

Evolution

The Big Picture

Darwin's alternative explanation to Special Creation - Evolution

- "In the broadest sense, evolution is merely change ...
- **Biological evolution ... is change in the properties of populations of organisms that transcend the lifetime of a single individual.**
Individual organisms do not evolve; populations evolve.
- The changes in populations that are considered evolutionary are those that are inheritable via the genetic material from one generation to the next.

- Douglas J. Futuyma in *Evolutionary Biology*, Sinauer Associates 1986

Darwin's alternative explanation to Special Creation - Evolution

- "In the broadest sense, evolution is merely **change** ...
- **Biological evolution ... is change in the properties of populations of organisms that transcend the lifetime of a single individual.**
Individual organisms do not evolve; populations evolve.
- The changes in populations that are considered evolutionary are those that are **inheritable via the genetic material** from one generation to the next.

- Douglas J. Futuyma in *Evolutionary Biology*, Sinauer Associates 1986

Natural Selection

- Condition #1 – Not all offspring in a population born survive and reproduce
- Condition #2 – Individuals in a population vary in their traits
- Condition #3 – Some variations give individuals a survival and reproductive advantage

Natural selection is a process where some organisms in a population have traits that make them better adjusted to an environment so they are better able to survive and reproduce, passing on those traits to succeeding generations

- Population
 - A group of individuals of one species that lives and reproduces in a particular area
- Trait
 - A genetically determined characteristic of an organism
- Homologous structures
 - Structures that look similar in different organisms because they came from a common ancestor. They may not function the same in all organisms

- Mutation
 - A spontaneous change in an organism's genetic material (DNA)
- Adaptation
 - A mutation that helps an organism survive in its environment
- Selective pressure
 - Pressure from the environment on an organism that favors some traits over others, allowing one organism to have an advantage over another

- Species
 - Older definition: individuals in a population who can mate and produce offspring
 - Newer definition: Ecological species – a population whose habitats and behaviors keep them from interbreeding
- Speciation – a new species forming
 - Geographic isolation - when two populations of a single species are separated from one another and begin to change
 - Reproductive isolation – organisms that cannot interbreed in nature to produce offspring

- Extinction
 - The end of an organism or a species; The death of the last individual of a species

Convergent Evolution

Organisms not closely related evolve similar traits as a result of similar environments or ecological niches

- Evolution

1. Species evolve, not individuals
2. Species evolve from common ancestors
3. New species form from existing species
4. Evolution usually occurs gradually; It *can* occur in a shorter timeline
5. Natural selection is the most important mechanism by which adaptive evolution occurs. It causes traits of a group to change over time.

- Natural Selection
 - A process where some individuals in a population have an advantage over others that makes them better suited to their environment so they survive and reproduce
- Condition 1
 - Not all offspring in a population born survive and reproduce
- Condition 2
 - Individuals in a population vary in their traits
- Condition 3
 - Some variations give individuals a survival and reproductive advantage

Evidence for Evolution

1. The fossil record
 - Most fossil species are different than the ones that exist today; Change over time
2. Structural similarities among organisms
 - Similarities between fossil and living species
3. The geographic distribution of organisms
 - Where in the world similar species are found; Plate tectonics
4. Embryological similarities among organisms
 - Similarities among embryos from different species

Evidence for Evolution

5. The pattern of organism groupings

- Hierarchical classification of organisms shows relatedness

6. Molecular similarities among organisms

- Similarities among DNA and proteins among different species

7. Direct observation of ongoing evolution

- Modern observation of evolution in species with short generation times