Evolution- The change in genetic composition of a population over successive generations, which may be caused by natural selection. (change over time)

Evidence of Evolution

Fossils: Always extracted from sedimentary rock

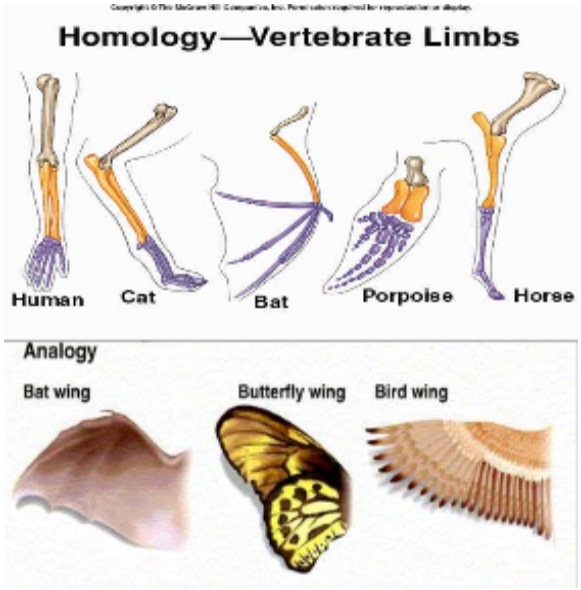
Specimens from:

Tar pits- The La Brea tar pits. From them came a mammoth, older version of elephants. This shows what our elephant evolved from. The mammoth was covered in hair which was an adaptation to its cold environment. There was also a coyote called the Pleistocene coyote that was slightly larger than our present day coyote.

Ice: Otzi, the human was mummified in ice.

Amber- (Commonly called Fossilized Resin) there was extreme feather evolution 70-85 million years ago. The feather was trapped in the amber. These feathers came from dinosaurs and early birds, the amber preserves the structure and pigments. It is now thought that early simple structures called proto-feathers gradually evolved through five stages into branched structures as seen on modern birds today.

I. **Petrified specimens**- Petrified wood is found in numerous locations around the world and represents remains of ancient forests. From ancient cladoxylopsida and tree fern forests that lived in the mid Devonian period 380 million years ago to relatively modern hardwood and conifer forests that lived only a few million years ago, tree and plant fossils provide a window into past environments and help us understand earth's history and evolution.



Imprints: Geological records of biological activity

Comparisons

Anatomy

1. **Homologous**: Same ancestry but may perform ff function
2. **Analogous**: Same function but different ancestry
3. **Vestigial**: Structures we no longer need

Biochemistry: Branch of science concerned with the chemical and physicochemical processes that occur within living organisms.

Embryology: Branch of biology and medicine concerned with the study of embryos and their development.

Biogeography: Branch of biology that deals with geographical distribution of plants and animals.

Carbon 14 vs. Relative dating

Carbon dating- gets the age of the fossil based on how much carbon there is in fossil. Based on how much carbon 14 there is in the fossil that will determine how many half lives it has gone through. Each half life equal 5730 years.

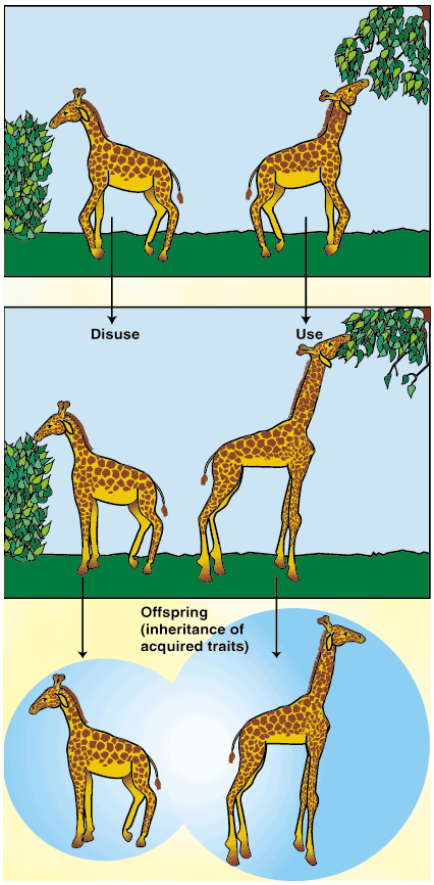
Relative Dating- dating based on what layer it is in the sedimentary bed layer. This determines the age in terms of the relative order of past events without determining the exact age.

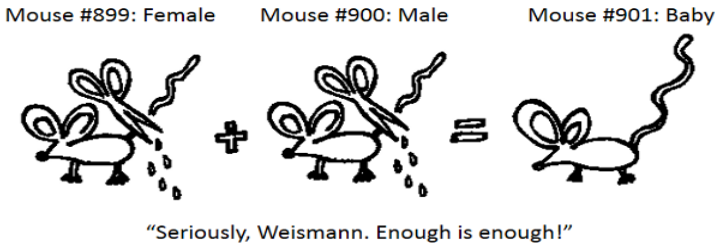
Heterotroph Hypothesis

- First living organism was a Heterotroph
  Heterotrophs are organisms that obtain energy by feeding on others in their environment
- Then came autotrophic organisms(algae and green plants)
  - Organisms that make their own food
  - process of photosynthesis
- Aerobic organism
  - an organism that can survive and grow in an oxygenated environment
- Multicellular
  - Having or consisting of many cells or more than one cell to perform all vital functi

Theories of Evolution

Weismann (1870)





"Seriously, Weismann. Enough is enough!"

Darwin (1831)

Natural selection

1. Overpopulation: Too many people than habitat can support
2. Competition: Nonaggressive people can't survive, kills off those who can't reach the food
3. Variation: Bigger than others, taller than others, stronger, the edge is given to other people
4. Survival of the fittest
5. Transmission of favorable variation
6. Evolution of species

Factors that help drive evolution

Speciation: Arise of a new species from an old one

Adaptive radiation: Diversification of several new species from a recent ancestral source, each adapted to utilize or occupy a vacant adaptive zone

Barriers: Reproductive isolation, these prevent members of 2 different species to produce offspring habitat factors- 2 species live in the same area but different habitats. Behavioral factors-species-specific signals & elaborate behaviors to attract mates. (Ex. bird songs & dances, firefly lighting patterns **Ex**: Chemical pheromones (moths, humans)

Temporal Factors: Reproductive isolating mechanism in which members of different species mate at different times of the year/ in different seasons.

Founder effects: That if 2 organisms of the same species produce offspring even if their offspring continue reproducing in an enclosed environment the genes will be similar mutation variation

Gene flow:Transfer of alleles or genes from one population to another

Transmission of favorable traits

Reproductive Isolation: Certain sexual parts don't fit into other sexual parts

Hardy Weinberg Equation

$p^2 + 2pq + q^2 = 1$ (p is dominant allele, q is recessive allele)

Co-evolution

2 or more species having a close ecological relationship evolve together such that one species adapt to the changes of the other, thereby affecting each other's evolution.

EX : **Hummingbirds and Ornithophilous flowers:** Hummingbirds feed on nectar from the flowers, pollinating them in the process. In this mutually beneficial relationship, plants have evolved flowers that attract birds with colours that are conspicuous to the bird, and shaped to perfectly accommodate the bird's beak. This has happened in a number of hummingbird/plant pairs.

Yucca moths and Yucca plants: Yucca flowers are a certain shape so that moth can pollinate them. The moths lay their eggs in yucca flowers and larvae live in the developing ovary and eat yucca seeds.

Ecology: Branch of biology dealing with interactions between organisms and their environment

Abiotic and Biotic factors that influence ecosystems

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

Abiotic: Nonliving things

Biotic: Living things

Biosphere: Part of the earth where living things exist.

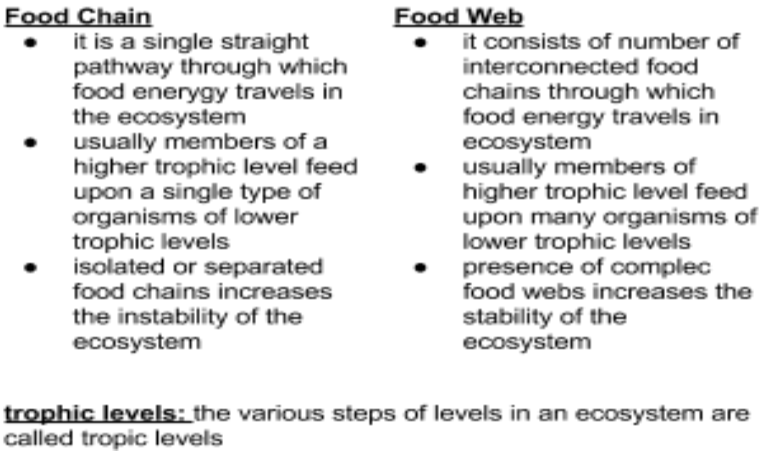
Ecosystem: System that includes all living organisms in an area as well as its physical environment functioning together as a unit.

Community: Ecological unit composed of a group of organisms of different species occupying an area, usually interacting with each other and their environment.

Population: Group of organisms of 1 species that interbreed and live in the same place at the same time

Species: Individual belonging to a group of organisms having common characteristics and are capable of mating with one another to produce fertile offspring

Individual: Single, separate organism (animal or plant) distinguished from others of a same kind.



Keystone Species: Species on which many other populations ultimately depend for survival.

- **Beavers**: Considered habitat engineers because they change the environment by building dams. This provides still water in which many species can flourish

Bees: By pollinating bees contribute to their survival. Plants are shelter for insects, which are then eaten by other species

- **Elephants**: By eating small trees, elephants preserved grasslands, as the grasses need plenty of sun to survive. If they were not there, the savanna would convert to a forest or shrublands.
- **Wolves**: Being a top predator, wolves are important in many habitats. Wolves keep deer populations in check and too many deer will eat small trees, which leads to fewer trees. In turn, there would be fewer birds and beavers and the whole ecosystem would change

Producers: Plants. They produce their own food by using light energy from the Sun, carbon dioxide from the air and water from the soil to produce food - in the form of glucose. (autotrophic)

Consumers: Animals as they cannot make their own food, so they need to eat plants and/or animals.(heterotrophic)

Primary: Usually herbivores, feeding on plants and fungus

Secondary: Mainly carnivores and prey on other animals

Tertiary: Capable of feeding on secondary and primary consumers

Decomposer: Bacteria and fungi as they eat decaying matter - dead plants and animals and in the process they break them down and decompose them, they release nutrients and mineral salts back into the soil - which then will be used by plants.

Scavenger-Animal that eats carcasses abandoned by predators, digs through trash cans for foodtrue scavengers seldom kill their own prey (but many animals are not exclusively scavengers)

Biomass: Mass of organisms in a given area of volume

Biomass Pyramid: A graphical representation to show the relative amounts of biomass at each trophic level.

Niche: Role of an organism in an ecosystem

Habitat: Where an organism lives

Relationships that can exist between organisms,

Predator-prey - An interaction between two organisms of unlike species in which one of them acts as predator that captures and feeds on the other organism that serves as the prey.

Forms of Symbiosis:

Mutualism: Both individuals benefit from the association.

Commensalism: 1 of them benefits from the association whereas the other is largely unaffected or not significantly harmed or benefiting from the relationship.

Parasitism: 1 organism benefits at the expense of another organism usually of different species

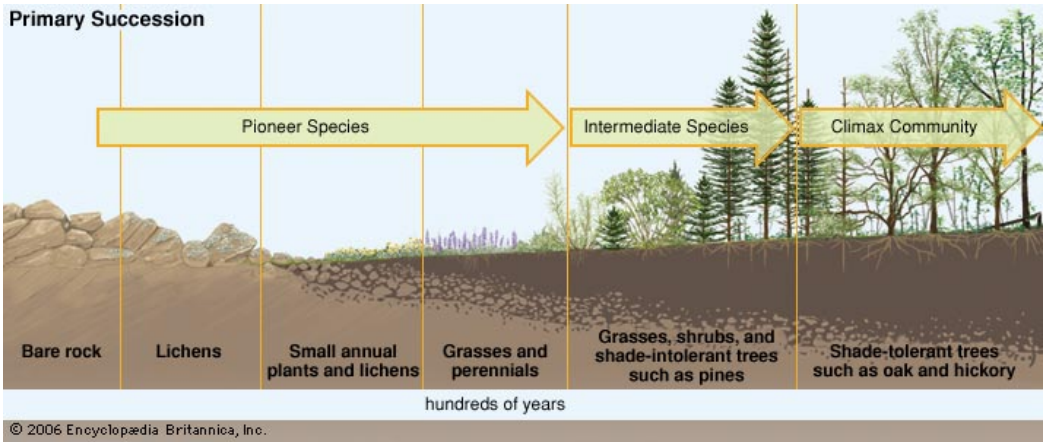
Ecological Succession

Primary Succession: Succession that begins in an area with no remnants of a community

Secondary Succession: Occurs in an area that was only partially destroyed by disturbances

Pioneer Organisms: First species to colonize barren areas

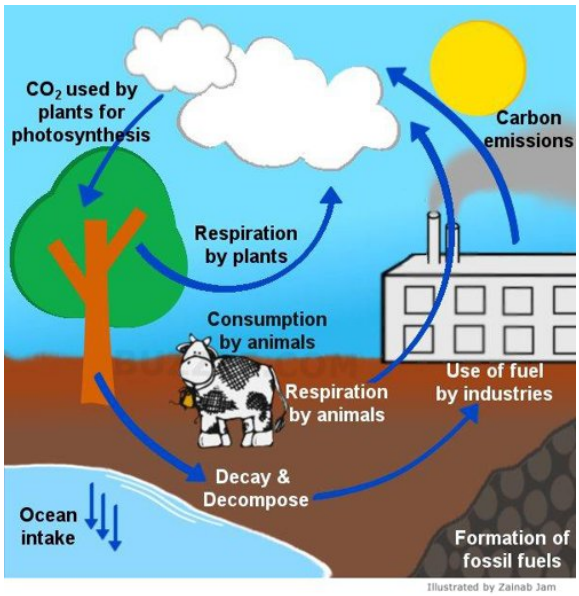
Climax Community: Ecological community in which populations of plants or animals remain stable and exist in balance with each other and their environment. Is the final stage of succession, remaining relatively unchanged until destroyed by an event such as fire or human interference



Water cycle

Evaporation: When heat of the sun causes water to turn to water vapor, it is known as evaporation.

Condensation: As water vapor moves higher in the atmosphere, it cools down due to a decrease in the temperature. On cooling, water vapor condenses to form tiny droplets of water condensation



Precipitation: Tiny droplets of water formed as a result of condensation keep accumulating in the clouds. When a cloud can no longer accommodate any water droplets, water is released from in form of rain, hail, sleet, snow

Runoff: Water that falls back to the surface of the earth either stays on the surface of the earth, or flows off surface into water bodies like rivers, lakes and reservoirs. This flow is run-off

Transpiration: Plants absorb water from soil and transport it to the leaves.When this water evaporates from leaves and stem, transpiration.

Infiltration: When water on the surface seeps down the ground, it is infiltration. It later forms aquifers in low-lying regions.

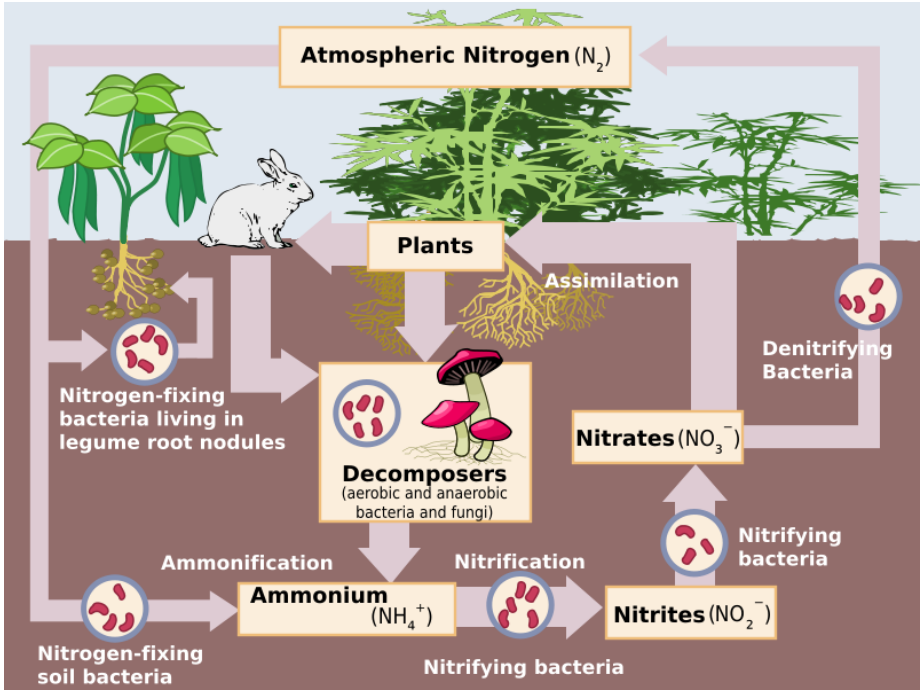
Carbon Cycle

Carbon moves from the atmosphere to plants

- In the atmosphere, carbon is attached to oxygen in a gas CO_2. With the help of the Sun, through the process of photosynthesis, CO2 is pulled from air to make plant food from carbon.
- Carbon moves from plants to animals
- Through food chains, carbon that is implanted moves to the animals that eat them. Animals that eat others get carbon from their food

Carbon moves from plants and animals to ground

- When plants and animals die, their bodies, wood and leaves decay bringing carbon into the ground. Some become buried miles underground and become fossil fuels in millions of years.
- Carbon moves from living things to the atmosphere
- Each time you exhale, you are releasing CO_2 into the atmosphere. Animals and plants get rid of carbon dioxide gas through a process called respiration.
- Carbon moves from fossil fuels to the atmosphere when fuels are burned
- When humans burn fossil fuels to power factories, power plants, cars and trucks, most of the carbon quickly enters the atmosphere as carbon dioxide gas. Each year, five and a half billion tons of carbon is released by burning fossil fuels. That's the weight of 100 million adult African elephants! Of the huge amount of carbon that is released from fuels, 3.3 billion tons enters the atmosphere and most of the rest becomes dissolved in seawater.



Carbon moves from the atmosphere to the oceans Oceans, and other bodies of water, soak up some carbon from the atmosphere.

Processes in the Nitrogen Cycle

Fixation: Process of making nitrogen usable by

plants. Bacteria change nitrogen into ammonium.
Nitrification: Ammonium gets changed into nitrates by bacteria. Nitrates are what plants can absorb
Assimilation: How plants get nitrogen. They absorb nitrates from the soil into their roots. Then the nitrogen gets used in amino acids, nucleic acids, and chlorophyll.
Ammonification: This is part of the decaying process. When a plant or animal dies, decomposers like fungi and bacteria turn the nitrogen back into ammonium so it can reenter the nitrogen cycle.
Denitrification: Extra nitrogen in the soil gets put back out into the air. There are special bacteria that perform this task as well.
Plants take up the nitrates and convert them to proteins that travel up the food chain through herbivores and carnivores. When organisms excrete waste, nitrogen is released back into the environment. When they die and decompose, nitrogen is broken down and converted to ammonia. Plants absorb some ammonia; the remainder stays in the soil, where bacteria convert it back to nitrates. The nitrates may be stored in humus or leached from the soil and carried into lakes and streams. Nitrates may also be converted to gaseous nitrogen through denitrification and returned to atmosphere, continuing the cycle.
Importance: Plants and animals could not live without nitrogen. It is an important part of many cells and processes such as amino acids, proteins, and even our DNA. It is also needed to make chlorophyll in plants, which plants use in photosynthesis to make their food and energy.
Nitrogen-fixing bacteria: Nitrogen-fixing bacteria, microorganisms capable of transforming atmospheric nitrogen into fixed nitrogen, inorganic compounds usable by plants. More than 90 percent of all nitrogen fixation is affected by them.
Two kinds of nitrogen fixers are recognized: free-living (non-symbiotic) bacteria, including the cyanobacteria (or blue-green algae) and mutualistic (symbiotic) bacteria such as *Rhizobium,* associated with leguminous plants, and *Spirillum lipoferum,* associated with cereal grasses.
Nitrifying bacteria: Any of a small group of aerobic bacteria(family Nitrobacteriaceae) that use inorganic chemicals as an energy source. They are microorganisms that are important in the nitrogen cycle as converters of soil ammonia to nitrates, compounds usable by plants.
Denitrifying bacteria: Microorganisms whose action results in the conversion of nitrates insoil to free atmospheric nitrogen, thus depleting soil fertility and reducing agricultural productivity.
Lightning-Fixation: Lightning plays a minor part in the fixation of atmospheric nitrogen. The extreme heat of a lightning flash causes nitrogen to combine with oxygen of the air to form nitrogen oxides. The oxides combine with moisture in the air. The fixed nitrogen is carried by rain to the earth, where, in the form of nitrates, it is used by plants.
Excretion: When organisms excrete waste, the nitrogen is released back into the environment. When they die and decompose, the nitrogen is broken down and converted to ammonia.
Decomposition: When they die and decompose, nitrogen is broken down and converted to ammonia
Different Biomes
Tundra: Extremely cold climate, Low biotic diversity, Simple vegetation structure, Limitation of drainage, Short season of growth and reproduction, Energy and nutrients in the form of dead organic material, Large population oscillations

Taiga

Fires are common in the taiga biome and is necessary to help rid the area of old and sick trees.

Not much variety in plants. Majority,conifer trees which is why taiga is referred as the coniferous fo

The conifer trees in the taiga biome are referred to as evergreen. This means they remain green all ye round and never drop their leaves.

Because evergreen trees do not drop leaves, there is nothing to keep the soil in the taiga full of nutrie This is the reason why there is not much variety in the vegetation.

Desert

Desert biome,ecosystem that forms due to the low level of rainfall it receives each year. Cov about 20% of the Earth. 4 major types of desert in this biome - hot and dry, semiarid, coastal cold. All able to inhibit plant and animal life that are able to survive there.

Grassland: Grassland biomes are made mostly of grasses. They are said to be between a forest and a desert when it comes to rainfall. They do not receive enough rainfall to grow trees like a forest but they contain lots of grass so they receive more rain than a desert.

Temperate Deciduous Forest: Temperate deciduous forest biome is characterized by leaf-shedding trees and its seasons. Biome experiences all 4 seasons. Temperate deciduous forest biome is located in U.S, Canada, Europe, China, and Japan. There are also some parts of Russia that contain this biome.

Tropical Rain Forest: The tropical rainforest biome is an ecosystem that covers about 7% of the Earth's surface. They are found all over the world but the majority of the tropical rainforest lies in South America in Brazil. The weather in the tropical rainforest is rainy yet pleasant all year round, day or night.

Marine: Marine regions cover about three-fourths of the Earth's surface and include oceans, coral reefs, and estuaries. Marine algae supply much of the world's oxygen supply and take in a huge amount of atmospheric carbon dioxide. The evaporation of the seawater provides rainwater for the land

Freshwater: Freshwater biome is made up of any of body of water that is made of freshwater such as lakes, ponds, streams, and rivers. They cover 20% of Earth and are in various locations spread out all over the world. Most freshwater biomes consist of moving water and contain many types of fish.

<u>Human impacts on the biosphere</u>

Ozone depletion: Hole in the ozone : Acid rain : Deforestation : Burning of fossil fuels, Population increase : Invasive and extirpated species : Biological magnification,

Exotic: Species intentionally or accidentally transported by man into an environment outside its range.

Endemic: Species being unique to a defined geographic location, such as an island, nation, country or other defined zone, or habitat type; organisms that are indigenous to a place are not endemic to it if they are also found elsewhere.

Carrying Capacity: How many organisms a habitat can carry

Limiting Factors: Resource or environmental condition that limits the growth, abundance, or distribution of an organism or a population of organisms in an ecosystem.