

## **Chapter 10 – Principles of Evolution**

### *10.1 – Early Ideas about Evolution*

**MAIN IDEA: Early scientists proposed ideas about evolution.**

- Evolution: The process of biological change in which descendants differ from their ancestors.
- Species: A group of organisms so similar to one another that they can reproduce and have fertile offspring.
- Scientists that contributed to the theory of evolution:
  - Carolus Linnaeus – developed classification system
  - Buffon – suggested Earth was very old
  - Erasmus Darwin – Charles Darwin’s grandfather; proposed the idea of a common ancestor.
  - Lamarck – proposed that changes in an environment caused an organism’s behavior to change.

**MAIN IDEA: Theories of geologic change set the stage for Darwin’s theory.**

- Fossils: Traces of organisms that existed in the past.
- Theory of Catastrophism: States that natural disasters, such as floods and volcanoes, have happened often during Earth’s long history.
- Gradualism: Slow changes in landforms over time
- Uniformitarianism: Geologic processes that shape Earth are uniform through time. This idea was formed by Charles Lyell.

Gradualism emphasizes slow changes on Earth over long periods of time, while catastrophism emphasizes change through natural disasters.

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### *10.2 – Darwin’s Observations*

**MAIN IDEA: Darwin observed differences among island species.**

- Variation: The difference in the physical traits of an individual from those of other individuals in the group to which it belongs.
- Adaptation: A feature that allows an organism to better survive in its environment.

Charles Darwin noticed variation in species on the Galapagos Islands (islands off the coast of South America). These observations led Darwin to realize that species are somehow able to adapt to their surroundings.

**MAIN IDEA: Darwin observed fossil and geologic evidence supporting an ancient Earth.**

Darwin found fossil evidence of species changing over time. This and other observations supported Charles Lyell’s theory of Uniformitarianism – that daily geologic processes can add up to great change over time.

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### 10.3 – Theory of Natural Selection

#### **MAIN IDEA: Several key insights led to Darwin’s idea for natural selection.**

- Artificial Selection: The process by which humans change a species by breeding it for certain traits.
  - We do this with food. For instance, we use artificial selection to breed tomatoes that are big, bright and juicy.
- Heritability: The ability of a trait to be passed down from one generation to the next.
- Natural Selection: The mechanism by which individuals that have inherited beneficial adaptations produce more offspring than do other individuals.
- Population: All individuals of a species that live in an area.

#### **MAIN IDEA: Natural selection explains how evolution can occur.**

- Fitness: A measure of the ability to survive and produce more offspring relative to other members of the population.

There are four main principles to the theory of natural selection.

- Variation – the heritable difference among individuals in a population
- Overproduction – the more offspring you have, the greater the competition for resources among offspring (sibling rivalry).
- Adaptation – more successful individuals are “naturally selected” to live longer and produce more offspring that will inherit the good adaptations of the parents.
- Descent with modification – with each new generation, more and more individuals will have adaptations that are well-suited for survival. They build up within a population over time.

#### **MAIN IDEA: Natural selection acts on existing variation.**

Changing environments: As the environment changes, different traits will become beneficial.

Adaptations as compromises: Some structures may take on new functions. For example, a panda has 5 “fingers” AND an enlarged wrist bone that serves as an extra finger to grip bamboo with. So it functions both as a wrist and a thumb.

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### 10.4 – Evidence of Evolution

#### **MAIN IDEA: Evidence for evolution came from many sources.**

*Fossils:* Fossil organisms in the bottom (older layers) are more primitive than those in the top (newer layers).

*Geography:* Island species most closely resemble the species on the closest mainland.

- Biogeography: The study of the distribution of organisms around the world.

*Embryology:* Embryos of very different species look very similar, suggesting a common ancestor. For example, human embryos look a lot like tadpoles.

*Anatomy:*

- Homologous structures: Features that are similar in structure but appear in different organisms and have different functions. For example, our arms and fingers are very similar to those in a bat; however we use those body parts very differently than a bat does.
- Analogous structures: Structures that perform a similar function but are not similar in origin. For example, bats and bees both have wings for flight, but bat wings are made of bones, whereas bee wings are made of membranes.

**MAIN IDEA: Structural patterns are clues to the history of a species.**

- Vestigial structures: Remnants of organs or structures that had a function in early ancestors. For example, our tonsils used to have a purpose in early human history, but now we can get them removed without a problem.

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*10.5 – Evolutionary Biology Today*

**MAIN IDEA: Fossils provide a record of evolution.**

- Paleontology: The study of fossils or extinct organisms,

Paleontology provides new information and evidence for evolution.

**MAIN IDEA: Molecular and genetic evidence support fossil and anatomical evidence.**

*DNA sequence analysis* – The more similar two organisms are, the more similar their DNA will be.

*Pseudogenes* – These genes are sort of like vestigial organs. They used to serve a function, but no longer do. Organisms with the same pseudogenes reflect a common ancestor.

*Homeobox Genes* – These are genes that control the development of specific structures. They indicate a common ancestor.

*Protein Comparisons* – Similarities in the proteins of different organisms reflect a shared ancestry.

**MAIN IDEA: Evolution unites all fields of biology.**

The basic principles of evolution are used in fields such as medicine, geology, geography, chemistry and ecology. The principles of evolution help us understand endangered species and how to help them.