

Section 12.5 Radiation of Multicellular Life

I. Multicellular life evolved in distinct phases.

A. Life moved onto land during the *Paleozoic* Era.

1. *Multicellular organisms* first appeared during the Paleozoic era.
2. The era began 544 million years ago and ended 248 million years ago.
3. The **Cambrian explosion** led to a *huge diversity of animal* species.



B. *Reptiles* radiated during the Mesozoic era.

1. The *Mesozoic* era is known as the Age of Reptiles.
2. It began 248 million years ago and ended 65 million years ago.
3. **Dinosaurs, birds, flowering plants, and first mammals** appeared.



C. **Mammals** radiated during the **Cenozoic** era.

1. The **Cenozoic** era began 65 million years ago and continues today.
2. **Placental** mammals and **monotremes** evolved and diversified.
3. Anatomically modern **humans appeared late** in the era.



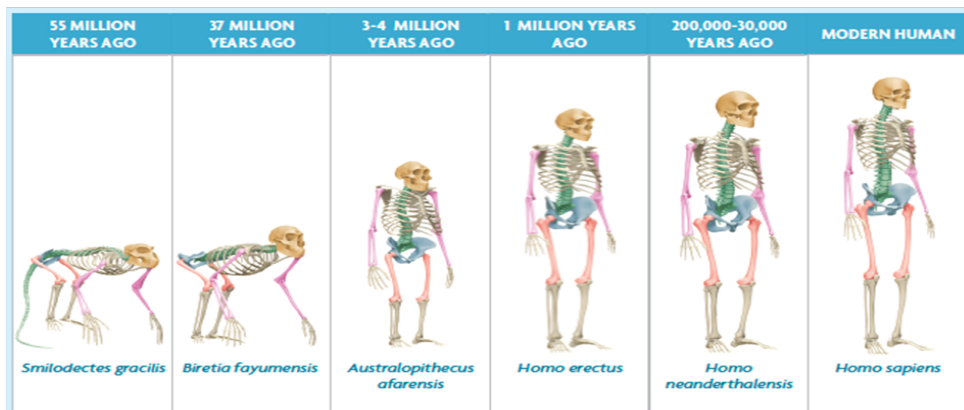
Section 12.6 Primate Evolution

I. Humans appeared late in Earth's history

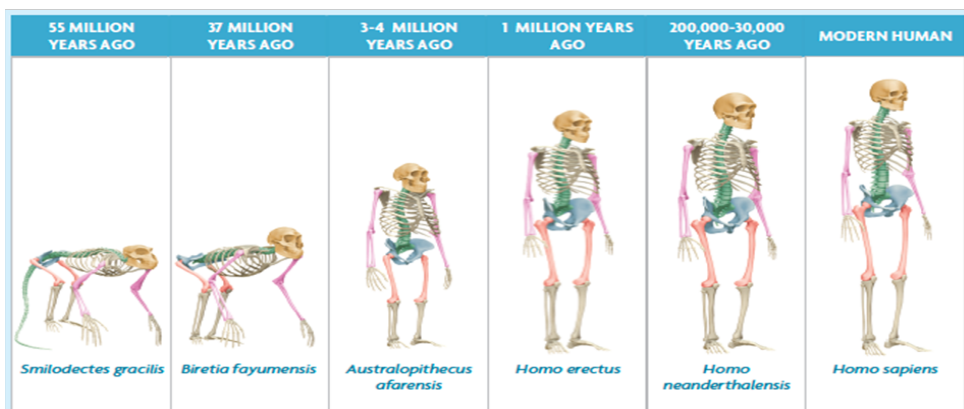
A. Humans share a common ancestor with other primates.

1. **Primates** are mammals with flexible hands and feet, **forward-looking eyes**, and **enlarged brains**.
 - a. **Brachiation** - able to rotate arms in a circle around shoulder joint.
 - b. **Opposable thumb** - can move against fingers
2. One of the **traits lost** by ancient and modern day humans but retained by other primates is -
-Prehensile tail - a trait enabling some primates to hang by their tails from tree branches while feeding.

3. A trait gained by ancient and modern day humans - **Bipedal**, meaning “walking on two legs.”
- foraging
 - carrying** infants and food
 - using tools**
 - walking upright** has important adaptive advantages
 - changes in **skeletal structure** made bipedalism possible



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Ch. 10 Principles of Evolution

Section 10.1 Early Ideas About Evolution

I. There were theories of biological and geologic change before Darwin.

A. Early scientists proposed ideas about evolution.

1. *Evolution* is the biological change process by which descendants come to differ from their ancestors.
2. A *species* is a group of organisms that can reproduce and have fertile offspring.

B. There were many important naturalists in the 18th century.

1. **Linnaeus:** classification system from kingdom to species
2. **Buffon:** species shared ancestors rather than arising separately
3. **E. Darwin:** more-complex forms developed from less-complex forms
4. **Lamarck:** environmental change leads to use or disuse of a structure

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II. Theories of geologic change set the stage for Darwin's theory.

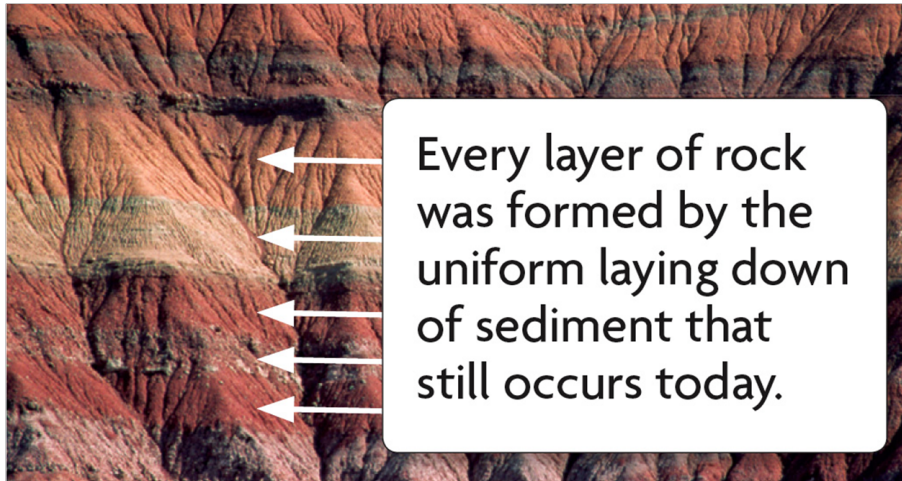
*There were three theories of *geologic change*.

-*catastrophism*

-*gradualism*

-*uniformitarianism*

- **Uniformitarianism is the prevailing theory of geologic change.**



Section 10.2 Darwin's Observations

I. Darwin's voyage provided insight on evolution.

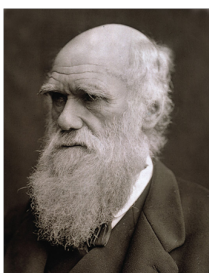
A. Darwin observed differences among island species.

1. Variation is a difference in a physical trait.

- Galápagos* tortoises that live in areas with tall plants have long necks and legs.
- Galápagos finches* that live in areas with hard-shelled nuts have strong beaks.

2. An adaptations is a feature that allow an organism to better survive in its environment.

- Species are able to *adapt* to their environment.
- Adaptations can lead to *genetic change* in a population.



B. Darwin observed fossil and geologic evidence supporting an ancient Earth.

1. Darwin found *fossils of extinct* animals that resemble modern animals.
2. Darwin found **fossil shells high up in the Andes mountains**
3. He saw land move from *underwater to above sea level* due to an earthquake.
4. Darwin extended his observations to the *evolution of organisms*.



- C. *Natural selection* is a mechanism by which individuals that have inherited beneficial adaptations produce more offspring on average than do other individuals.
- D. *Heritability* is the ability of a trait to be passed down. There is a struggle for survival due to overpopulation and limited resources.
- E. Darwin proposed that *adaptations* arose over many generations.

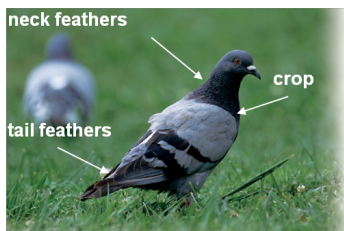


Section 10.3 The Theory of Natural Selection

Darwin proposed natural selection as a mechanism for evolution.

I. Several key insights led to Darwin's idea for natural selection.

- A. Darwin noticed a lot of *variation* in domesticated plants and animals.
- B. *Artificial selection* is the process by which humans select traits through breeding.



II. Natural selection explains how evolution can occur.

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

- variation*
- overproduction*
- adaptation*
- descent with modification*



III. Natural selection acts on existing variation.

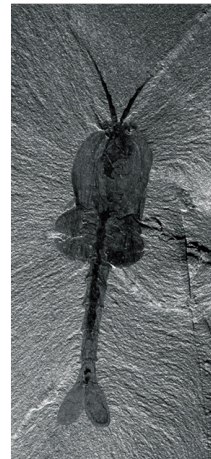
- Natural selection can act only on *traits that already exist*.
- Structures take on *new functions* in addition to their original function.

ADD TO NOTES - *Fitness is the measure of ability to survive & produce more offspring of an individual within a population in a given environment.*



Section 10.4 Evidence of Evolution

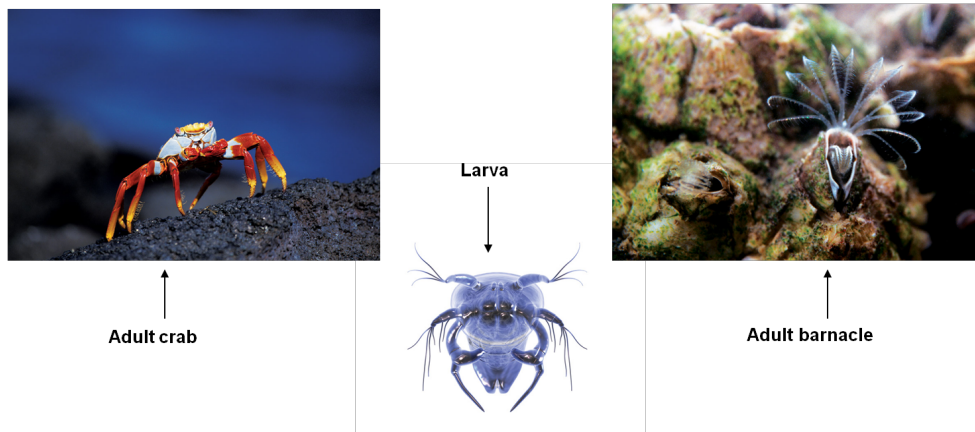
- I. Evidence of common ancestry among species comes from many sources.
 - A. Evidence for evolution in Darwin's time came from several sources.
 1. *Fossils* provide evidence of evolution.
 2. Fossils in *older layers* are more primitive than those in upper layers.



3. The study of *biogeography* provides evidence of evolution.

-island species most *closely resemble* the nearest mainland species

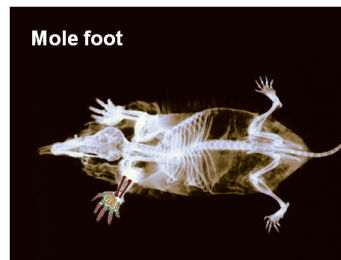
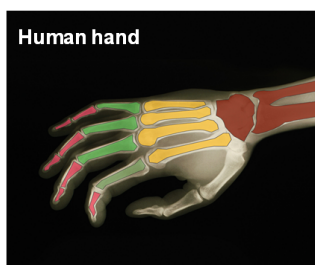
-*populations* can show variation from one island to another



4. The study of *anatomy* provides evidence of evolution.

-*Homologous* structures are similar in structure but different in function

-Homologous structures are evidence of *acommon ancestor*.



-*Analogous* structures have a similar function.

-Analogous structures are *not evidence* of a common ancestor.

Human hand

Mole foot



B. Structural patterns are clues to the history of a species.

1. *Vestigial* structures are remnants of organs or structures that had a function in an early ancestor.
2. **Ostrich wings** are examples of vestigial structures.



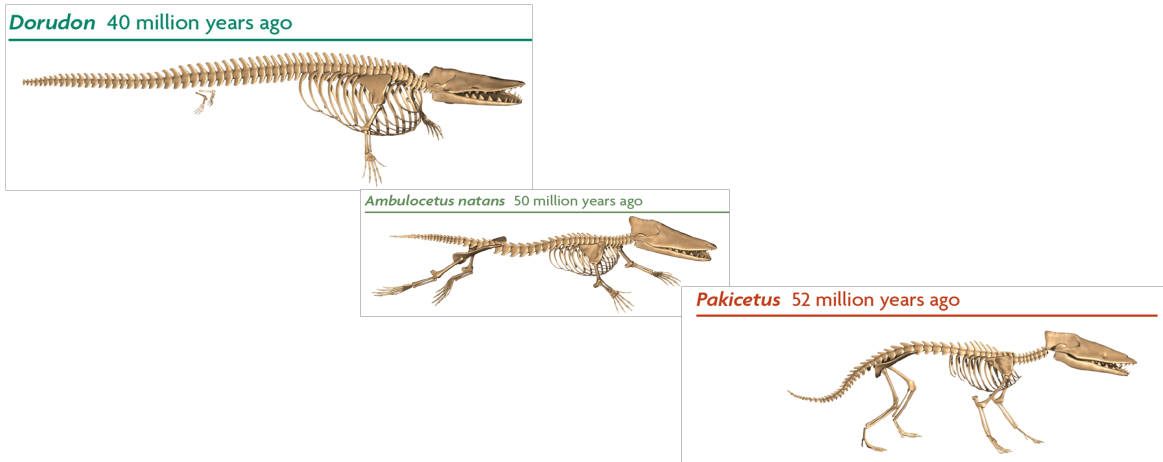
Section 10.5 Evolutionary Biology Today

New technology is furthering our understanding of evolution.

A. Fossils provide a record of evolution.

1. Paleontology is the study of fossils or extinct organisms.

-provides *evidence to support* evolution.



B. Molecular and genetic evidence support fossil and anatomical evidence.

1. Two *closely-related* organisms will have **similar DNA sequences**

Molecular Evidence

The DNA sequences of whales and ungulates are very similar, as demonstrated by the DNA fragments below.

Hippopotamus	TCC TGGCA GTCCA GTGGT
Humpback whale	CCC TGGCA GTGCA GTGCT

2. *Protein comparisons*, or **molecular fingerprinting** reveals similarities among cell types of different organisms.

3. *Pseudogenes* are sequences providing evidence of evolution.
 - no longer function
 - carried along with functional DNA
 - can be clues to a common ancestor
4. *Hox genes* indicate a very distant common ancestor.
 - control the development of specific structures
 - found in many organisms



C. Evolution unites all fields of biology.

1. Scientist from *any fields* contribute to the understanding of evolution.
2. The basic principles of evolution are used in *many scientific fields*.

i.e. medicine, geology, geography, chemistry, & ecology