 4. Wind (Can affect heat and water loss for an environment)
 5. Rocks and soil types (pH and composition of the soil mainly affects plants directly; animals indirectly)
Please help students understand the connection between soil ↔ plants ↔ animals in terms of nutrient flow. This will help when you get to Outline 4 and the Biogeochemical cycles.

- V. **Climate** – the *average* weather conditions for an environment (usually measured on a yearly or monthly basis)
 - A. **Weather** –the *daily* conditions (Look outside and you’ll get the weather for the day.)
Please help students understand the time scale for each. The local news can be a homework assignment project. Have students record and graph each high and low for a month; then determine averages for that month.

Ecology Introduction (6.1) – Part 2

I. Biomes –Refers to large ecosystems in general with similar climate conditions

- A. These are affected by climate patterns (sun, wind, and rain patterns as seen by Hadley cells /Fig: 50.10)
1. The Hadley model basically shows that at the equator we have mostly water on a global perspective. Due to the intense heat the water evaporates and rises. It then begins to move toward the poles. As it moves higher in the air and toward the poles, the water vapor cools and condenses into rain. The rain mainly falls out of the air before reaching the Tropics, that is why we mainly find the Rainforests between the Tropics. Since all the moisture is gone from the air by the time the wind reaches the Tropics, we see deserts along the Tropic lines. Here again any water is evaporated because of the high heat and mixed with water vapor from the oceans to rise into the atmosphere. As it rises and continues to move toward the poles, it condenses and rains or snows below the polar circles. So we see lots of vegetation in this area. Because all the moisture is gone by the time the wind reaches the poles, the poles are also considered desert based on the lack of precipitation received.
 - a. Tropics (23.5° latitude= tilt of Earth)(North –Tropic of Cancer; South- Tropic of Capricorn)
 - b. Equator - 0° ; Poles 90°; Arctic or Antarctic circle – 66.6°

Please use a globe and the Hadley cell picture to walk students through the explanation above. It is really important that students see the light intensity, wind flow (due to the rotation of the Earth) can affect water distribution and thereby the organisms that live within a given area.

2. Local effects

- a. Oceans – These act as *heat banks*. (coastal/island areas generally warmer than interior areas)
It absorb the sunlight's energy (so we don't fry) during the day and releases the energy at night to keep the dark side of the planet warm.
- b. Mountains –These creates the *rain shadow effect*. This creates deserts on the *backside*.
 - As the winds come off the water, they are heavy with moisture. When those winds run into mountains, the air is forced upward resulting in the moisture getting cooler and condensing resulting in lots of rain on the front side of the mountain. With no moisture left as the winds reach the backside or "shadow side" of the mountain , you get deserts typically.
(Look at California and Nevada.) (Please point these locations out on a map.
 - Wind increases with altitude. (Plants tend to be smaller and animals furrer.)
 - Temperatures on average drop 6° C for each 1000 meters up in altitude.
- c. Ponds and lakes –stratification of temperature creates layers of differing temperature within the body of water and this leads to **thermoclines** and turnover of nutrients and O₂. This is ultimately due to seasonal changes in temperature. Warmer water rises and colder water sinks. Ice on the surfaces helps prevent this in winter so that the whole body of water does not freeze and thereby kill all life forms in the body of water.
- d. **Thermocline** - These are temperature gradients (layers) that occur within a body of water as water heats or cools.

VII. Microclimates – These are *small* ecosystems /environments. (For example, under a log/ shady side of a house)

Ecology Introduction - Part 3 (Aquatic Biomes of Earth)

I. Aquatic Biomes

- A. These cover roughly *75% of the Earth's surface*.
- B. These are initially responsible for *rainfall and global temperature regulation* by absorbing some solar energy.
- C. They help with O₂ production and CO₂ consumption. (Due to Phytoplankton performing photosynthesis.)

II. Regions to an Ocean body of water (Commonly referred to as Marine systems.)

- A. **Photic Zone** – This is the upper region with light penetration. (“photo” means “having light”)
- B. **Aphotic Zone**– This is the lower region without light penetration. (“Aphoto” means “having no light”)
- C. **Benthic Zone** - Bottom of the ocean. (**Benthos** – communities of bottom dwelling, detritus feeding organisms)
- D. **Abyss** – These are the *deepest parts* of the Benthic Zone. (deep sea trenches mostly)
- E. **Intertidal Zone** – This is a very harsh environment due to tides crashing and receding. It is rich in biodiversity due to the *presence of light* for photosynthesis.
- F. **Coral Reef** – These are *very rich* in biodiversity. They are often called “the Rainforests of the ocean.”
 - They are *endangered and therefore protected by laws*.
 - They are found in *warm water climates*.

III. Regions to a Fresh water body (lakes, ponds, and streams)

- A. **Littoral Zone** – The shallows. (“*littorally* where you find most of the organisms”)(Light is present for plants.
- B. **Benthic Zone** –The bottom area. (It may or may not have plants; it depends on depth of light penetration.)

IV. Types of Lakes based upon Nutrient Availability

- A. **Oligotrophic** –These are *nutrient poor* (oligio- means “little”) due to tending to be *very deep and very cold*.
 1. Appear clear due to lack of phytoplankton and nutrients at surface.
 2. Very little plant and animals because nutrients are at the bottom and thermocline is hard to occur.
- B. **Eutrophic** – These are *nutrient rich* (eu – means “broad” or “much”), and are *fairly shallow and warm*.
 1. They appear murky due to abundance of phytoplankton and dissolved nutrients in the water.
 2. Tend to have lots of plants and animals because nutrients within reach.
- C. **Mesotrophic** – These lakes are in between conditions. (meso means “middle”)
 1. Moderate plant and animals present; mostly around the edge areas.

Please help students see the connection between nutrient location (availability), light, and the amount of plant and animal lifeforms within each lake.

V. Streams and Rivers

- A. **Headwaters** – These are located in the mountains
 1. Waters are cold, clear, fast, narrow, nutrient poor, *high dissolved O₂* so this affects the animals and plants found here – high oxygen demand organisms such as trout.
- B. **Midstream** – These are located in between mountains and coast.
 1. Waters are warm, slow, wide, nutrient rich and murky due to erosion, lower dissolved O₂. (Plants and animals are *moderate oxygen demanding* such as bass or catfish.)
- C. **Estuary** – This is where fresh water meets salt water. (Such as the Bay of Mobile)
 1. *Very nutrient rich* because of all the dissolved materials from upstream; water appears almost black.
 2. Very rich in **Biodiversity** -amount and types of life forms. (Almost as rich as a rainforest or coral reef.)
- D. **Wetlands** – These are lands possessing water and above water plants.
 1. Two types exist –**swamp** (define by having trees) and **marsh** (defined by having reed grasses only)

2. They are *very* rich in biodiversity. (These areas are protected by law and serve as Gamelands and wildlife refuges.)
3. These help to *reduce flooding* by holding rain waters or hurricane waters. (VERY IMPORTANT)

Please help students see the connection between nutrient location (availability), light, amount of dissolved Oxygen and the amount of plant and animal lifeforms within each part of a river. Also please help students understand the importance of coastal wetlands in Alabama – food, tourism, protection from hurricanes.

Ecology Introduction - Part 4 (Land Biomes of Earth)

These are good student group projects. Give 5-8 minute reports with a poster board size visual art project. Should count as a major grade.

Land Biomes –Students need to know the following:

- A. General climatic conditions (Graphs showing precipitation and temperature)
- B. General plant characteristics
- C. General animal characteristics
- D. General soil conditions as it relates to nutrients

In the following Biomes:

- A. Tropical Rain Forest
- B. Savannah
- C. Desert – Hot
- D. Desert - Polar
- E. Taiga
- F. Tundra
- G. Temperate Deciduous Forest
- H. Grasslands
- I. Chapparral