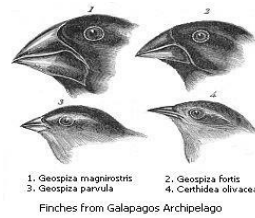
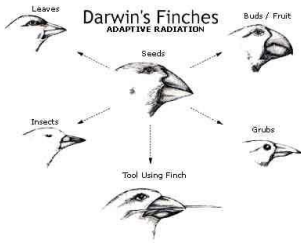


Evolution Notes

Evolution: Gradual accumulation of adaptations over time.

Charles Darwin:

- a. **HMS Beagle** – 1831 – Famous for his study with Finches on Galapagos Island.
- b. He wrote the book, **The Origin of Species**.
- c. **Darwin's 3 main theories**
 1. All life on Earth has an earlier form
 2. Populations accumulate changes over time
 3. All life is a branching tree and shares common ancestors.



Natural Selection: A explains how evolution can change a population

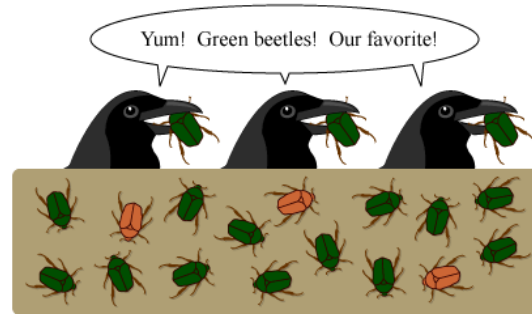
Four Components of Natural Selection

1. **Genetic Variation – Individuals have variation in their genes**
Example – Better eye sight, can run faster, camouflage
2. **Population produces more offspring than can survive.**
3. **Organisms better fit for the current environment survive.**
4. **The trait that makes the parent a better fit for the environment gets passed to the offspring.**

Evidence for Evolution

1. Structural Adaptations
2. Physiological Adaptations
3. Fossils
4. Anatomy
5. Embryology
6. Biochemistry

Natural selection, in a nutshell:



Structural Adaptations:

1. Part or all of an organism changes/adapts to allow an organism to survive better in their environment. This is a very gradual process occurring over generations.
2. **Mimicry** – Where one species resembles or mimics another species.
Example – A harmless Syrphid Fly adapts to look like a harmful Yellow Jacket Wasp to avoid predators. Snakes
3. **Camouflage** – Where an organism blends with their surroundings so they are not easily found by predators.
Example - Octopus, cuttlefish, many marine organisms



Physiological Adaptations:

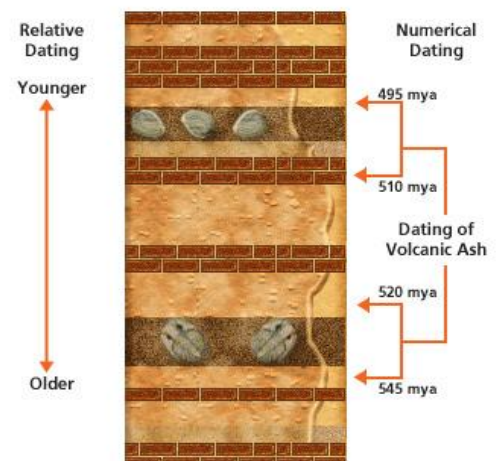
1. These are adaptations that occur much faster than structural adaptations
2. They are changes to an organism's metabolic processes.

Example – Antibiotic Resistance in bacteria. Those bacteria that are not killed by the antibiotic survive to reproduce. They pass their resistance to their offspring and after several generations there is a large population of resistant bacteria.



Fossils

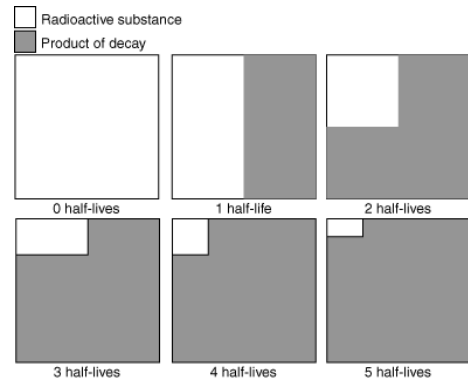
1. A fossil is evidence of an organism that lived long ago.
2. Fossils can give an overall picture of how species evolved.
3. By comparing fossils from different time periods, paleontologists can start to discover which organisms are related and how evolution has occurred.
4. **Two ways fossils to figure out how old a fossil is –**



- **Relative Dating** –
 1. Looks at what fossils are found in different layers of the earth.
 2. Youngest fossils will be found at the top and oldest at the bottom.
 3. Used for determining appearance and extinction of the species.

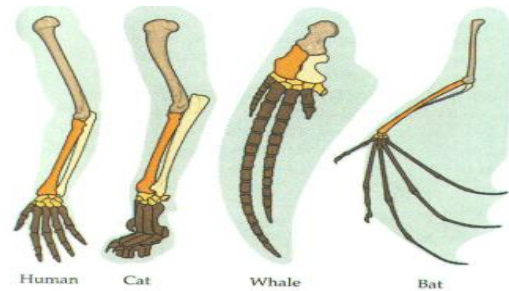
- **Radiometric/Absolute Dating** –

1. Each fossil contains a radioactive isotope that decays over time.
2. Over time, that decay forms a new element.
3. Scientists measure how much of the fossil is decayed and how much is normal to find the “half-life”.

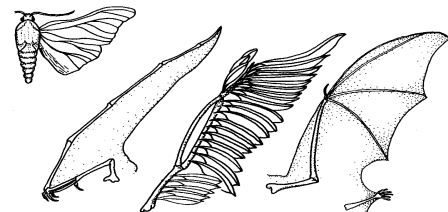


Anatomy

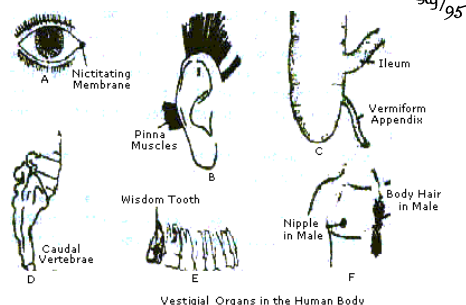
1. **Homologous structures:** Structures in organisms that are similar in arrangement.
 - Show evidence that organisms have a common ancestor. It would be unlikely for so many animals to have similarities if each species arose separately
 - Example: Forelimb bones



2. **Analogous Structures:** Structures in organisms that are similar in function.
 - These organisms do not have common ancestors, but have adapted to a similar way of life.
 - Examples – Bird wings and insects



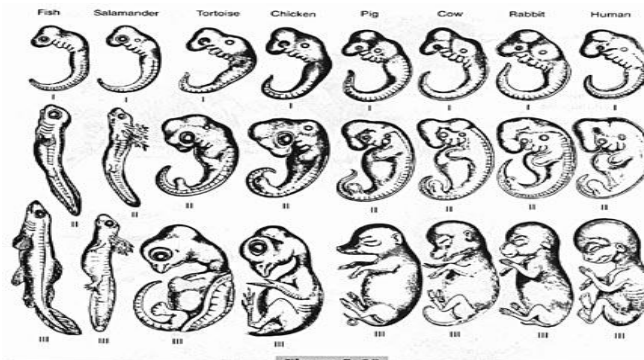
3. **Vestigial Structures:** Body Structures that have no function in the present day but were probably useful to ancestor.



- Ostriches and penguins have wings but don't fly, humans have a tail bone but no tail, humans have an appendix but it isn't needed.

Embryology

- An embryo is the earliest stage of development and young embryos relatively indistinguishable. The similarities suggest a distant, common, ancestor.



are

Figure 5-10
A series of embryos of different vertebrates at comparable stages of development. The earlier the stage of development, the more strikingly similar are the different groups. Note that each of the embryos begins with a similar number of gill arches (pouches below the head) and a similar vertebral column. In later stages of development, these and other structures are modified to yield the various different forms. (The embryos in the different groups have been scaled to the same approximate size so that comparisons can be made between them.) (From Romanes, adapted from Haeckel.)

Biochemistry

- Similarities between RNA and DNA sequences show how species are related. The closer the sequence, the more similar the species.

Evolution of a new Species

- What is a species? A species is a group of organisms that look alike and can interbreed to produce fertile offspring in nature.
- Evolution of a new species is called speciation. It occurs when member of a similar population no longer interbreeds to produce fertile offspring in nature.

Ways for a species to Evolve

1. Geographic isolation – when part of a population of the same species becomes geographically isolated from the remainder by change in ocean level, mountains, canyons, volcanoes.
2. Reproductive isolation – when the genetic material becomes so different that they can no longer mate and produce fertile offspring.
 - Behavior differences can keep them from interbreeding – mating at different times of the year
3. Change in chromosome number – mistakes during cell division can cause too many genes and a mutation occurs, making a new species.

Patterns of Evolution

1. Divergent Evolution – occurs when a species that was once similar to ancestral species become increasingly different.
 - a. This occurs with population adapting to different environmental condition change and eventually become new species
 - b. This can occur when an ancestral species evolve into many different species to fit diverse habitats.
2. Convergent Evolution – occurs when unrelated species evolves similar traits because they live in similar traits because they live in similar environments in different parts of the world. Ex. Cacti, fish

Mechanisms of Evolution

1. A population is defined as members of a species that live in one area.
2. Populations evolve, not individuals.
3. Populations are always either evolving or are in a state of genetic equilibrium.

Changes in Genetic Equilibrium

1. Gene flow – the movement of individuals in and out of the population. This can introduce or remove alleles in the gene pool.
2. Genetic Drift – The alteration of allele frequencies by chance events. This occurs when populations become isolated. Ex. Amish populations – recessive alleles are more common.
3. Mutations – mutations caused by chance or environmental factors can introduce new alleles to the gene pool. These mutations can be good or bad.

Natural Selection (ways natural selection can shape a population)

1. Stabilizing selection
 - a. Favors average individuals
 - b. Reduces the variations in the population
2. Directional selection
 - a. Favors one extreme (high or low)
 - b. Rapid change
3. Disruptive Selection
 - a. Favors both extremes in the population
 - b. The average is weeded out
 - c. Leads to evolution of new species

