Evidence of Evolution
Objectives

- Identify the evidence for evolution
- Differentiate between homologous, analogous, and vestigial structures
- State the Law of Superposition
- Explain how the fossil record is used as evidence of evolution
Evidence of Evolution

- Homologous structures
- Geographic distribution of living species
- Similarities in embryology
- Similarities in macromolecules
- Fossil record
Homologous Structures

- **Homologous structures** are similar features that originated in a shared ancestor.
- Similar in skeletal structure but have different functions.
- Derived from the same structures in the embryo.
Analogous Structures

- Analogous structures are features that serve identical functions and look somewhat alike.
- Very different embryological development.
- Very different internal anatomy.
Vestigial Structures

Many organisms have features that have no useful function

Examples:
- Human tailbone
- Human appendix
- Some snakes have tiny pelvic and limb bones
- Whales have pelvic bones and a 4-chambered stomach like cows

Vestigial structures are features that were useful to an ancestor, but they are not useful to the modern organism that has them
Geographic Distribution of Living Species

Organisms that do not share a common ancestor develop similar physical features.

Similar features are developed due to the organisms living under similar ecological conditions.

- Exposed to similar pressures of natural selection
Similarities in Embryology

- The early stages of different vertebrate embryos are similar to each other.
  - Indicate a common ancestry

- Embryonic similarities fade as development proceeds.
Similarities in Macromolecules

Many organisms have similar RNA and DNA

Many species have the red-blood-cell protein hemoglobin

- Human hemoglobin and gorilla hemoglobin differ by one amino acid
- Human hemoglobin and frog hemoglobin differ by 67 amino acids

Molecular biology can confirm the evolutionary histories suggested by fossils and anatomy
Fossil Records

Fossil – a trace of a long-dead organism
- In 1668, Robert Hooke concluded that fossils are the remains of plants and animals
- Hooke hypothesized that living organisms had somehow been turned to rock

Fossils are often found in sedimentary rock

Hard minerals replace the tissue of an organism, leaving rocklike structures

Fossil records provide evidence of the history of life on Earth
Distribution of Fossils

In 1669, Nicolaus Steno proposed the **law of superposition**

- States that successive layers of rock or soil were deposited on top of one another by wind or water.

The lowest stratum (layer) in a cross section of Earth is oldest, while the top stratum is the most recent.

Fossils in a single stratum are approximately the same age (relative age).

Fossil’s actual age in years (absolute age) can be estimated from radiological evidence.
Succession of Forms

Fossil-bearing strata show when species of organisms appeared, how long they existed, and if/when they became extinct.

Fossil record indicates that there were several mass extinctions.

- **Mass extinctions** – brief periods during which large numbers of species disappeared.

Mass extinctions likely result from:
- Drastic changes in the environment
- Volcanic activity
- Collisions with asteroids
Biogeography

**Biogeography** – study of geographical distribution of fossils and of living organisms

Shows that new organisms arise in areas where similar forms already lived.
Fossil Record as Evidence of Evolution

- Scientists can document the fact that life on Earth has changed over time by comparing fossils from older strata with fossils from newer strata.

- Transitional fossils document intermediate stages between modern species from those that are extinct.
Notes Review

Identify the evidence for evolution

- Homologous structures
- Geographic distribution of living species
- Similarities in embryology
- Similarities in macromolecules
- Fossil record
Differentiate between homologous, analogous, and vestigial structures

- **Homologous structures** are similar features that originated in a shared ancestor. They are similar in skeletal structure but have different functions.

- **Analogous structures** are features that serve identical functions and look somewhat alike. They have very different internal anatomy.

- **Vestigial structures** are features that were useful to an ancestor, but they are not useful to the modern organism that has them.
Notes Review

State the Law of Superposition.

The law of superposition states that successive layers of rock or soil were deposited on top of one another by wind or water.
Notes Review

Explain how the fossil record is used as evidence of evolution.

- Scientists can document the fact that life on Earth has changed over time by comparing fossils from older strata with fossils from newer strata.
- Transitional fossils document intermediate stages between modern species from those that are extinct.