Geology - Evolution

What is Paleontology?

↕ Hydrothermal vents

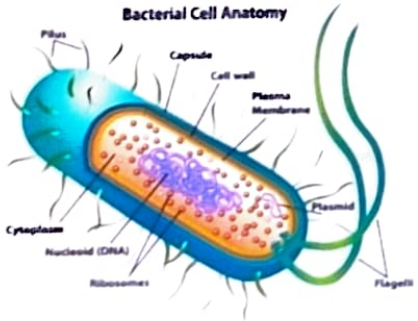
- Origin of life.

→ Non - Living organisms

↓

Living organisms

organic molecules



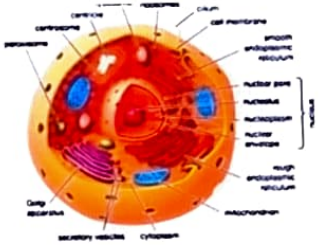
- Rise of eukaryotes

↳ Prokaryotes + → [no nucleus]

Eukaryotes → [nucleus]

↳ other organelles

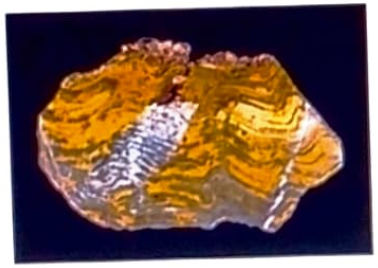
↳ more complex



↳ 1.8 billion yrs ago.

Symbiotic Relationship

↳ E.g. prokaryotes engulfing prokaryotes to form eukaryotes.



The Cambrian Explosion

The Cambrian Explosion

form eukaryotes.

Volcanoes + coral reefs.

- Evolution of multicellular organisms.

↳ 1.2 billion yrs ago.

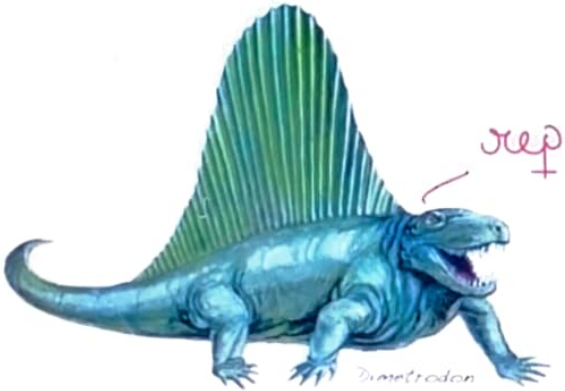
- The Cambrian Explosion

↳ rapid diversification of life.

↳ 541 million yrs ago

↳ arthropods (snails, octopuses, oysters), molluscs, chordates.

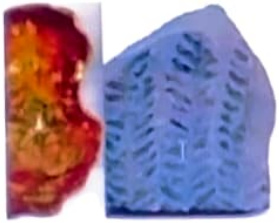
- ↳ insects, spiders, centipedes, millipedes
- → nerves
- → tails
- ↳ vertebrates
- ↳ invertebrates



reptiles

- Evolution of land plants.
  - ↳ 470 million yrs ago.
  - ↳ algae, shallow water

- Evolution of Dinosaurs
  - → 245 million yrs ago
  - → 180 million yrs they were ruling the planet.
  - → Extinct – 66 million



→ Extinct – 66 million yrs ago.

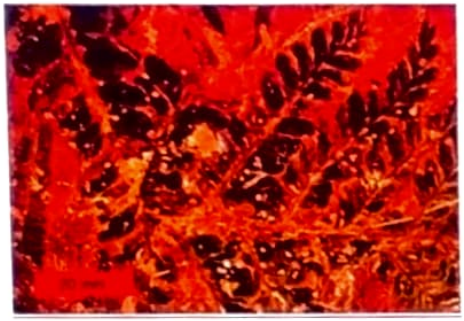
↳ Tyrannosaurus rex

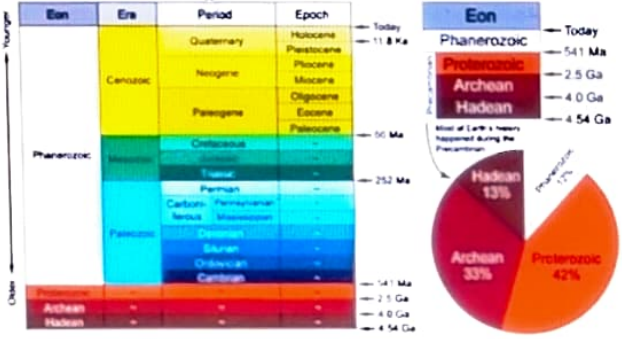
↳ Triceratops

↳ Stegosaurus

- The evolution of mammals.

↳





↳ 200 million years ago.

↳ presence of hair, mammary glands, a well developed brain, four chambered heart.

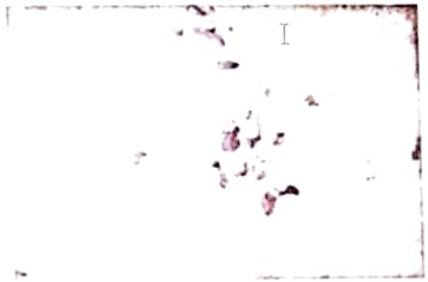
- Evolution of humans.

↳ large brains

↳ bipedal locomotion

↳ use of complex

language



Fossil

Sedimentary fossils

↳ sedimentary rocks

- 2 types –

→ Body fossils

→ Trace fossils

↳ footprints, burrows, nests.

↳ molds / casts → mineral rich water

↳ sediments

Paleontology is the study of fossils and the history of life on Earth. It is a branch of geology that uses fossils to understand the evolution of organisms, the environments in which they lived, and the changes that ha occurred in those environments over time.

Here are some of the major steps in the evolution of life forms, as illustrated by fossils:

1. The origin of life

The origin of life is one of the most fundamental questions in science. Scientists are still working to understand how the first living organisms arose from non-living matter. However, there is evidence to suggest that life may have originated in hydrothermal vents on the ocean floor, where the conditions are favorable for chemical reactions that could have led to the formation of organic molecules.

2. The rise of eukaryotes

Eukaryotes are organisms that have cells with a nucleus and other specialized organelles. They are more complex than prokaryotes, which are organisms that do not have a nucleus.

The first eukaryotes appeared about 1.8 billion years ago. It is thought that they may have evolved from prokaryotes that engulfed other prokaryotes and formed a symbiotic relationship.

3. The evolution of multicellular organisms

Multicellular organisms are made up of two or more cells that work together to form a single organism. The first multicellular organisms appeared about 1.2 billion years ago.

The evolution of multicellularity was a major step in the evolution of life, as it allowed for the development of more complex organisms with specialized tissues and organs.

4. The Cambrian explosion

The Cambrian explosion was a period of rapid diversification of life that occurred about 541 million years ago. During this time, many of the major groups of animals, such as arthropods, mollusks, and chordates, first appeared in the fossil record.

The Cambrian explosion is thought to have been caused by a combination of factors, including changes in the environment and competition between different groups of organisms.

5. The evolution of land plants

The first land plants appeared about 470 million years ago. They evolved from algae that lived in shallow water.

The evolution of land plants was a major step in the evolution of life, as it allowed for the development of ecosystems on land.

6. The evolution of dinosaurs

Dinosaurs first appeared about 245 million years ago and dominated the land for about 180 million years. They went extinct about 66 million years ago, possibly due to an asteroid impact.

Dinosaurs were a diverse group of reptiles that included many different sizes and shapes. Some of the most famous dinosaurs include Tyrannosaurus rex, Triceratops, and Stegosaurus.

Mammals first appeared about 200 million years ago. They are thought to have evolved from reptiles.

Mammals are characterized by the presence of hair, mammary glands, and a four-chambered heart. They also have a relatively high metabolism and a well-developed brain.

8. The evolution of humans

Humans are primates that first appeared about 7 million years ago. We evolved from other primates, such as chimpanzees and bonobos.

Humans are characterized by our large brains, bipedal locomotion, and ability to use complex language.

What are Fossils?

Fossils are the preserved remains of ancient organisms. They can be formed in a variety of ways, but the most common way is when an organism dies and its body is buried by sediment. Over time, the sediment compresses and hardens, forming rock. The organism's remains are then preserved in the rock.

Fossils can be found in all types of rocks, but they are most common in sedimentary rocks. Sedimentary rocks are formed from layers of sediment that have been deposited over time. The oldest layers of sediment are at the bottom, and the youngest layers are at the top. This means that fossils found in sedimentary rocks are arranged in chronological order, from oldest to youngest.

Types of Fossils

There are two main types of fossils: body fossils and trace fossils.

Body fossils are the preserved remains of the organism's body or body parts. They can be complete or incomplete, and they can be preserved in a variety of ways. Some body fossils are preserved as molds or casts. A mold is formed when the organism's body is buried by sediment and then decays. The sediment then fills in the space where the organism was, forming a mold of its body. A cast is formed when the mold is filled with mineral-rich water. The minerals then harden, forming a cast of the organism's body.

Other body fossils are preserved as petrifactions. A petrification is formed when the organism's body is replaced by minerals. This can happen when the organism is buried in mineral-rich water. The minerals then slowly replace the organism's body, one molecule at a time.

Trace fossils are evidence of an organism's activity, such as footprints, burrows, or nests. Trace fossils are less common than body fossils, but they can be just as informative. For example, trace fossils can tell us about an organism's locomotion, feeding behavior, and social interactions.

Importance of Fossils

Fossils are important for a number of reasons. First, they provide evidence of life on Earth over time. By studying fossils, scientists can learn about the evolution of life and the environments in which ancient organisms lived.

Second, fossils can be used to correlate rock layers from different locations. This is important for understanding the geological history of an area.

Third, fossils can be used to identify and map mineral resources. For example, oil and gas deposits are often associated with certain types of fossils.

Hydrothermal vents are fissures on the seabed from which geothermally heated water discharges. They are commonly found near volcanically active places, areas where tectonic plates are moving apart at mid-ocean ridges, ocean basins, and hotspots.

Arthropods are the most diverse phylum of animals, with over a million known species. They include insects, spiders, crustaceans, and myriapods (centipedes and millipedes). Arthropods are characterized by their segmented bodies, jointed appendages, and external skeletons made of chitin.

Molluscs are the second most diverse phylum of animals, with over 100,000 known species. They include snails, clams, oysters, squid, and octopuses. Molluscs are characterized by their soft bodies, which are often protected by a hard shell.

Chordates are a phylum of animals that includes vertebrates, as well as two groups of invertebrates: tunicates and cephalochordates. Chordates are characterized by the presence of a notochord (a dorsal rod of flexible cartilage), a dorsal nerve cord, pharyngeal slits, and a post-anal tail at some point in their development.

Sedimentary rocks are rocks that are formed from the accumulation and lithification (hardening) of sediment. Sediment is composed of loose particles of rock, minerals, and organic matter that have been weathered and eroded from pre-existing rocks. Sediment can be transported by water, wind, ice, or gravity, and it is eventually deposited in lakes, oceans, rivers, deserts, and other environments.