Principals of Ecology

Ecology : the study of the relationships among organisms and their environment.

Biotic and Abiotic Factors

Abiotic

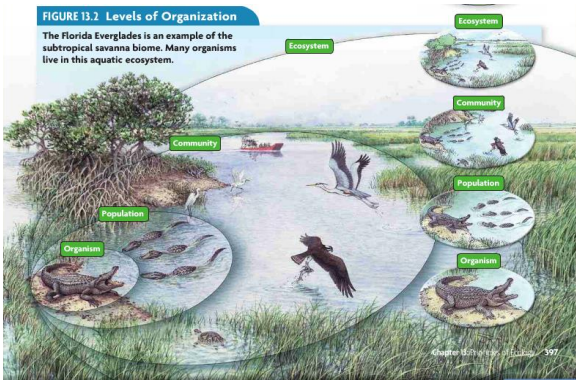
The *nonliving* factors in an organism's environment

Biotic

The *living* factors in an organism's environment

Abiotic	Biotic
• Air (O_2, CO_2, N_2, etc) • Water • Light • Wind • Soil • pH • Temperature • Salinity • Humidity • Inorganic nutrients (N, P) • Etc.	• Other organisms, so: • Competition • Predation • Symbiosis – Mutualism – Parasitism • Disease agents

Levels of Ecological Organization 1



Levels of Ecological Organization 2

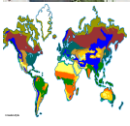
Organism: An individual

Population: All individual organisms of a single species that share the same geographic location at the same time.

Community: A group of interacting populations (different species) that occupy the same area at the same time.

Levels of Ecological Organization 3

Ecosystem: A *community* and all of the *abiotic factors* that affect it.



Biome: A large group of *ecosystems* that share the same climate and have similar types of communities.

Biosphere: All *biomes* together; the Earth

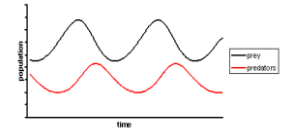
Stability in an Ecosystem

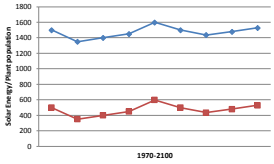
A *stable ecosystem* is one where:

- **The population of each organism fluctuate at a predictable rate.**
- **The supply of resources in the physical environment fluctuates at a predictable rate.**
- **Energy flows through the ecosystem at a fairly constant rate over time.**

These fluctuations in populations and resources ultimately result in a stable ecosystem.

Population Fluctuations





Populations fluctuate in relation to each other

These fluctuations in populations and resources ultimately result in a stable ecosystem.

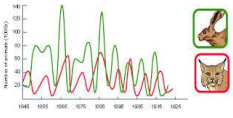
Ecological Relationships

Organisms in an ecosystem constantly interact. The interactions among the organisms generate stability within ecosystems. There are many different types of interactions (AKA relationships):

1. Predation (*Predator – Prey*)
2. Competition (*for food, mates, or habitat*)
3. Symbiosis (*Parasitism, Mutualism, Commensalism*)

Ecological Relationships –Predator – Prey

Predation: is an interaction between species in which one species (the *predator*) eats the other (the *prey*)



Predator – Prey populations normally fluctuate together.

The 2 populations have a direct relationship in terms of their numbers;

Prey ↑ Predator ↑ Prey ↓ Predator ↓

Ecological Relationships –Competition

Competition: is a relationship that occurs when two or more organisms need the same resource at the same time. (*Resources can be food, habitat, ECT*).

Can be between members of same species or 2 different species that share the same ***NICHE***.

Niche: the role of an organism in its environment including type of food it eats, how it obtains its food and how it interacts with other organisms.

Ecological Relationships –Competition 2

Two species with ***identical ecological*** niches ***cannot coexist*** in the same habitat.

Competition usually results in a decrease in the population of a species less adapted to compete for a particular resource

Examples of competition

1. Lions and Cheetahs compete for gazelles. *(Interspecies)*
2. Different forest plants compete or soil nutrients *(Interspecies)*
3. Two Blue Jays compete with each other for the same mate or nesting location. *(Intra-species)*
4. Oak saplings compete w/ each other for space to take root and grow. *(Intra-species)*

Competition exclusion principle: 2 species can not occupy the same niche in the same system or area.

Red and Grey Squirrels

Habitat: Trees

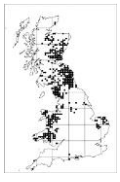
Diet: acorns, hickory nuts, walnuts, beechnuts

Predators: Hawks, Owls, Red Fox, Raccoons

These 2 species occupy the same niche, so as a rule they do not live in the same area

Grey

Red



Ecological Relationships –Symbiosis

A ***symbiotic relationship*** exists between organisms of two different species that live together in direct contact.

The balance of the ecosystem is maintained by symbiotic relationship.

If the population of one or other of the symbiotic organisms becomes unbalanced, the populations of both organisms will fluctuate in an uncharacteristic (odd) manner.

3 Types: parasitism, mutualism, and commensalism.

Ecological Relationships –Parasitism

Parasitism: one organism (the parasite) benefits at the expense of the other organism (the host).

Host usually not killed. If so then parasite usually dies as well.

Examples:

Fleas and Dogs 

Mosquitos and Humans 

Intestinal Worms and Host. 

Ecological Relationships –Mutualism

Mutualism: both organisms benefit. Because the two organisms work closely together, they help each other survive. Examples:

Bacteria and Termites: Bacteria, which have the ability to digest wood, live within the digestive tracts of termites.

Sea Anemone and Clownfish: the anemone receives protection from polyp-eating fish, like Butterfly Fish, which the Clown Fish chases away. The anemone also gets fertilizer from the feces of the Clown Fish.

Ecological Relationships –Commensalism

Commensalism: one organism benefits and the organism is not affected.

Whales and Barnacles: barnacles attach to whales and are dispersed to different environments where they can obtain food and reproduce.

Cattle Egrets and Livestock: cattle walking in pasture, scare insects into the air and egrets eat the insects.

WS-Ecological Relationships A & B

A Remora and the shark: Remora fish are small fish that make their niche by picking up the scraps that sharks leave behind while feeding. The shark makes no attempt to prey on the remora fish.

Remora: ★helped ☐harmed ☐not harmed/not helped
Shark: ☐ helped ☐harmed ★not harmed/not helped
Symbiotic Relationship: Commensalism

B Spider crab and algae: Spider crabs live in shallow areas of the ocean floor, and greenish-brown algae lives on the crabs' backs, making the crabs blend in with their environment, and unnoticeable to predators. The algae get a good place to live, and the crab gets camouflage.

Spider crab: ★helped ☐harmed ☐not harmed/not helped
Algae: ★helped ☐harmed ☐not harmed/not helped
Symbiotic Relationship: Mutualism

Key Terms

Trophic Levels: are different levels at which organisms will consumer or taken in energy.

Autotrophs: Organisms that use the sun's energy to make their own food

Heterotrophs: Organisms that get their energy by consuming other organisms

Herbivores: Animals that eat ONLY plants

Carnivores: Animals that eat ONLY other animals

Omnivores: Animals that eat either plants or animals

Decomposers: they break down the organic compounds in dead remains and release their raw materials, back into the environment.

Trophic Level Positions

Primary Producer: Photosynthetic organisms that use the sun's energy and minerals from the environment to make food for themselves and others (*Autotrophs*)

Primary Consumers: organisms that take in primary producers only as an energy source. (*Herbivores*)

Top or Secondary Consumers: organisms that take in primary producers (very rarely) , or primary consumers or other secondary consumers as an energy source

Decomposers: break down dead material in its component elements and minerals (C, N, P, Ca). Usually found in soil.

Examples: Bacteria, fungus, worms

Primary Producer Marine Algae 

Primary Consumer: Copepod 

Secondary Consumer: Alewife 

Secondary Consumer: Mahi-Mahi (Larger) 

Top Consumer: Tiger Shark 

Trophic Level Diagrams-Graphics

Pyramid of numbers: Shows how much of each species present.

Trophic or energy pyramid : shows energy movement in system *(usually has energy unit)*

Food Chain: Direct flow of energy through organisms

Food web: indirect flow of energy through organisms

Trophic Level Diagrams-Graphics-2

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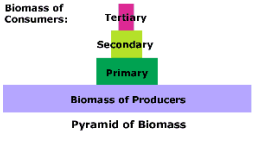
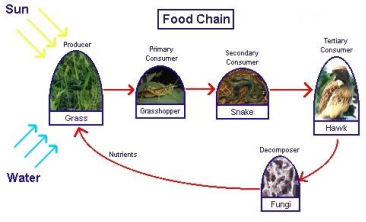


Biomass Pyramid: Shows the total MASS of all living things on a certain level, *may or may not have a mass unit attached* (Kg or Kg/m^2)

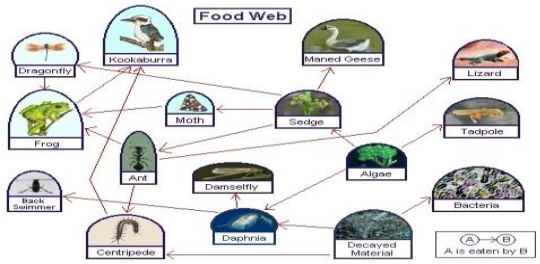
Food Chains vs. Food Web

The movement of energy can be explained through the trophic levels in two processes.

Food Chain- Direct flow of energy through organisms



Food web: is the indirect flow of energy through organisms. It shows the relation between all organisms and parts in the system



Systems "Spheres" of the Planet

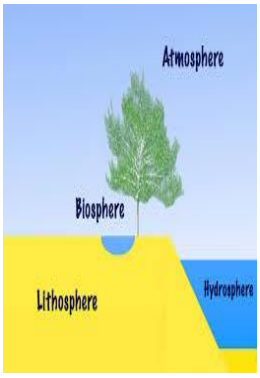
Biosphere: The portion of Earth that is inhabited by life

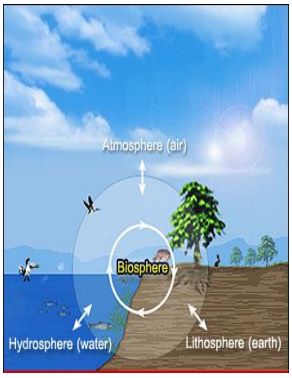
Geosphere: includes the Earth's interior, rocks and minerals, landforms (Lithosphere)

Hydrosphere: is the liquid water component of the Earth. It includes the oceans, seas, lakes, ponds, rivers and streams

Atmosphere: a layer of gases surrounding the planet Earth, including the ***ozone layer***

Systems "Spheres" of the Planet - 2





Bio-geochemical cycles

Bio-geochemical cycles: the movement of a particular form of matter (H_2O, C & N) through the ***living*** and ***nonliving*** parts of an ecosystem.

*** Remember***

Earth is a "closed" system: no new materials to speak of enters all recycled

Conservation of Matter: matter can not be created or destroyed on changes form

3 Cycles that we will deal with

Carbon Cycle, Water (Hydrologic) Cycle and Nitrogen Cycle

Carbon Cycle

Carbon is one of the major components of the biochemical compounds of living organisms (proteins, carbohydrates, lipids, nucleic acids).

Carbon is located in:

- Living organisms
- Decaying Plants and Animals
- Atmosphere (CO_2)
- Fossil Fuels

Carbon Cycle-2

Carbon moves through the biosphere by:

Photosynthesis

Respiration

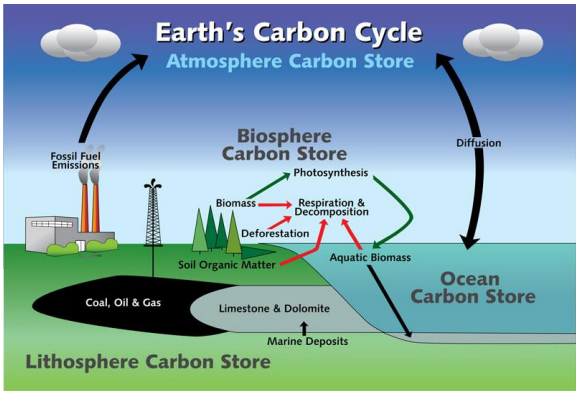
Use of bio-compounds by living organisms

(EX. Eating food)

Combustion (EX. Burning fossil fuels)

Weathering (EX. Ocean acts on rocks to break them down and release carbon the contain)

Carbon Cycle-3



Water (Hydrologic) Cycle

Water Cycle: movement of water through the biosphere.

- Water is needed by living organisms for photosynthesis , elimination, and other life sustaining activities.
- Water cycle is driven by energy from the sun that caused evaporation of bodies of water (lakes/oceans ect.) ★
- Living organisms play a major roll in the water cycle.
- Pollutants in the air are also filtered out by the water cycle.

★ Water (Hydrologic) Cycle -2 ★

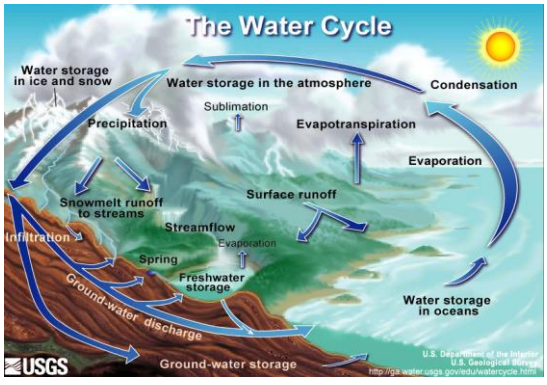
Water is cycled through the plant by:

Respiration: water is released as a product of cellular respiration.

Transpiration: water being released by plants to the atmosphere.

Evaporation: liquid water transformed into water vapor and released to atmosphere form bodies of water.

Water (Hydrologic) Cycle -3



Limiting Factors--Factors that effect populations

Population: All of a single species that share the same location at the same time.

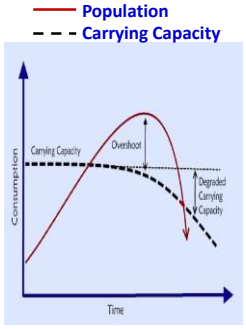
Populations can be described (discussed) based on their size, density, or distribution.

Population density measures the number of individual organisms living in a defined space. (EX. People per sq mile or organism per acre)

The maximum population an ecosystem can contain and still replenish its resources is called *Carrying Capacity*

Factors that effect populations-2

As population increases, beyond the carrying capacity of an area or system, the amount of resources (food, habitat) starts to be depleted and the carrying capacity actually is reduced and the population starts to die out or leave.



Factors that effect populations 3

Limiting Factors: factors (things) that regulate or control the size and help of a population.

4 kinds of limiting factors:

- Biotic
- Abiotic
- Density dependent
- Density Independent

Factors that effect populations 4

Abiotic and biotic factors limiting factors can change within an ecosystem and may affect a population.

Abiotic factors that may effect a population can be chemical or physical. (EX. water, nitrogen, oxygen, salinity, pH, soil nutrients , climate)

Biotic factors include all of the living components of an ecosystem (bacteria, fungi, plants, and animals)

A change in these factors may increase or decrease the size of a population.

Negative affects will cause populations to decrease

Positive Effects will cause populations to increase

Factors that effect populations 5

1. *DENSITY DEPENDENT*: factors that are density-dependent are those that effect large populations more than smaller ones. These limiting factors are triggered by increases in population density (crowding)

2. *DENSITY-INDEPENDENT* factors that are occur no matter how large the population. Effect on the population is the same no matter what size the population is.

Factors that effect populations 6

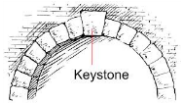
Density Independent	Density Dependent
Human Impact	Competition
Natural Disasters	Parasitism
Climate Change	Disease
Drought	Predation
	Habitat

Key Stone Species

Keystone species: A species that is critical to ecosystem because it affects the well being of a large number of species in the community.

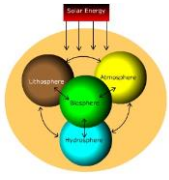
Ex. Sea otter: they keep the correct balance in the CA kelp forests because they controlled the sea urchin population.

THIS IS THE SPECIES THAT IF IT IS REMOVED WOULD LIKELY CAUSE THE SYSTEM TO COLLAPSE



Maintaining Environmental Quality

Environmental quality of the planet is effected by the health of all the sphere on the earth (Hydro, Geo, Bio, Atmospheres)



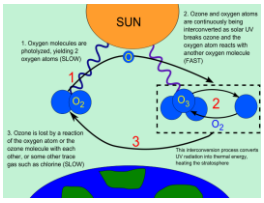
All of the biogeochemical cycles on the earth act together to maintain the environment.

Atmospheric Quality

Plants use photosynthesis to produce oxygen and absorb CO_2 form the atmosphere to maintain balance

Oxygen in the atmosphere creates the ozone layer, which filters out some of the harmful UV radiation from the sun and allows life to exist on earth.

The ozone layer is a layer of O_3 that blocks out harmful UV radiation



Atmospheric Quality -2

There are many natural and man made pollutants in the atmosphere, these are naturally filtered out by *rain and snow.*

Nitrogen and Water: **are cycled into and out of the atmosphere through their cycles. Remember water evaporates and changes to water vapor in the atmosphere (from bodies of water) and transpires from plants.**

Greenhouse effect 1

** **It is a normal part of the planet!!!!**

If it were not for the greenhouse effect, the plant would be a solid ice ball floating in space!

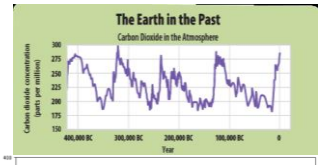
Greenhouse gases (*CO_2*, methane, Water vapor, O_2) in the upper atmosphere act as a barrier to hold in heat (*from the sun and earths core*), so that it can not leave the planet.

As a result the planet is warm enough to support life.

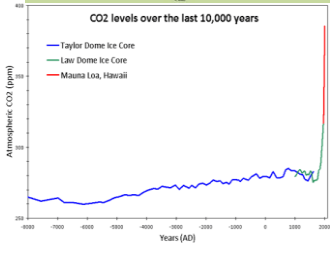
The amount of carbon dioxide in the atmosphere changes over time in cyclical manner, which is normal.

Greenhouse effect-2

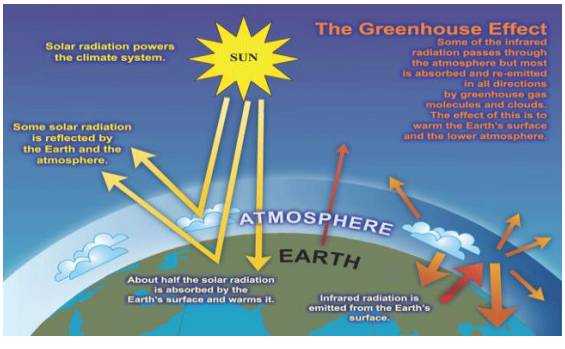
As mentioned, CO_2 levels fluctuate over time



However the planet's CO_2 levels have dramatically increased since the industrial revolution. It is thought that increased CO2 is contributing to climate change on earth



Greenhouse effect-3



Human Impact on the Environment

Pollution: **the turning out of contaminants into the environment by human activity.**

Air Pollution: **Factories, internal combustion engines, power plants (coal) Burning of fossil fuels releases SO_2, CFCs and CO_2 into the atmosphere.**

Water Pollution: **contaminants released into bodies of water from sources such as industry, agriculture (fertilizers and pesticides), oil off roads, leeching from landfills and hazardous waste dumps.**

Human Impact on the Environment-2

Loss of soil or soil becoming in-fertile.

Erosion: Top soil taken away be running water and wind. This has become an increasing problem as more land is cleared, trees and natural plant roots hold the soil in place.

Nutrient Depletion: occurs when the same crops are planted in the same place season after season. This can be combated by crop rotation or letting the land lay dormant for a period.

Human Impact on the Environment-3

Habitat Destruction: mainly deforestation, the cutting down of forests (mainly rain forests), for use as living space and agriculture. We have cut down over half the worlds rainforests during the last ½ of the 20th century. This is the main cause of loss of biodiversity and species extinction.

Deforestation results in the loss of oxygen production, and a **DECREASE** of oxygen in the atmosphere

Human Impact on the Environment-4

Loss of biodiversity: loss of the variety of species in the natural environment. This is concerning because, not only do we loss species, but as we have seen health of a population has effects on other species. The loss of one can lead to the loss of another and that to the loss of another.

** **Biodiversity**: total amount of different species that exist on the planet (all life)

Human Impact on the Environment-5

Introduction of invasive species: A species not native to a given area. Humans have deliberately or accidentally introduced species in to new areas and these species out-compete native species and often eliminate the native species from a system.

Zebra Mussel
Great Lakes

Sika Deer
Maryland

Snake Head
Fish USA

Human Impact on the Environment-6

Species Extinction: many species have gone or are going extinct due to human activity mainly pollution, over harvesting, and habitat destruction.

Caribbean Monk Seal

Human Causes: Over-harvesting, and habitat removal.

Baiji River Dolphin

Human Cause: pollution from the industrialization of China

★ Human Impact on the Environment-7

Depletion of Energy Resources

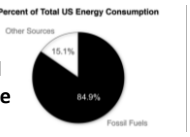
Human population has depleted many of the non renewable resources of the planet.

Non-Renewable Resources: Resources that are being used faster than they can be replenished. (*Fossil Fuels-Wood ,Oil ect*)

Renewable Resources: Natural resources that can be replenished at the same rate that they are used.

- Wind Power
- Solar Power
- Geo-thermal Power
- Hydro-Electric

US Fossil Fuel Usage



Human Impact on the Environment-8

Over-Population

Many of the human impacts on the environment are due to over-population. The more people the more resources (land, energy, food ect) that are needed. The population has reached or is approaching the carrying capacity of the planet.

Carrying capacity: the maximum population size that can be supported in an environment for the system to be sustainable.

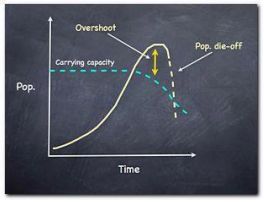
Sustainable: is a level at which a system (the earth) can reproduce resources at least as fast as they are used

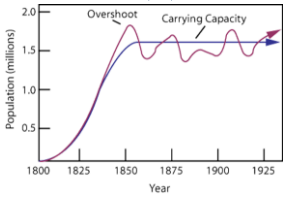
Human Impact on the Environment-9

Population Growth

Human population is increasing exponentially 1% per year. (200,000 people per day) (NOW 7 Billion+)

This means for there are more births than deaths





Human Impact on the Environment-10

Technological Intervention

Alternative Energy Sources: Technological developments have made it easier to rely on things like wind, hydro, and geothermal power (also nuclear)

Agricultural technology: improvements in farming techniques and crops (biotechnology GMOs) have lead to more food production. Sustainable farming practices have lead to more productivity of land.

Industrial technology: new advances in industry have tried to reduce pollution, industry however is a *MAJOR* cause of human impact on the environment