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Ecosystems Review

Ecosystem Structure:

- All ecosystems have two main components:
    - Abiotic factors: "nonliving" factors like physical or chemical conditions in the environment
        - EX) in a salt marsh, the abiotic factors would be: water temp, salinity, pH, soil composition, oxygen content in water
    - Biotic factors: "living" factors like all of the living organisms within an environment
        - EX) in a salt marsh, the biotic factors would be: all the plants, animals, and microorganisms (grass, fish, bacteria)
- Biotic factors can be organized into a hierarchy from lowest to highest level:
    - 1. Organisms
    - 2. Species
    - 3. Population
    - 4. Community
- *Ecosystem*: a community of different species that interact with each other and with the abiotic factors, allowing the overall ecosystem to respond to environmental changes
- *Niche*: consists of all the physical, chemical, and biological conditions that a particular species needs to live and reproduce within the ecosystem
    - EX) in a salt marsh, certain species of mussels have to live in certain areas of the marsh because those areas have what they need to survive, they live in their niches
    - *The Competitive Exclusion Principle*: Two species will never occupy the same niche. If they do, the competition will occur and one species will be excluded.

Species and Relationships:

- Species can be classified into two groups based on their niches
    - *Specialist species* - a species that can occupy only a few niches
        - EX) if they rely on only one food source (the panda, only eats bamboo)
        - Advantage: in a stable environment, they will have less competition

        - Disadvantage: more prone to extinction
    - *Generalist species* - a species that can occupy a broad range of niches
        - EX) a crab that has a large amount of varying food sources
        - Advantage: in a rapidly changing environment, can adapt and survive better than a specialist
        - Disadvantage: more competition for food
- Interactions between species:
    - Competition:
        - *Interference* - one species limits the access of another species to the resource
        - *Exploitation* - two or more species have equal access to the resource, but one uses it more quickly or efficiently than the others, thereby gaining an advantage
        - *Resource partitioning* - two or more species have equal access to the resource, but use it at different times or places, or in different ways
    - Predation:
        - *Carnivore-prey relationship* - carnivore (egret) hunts and eats prey (fish)
        - *Herbivore-prey relationship* - herbivore (cow) grazes on the plants in an ecosystem
    - Symbiosis:
        - One species (the symbiote) live on or in another species (host)
        - *Parasitism* - symbiote benefits, host is harmed or killed
            - EX) lice, tapeworms, leeches
        - *Mutualism* - both symbiote and host benefit
            - EX) bees and flowers, bees receive food and spread the flowers' pollen
        - *Commensalism* - one benefits while other neither benefits nor gets harmed
            - EX) plants that grow off of trees, good for plants, does not help or harm the trees
- Species in an Ecosystem:
    - *Native species* - normally live within a given ecosystem
        - EX) like the marsh grass and snails in the salt marsh
    - *Invader/Introduced species* -are not normally found in a given ecosystem, but they are deliberately or accidentally introduced into the ecosystem, usually by human activities. They may harm or benefit the ecosystem when they interact with the native species

        - EX) Zebra mussels in the Great Lakes, introduced when foreign freighters dumped bilge water containing their larvae, they had no predators, thrived, and are now causing problems by fouling intakes to power plants and ports
    - *Indicator species* - native species whose abundance and success provide information as to the overall health of the ecosystem, their decline means the ecosystem is in danger
        - EX) frogs in aquatic ecosystems
    - *Keystone species* - play one or more important roles that affect many other species within an ecosystem. Their loss could lead to the loss and decline of many other species.
        - EX) Sea otters, they keep the urchin pop in check so they don't multiply and destroy the kelp beds and therefore other animals
- Diversity and Edge Effects:
    - S*pecies Diversity*- the number of different species and their relative abundance in a given area
        - Best descriptor of a community, as a community ages it gets more diverse, the more species the more well-distributed = more diverse
    - *Edges* - boundaries between communities, can be natural or from human activities (rocks, roads, highways)
    - *Ecotones* - transitional zones at edges where each community competes for resources and a new community called an *edge community* forms
        - Abrupt edge: abrupt changes between communities with no edge community, can be caused by changes in the rock and soil types or typography or climate
        - Mixed edges - species from both communities invade the ecotone and compete for resources
            - Dominant: species from one dominates the edge community
            - Nondominant: species from both inhabit ecotone equally
        - Edge communities are usually more diverse than the communities on either side of the ecotone

<u>Major Biomes:</u>

- Tundra
    - Low precipitation, mostly snow, subfreezing/freezing temps
    - Permafrost soil, short growing season
    - Low growing plants
    - Mammals
- Temperate Deciduous Forest

    - Moderate temps, four seasons, abundant precipitation
    - Deciduous trees
    - Mammals
- Taiga (Boreal/Coniferous Forests)
    - Long, cold, dry winters + Short, moderately warm, wet summers
    - Evergreen trees and few deciduous trees
    - Mammals
- Temperate Rain Forest
    - Moderate temperatures, abundant rainfall and moisture
    - Conifers, Broadleaf evergreens
    - Mammals
- Tropical Rain Forest
    - Constant warm temps, heavy rainfall, long growing seasons
    - Large broadleaf evergreen trees, diverse plant species
    - Mammals, birds, insects, reptiles
- Savanna
    - Tropical wet and dry seasons
    - Grasses, shrubs, small trees
    - Grazing Mammals, Predatory Mammals, Birds
- Temperate Grasslands
    - Hot, dry summers + cold, snowy winters
    - Tall and short grasses
    - Mammals
- Shrubland
    - Hot dry summers and moist winters
    - Shrubs
    - Mammals, reptiles, birds
- Desert
    - Little precipitation (hot or cold)
    - Shrubs, Cacti
    - Reptiles, Mammals, adapted to dry conditions, rodents

<u>Ecological Pyramids (FOOD LEVELS):</u>

- 1 = Producer (lowest trophic level)
    - Captures the energy from the source (sunlight) and makes food
        - Example = grass
- 2 = Primary consumer
    - Eats the producer
        - Example = grasshopper/beetle

- 3 = Secondary Consumer
    - Eats the primary consumer
        - Example = sparrows, robins, blue birds
- 4 = Tertiary Consumer (usually highest trophic level)
    - Eats the secondary consumer
        - Example = hawks, eagles
- 5 = Decomposers
    - Break down all dead producers and consumers, release their nutrients back into the ecosystem
        - Example = bacteria, snails, fungi
- Energy becomes decreasingly available as trophic level increases
- All matter gets recycled
- As the new matter passes through the food chain, it gets more concentrated in organisms of each higher trophic level = biomagnification

<u>Natural Selection:</u>

- Charles Darwin: *The Origin of Species*
    - Similar organisms reproduce similar organisms: a dog reproduces a dog
    - The number of reproduced that survive is less than initially reproduced
    - Individuals have to compete with each other and other species for limited resources in the environment
    - In any population, individuals vary with respect to any given trait and these variations can be passed on to the next generation
        - Some are favorable, some are not
        - The ones that are favorable will survive and pass on the favorable traits to their offspring
        - Because of natural selection, the favorable traits will accumulate and the species will change or evolve
    - Giraffe example:
        - Short neck giraffes
        - With each generation, the giraffes with longer necks could reach food that was higher. In times of drought, they could reach more food than those with shorter necks, allowing them to survive.
        - The longer necked giraffes would pass this favorable trait on to the next generation and the average neck length would continue to evolve and increase with each new generation
- Directional Selection: an environmental change occurs that gives an advantage to a variation on one end of the distribution and against the other. Over time, the entire distribution shifts towards that end (longer necks).

- Stabilizing Selection: selection for the average form and against the extremes. Over time, the shape of the population curve becomes narrow at the mean and the mean increases. Gray snails survive and black and white snails are eaten.
- Disruptive Selection: selection for the extremes and against the average. Over time, the distribution divides into two separate populations. The gray snails are eaten and the black and white ones survive.