

7.2

The Evolution of an Idea

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The Evolution of our Understanding of Evolution



A horizontal timeline on a dark blue background with a black arrow pointing right. Five trapezoidal shapes, each with a different color (light blue, light green, grey, medium green, and dark green), are placed above the arrow. Below each shape is the name of a key figure in evolutionary thought and their dates. The names are: Aristotle (384-322 BCE), Buffon (1707 - 1788), Carl Linnaeus (1707 - 1778), Erasmus Darwin (1731 - 1802), Lamarck (1744-1829), Georges Cuvier (1769- 1832), and Charles Lyell (1797-1875).

Aristotle
(384-322 BCE)

Buffon
(1707 - 1788)

Carl Linnaeus (1707
- 1778)

Erasmus Darwin
(1731 - 1802)

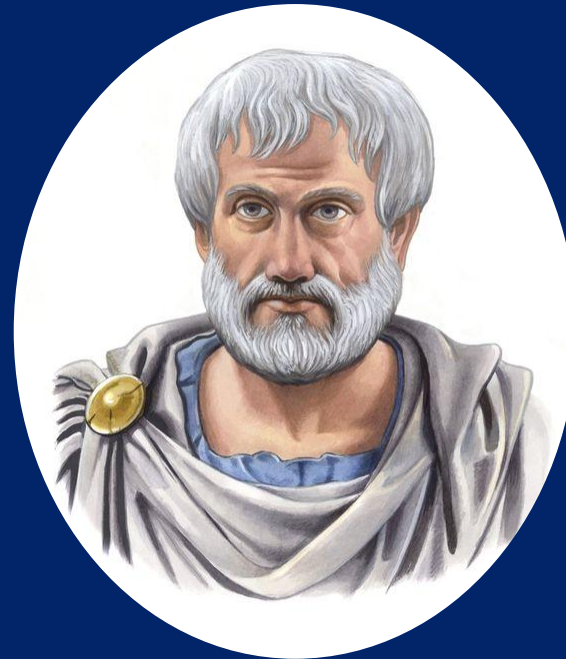
Lamarck
(1744-1829)

Georges Cuvier
(1769- 1832)

Charles Lyell
(1797-1875)

Aristotle (384 - 322 BCE)

- Most Europeans accepted the idea that Earth and all living things had been created in their **present forms** and were **immutable**
 - ◆ Living species could not change and had not changed.



Aristotle

Buffon

Linnaeus and E. Darwin

Lamarck

Cuvier and Lyell

Aristotle

Buffon

Linnaeus and E. Darwin

Lamarck

Cuvier and Lyell

Comte Georges-Louis Buffon (1707 - 1788)

- He studied **anatomy** and compared the **structure to the function** of various body parts
- He noted that some anatomical features serve no purpose



He wondered why pigs have extra toes that do not reach the ground.

- He believed that species had been **created in a more perfect form** but had changed over time

Carl Linnaeus and Erasmus Darwin

- Carl Linnaeus (1707 – 1778)
- Erasmus Darwin (1731 – 1802):

Both **also** proposed that life **changed over time**.

- Erasmus Darwin (Charles Darwin's grandfather) suggested life might have evolved from a **single original source**

They could **not** explain **HOW** living things changed.

- Without a plausible explanation to explain how a species could change, their ideas remained speculative.

Aristotle

Buffon

Linnaeus and E. Darwin

Lamarck

Cuvier and Lyell

Lamarck (1744 - 1829)

- A student of Buffon's
- Was the first to provide an explanation as to HOW species evolved (his explanation was faulty, but was an attempt!)

◆ Believed evolutionary **changes** resulted from 2 principles:

1. **Use and disuse** – structures that were used became larger and stronger, and structures that were not used became smaller and weaker
2. **Inheritance of acquired characteristics** – individuals could pass on characteristics they acquired during their lives

Aristotle

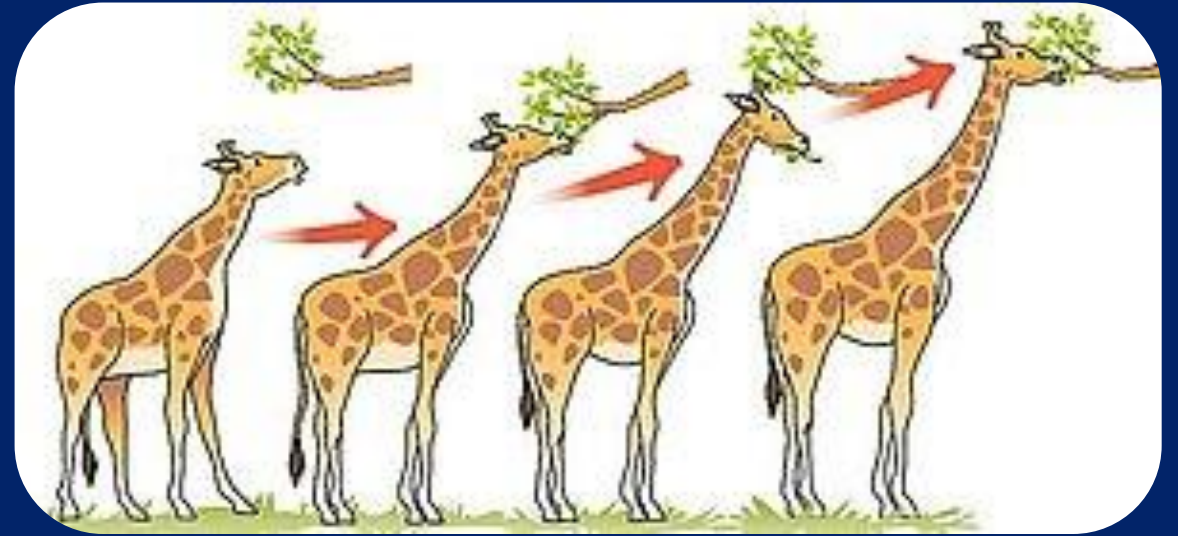
Buffon

Linnaeus and E. Darwin

Lamarck

Cuvier and Lyell

Lamarck



Aristotle

Buffon

Linnaeus and E. Darwin

Lamarck

Cuvier and Lyell

His ideas suggest that:

- the more a giraffe stretches its neck, the longer it will become
- the giraffe will pass down the long neck it acquired during its lifetime, to its offspring

Aristotle

Buffon

Linnaeus and E. Darwin

Lamarck

Cuvier and Lyell

Lamarck

Despite Lamarck's flawed theory, he made a number of important contributions to our understanding of evolution:

- all species **evolve** over time
- a **species** evolves in response to its **environment** and becomes better **adapted** to that environment
- changes are passed from **generation to generation**



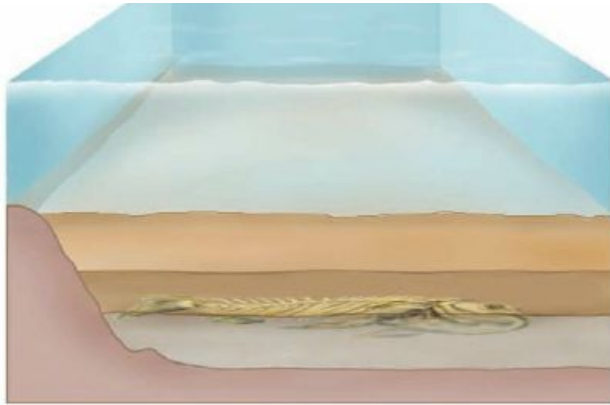
Note: Remains have to be at least 10, 000 years old to be considered a fossil!

Fossils

Scientists observed patterns of change over time by **studying fossils**.

- **Fossils:** preserved remains in rocks or other mineral deposits
- Fossils are formed when the **remains** of buried organisms are gradually replaced by **mineral deposits**.

Formation of Fossils: The Process



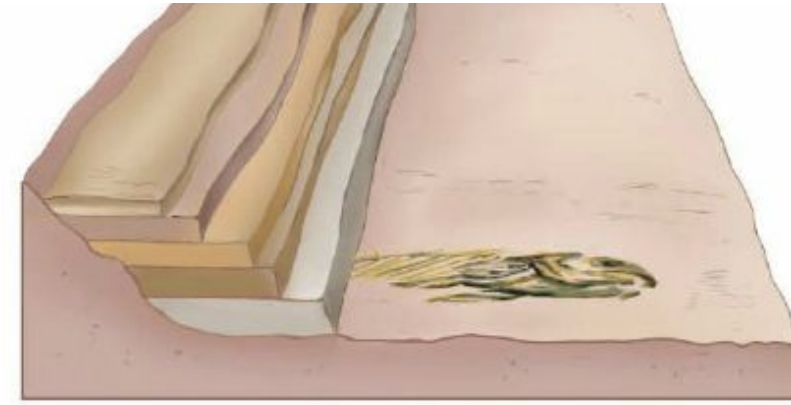
An organism dies and is quickly buried by sediment.

The lack of oxygen prevents decomposition.



The pressure causes the deposits to harden and form sedimentary rock

Fossil remains become mineralized



As erosion or excavation occurs, the fossil remains are exposed.



Fossils

Organisms can also be trapped and preserved in:

- amber (fossilized tree sap)
- volcanic ash
- ice formations

Georges Cuvier (1769 - 1832)



Paleontologist to first study fossils.

He found that:

- fossils of very simple organisms were found in all depths of fossil deposits
- fossils of more complex organisms are only found in shallow depths
- fossils in shallower depths are more likely to “resemble” living species
- the fossils from deeper layers were “simpler” than the more complex fossils above them
- rock layers contain fossils of many species that do not occur in layers above or below them

Aristotle

Buffon

Linnaeus and E. Darwin

Lamarck

Cuvier and Lyell

Cuvier



He did not believe that species change over time.

He developed the theory of **Catastrophism**:

- the theory that the pattern of fossils could be accounted for by a series of global catastrophes that wiped out most species on Earth
- i.e. layers with different species are a result of mass extinction events with new species then forming
- His theory **could not** explain why the species increased in complexity

Aristotle

Buffon

Linnaeus and E. Darwin

Lamarck

Cuvier and Lyell

Charles Lyell (1797 - 1875)

Father of modern geology

In opposition with Cuvier, Lyell came up with the theory of uniformitarianism.

- **Uniformitarianism:** the theory that geological changes are slow and gradual (not fast and catastrophic) and that natural laws influencing these changes are constant
- His theory put forth the idea that Earth was much older than previously thought



Aristotle

Buffon

Linnaeus and E. Darwin

Lamarck

Cuvier and Lyell

Charles Lyell (1797 - 1875)

Aristotle

Buffon

Linnaeus and E. Darwin

Lamarck

Cuvier and Lyell

Lyell put forth the following principles of uniformitarianism:

- Earth has been changed by the same processes in the past that are occurring in the present
- Geographical change is slow and gradual (rather than fast and catastrophic)
- Natural laws that influence these changes are constant and eternal

* Lyell's ideas were radical! Entire mountain ranges formed from slow processes



7.3 Voyage HMS Beagle

Charles Darwin

7.3

Voyage HMS Beagle

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By the end of this lesson you should be able to...

- Explain how Charles Darwin expanded on previous theories to explain how evolution occurred*

Charles Darwin (1809 - 1882)

→ Provided a plausible mechanism as to HOW evolution occurred



Darwin's Journey

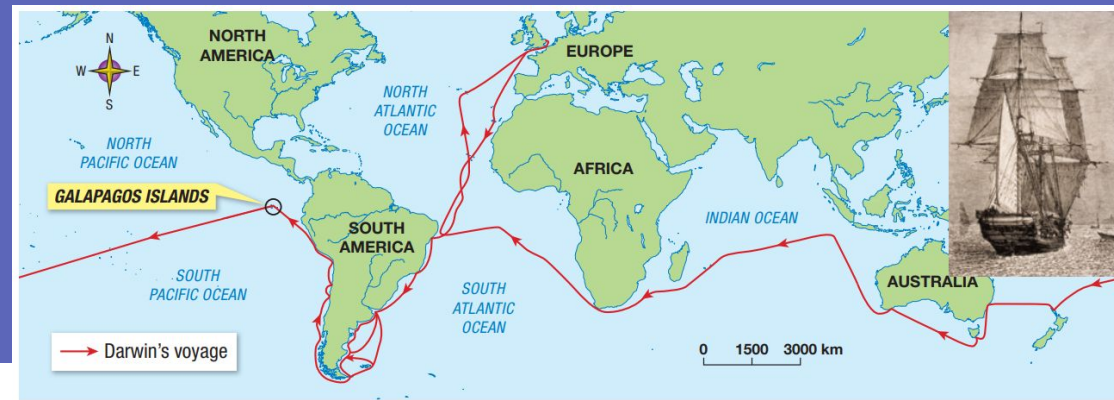
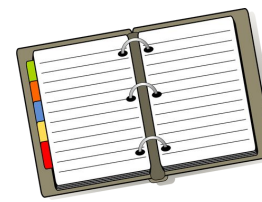


Figure 1 Darwin spent five years on the HMS *Beagle*. The ship was 27.5 m long and carried 74 people. Darwin's cabin was so small that he had to remove a drawer from the end of his bunk to make room for his feet when he lay down.

5 Year Voyage of the HMS Beagle

- Charles Darwin departed in December 1831 at the age of 22
- Primary mission: **survey and map** the coastal waters of South America for the British Navy
- Darwin was to **observe, record, and collect** species of rocks, minerals, plants, and animals.



Darwin began his journey believing species were Earth and species were immutable.

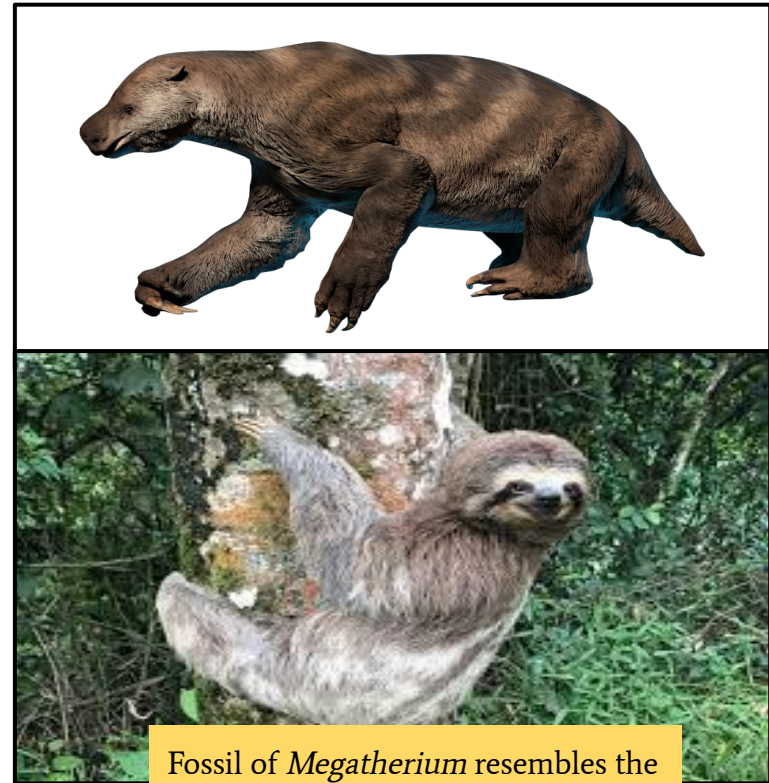
His observations however, convinced him otherwise...

Observations: Fossil Resemblance & Location

Darwin noticed some fossils of extinct species closely resemble extant (living) species.
→ The fossils were found where the present day species lived.



Fossil of giant *Glyptodon* resembles the present day armadillo - both in SA



Fossil of *Megatherium* resembles the present day sloth - both in SA



Darwin also discovered fossils of marine organisms high up in the Andes Mountains.

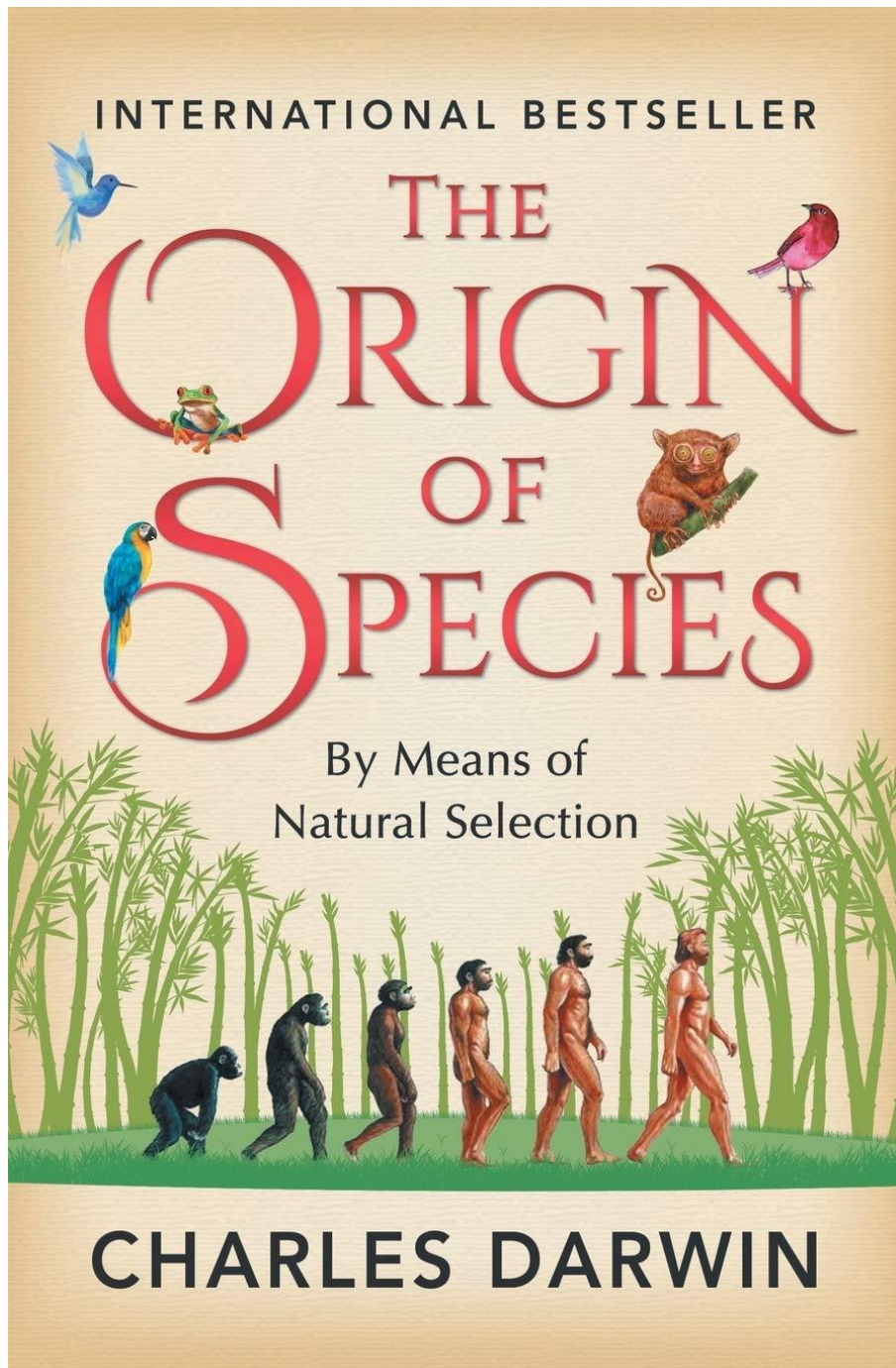
- Indicated that the mountains were once submerged in water
- This observation supported Lyell's theory that the Earth has undergone gradual change.



Darwin's Observations: Galapagos Islands

- **Species on the Galapagos only RESEMBLED those found on the mainland of South America**
(but did not live there)
- **Only species that lived there are those that could have arrived via air or water**
 - He found no large land mammals (they cannot swim large distances without access to fresh water)
 - No amphibians (they perish in salt water)
- **Across the 7 islands, he discovered 13 unique species of finches**





The Theory of Evolution

- With all this evidence, Darwin was certain that the Earth, and species were changing.
- He would spend the next 20 years formulating his theory of evolution
 - **Natural selection**