

# Introduction to Geology

**Geology** literally means "study of the Earth."



Physical geology examines the materials and processes of the Earth.  
Historical geology examines the origin and evolution of our planet through time.

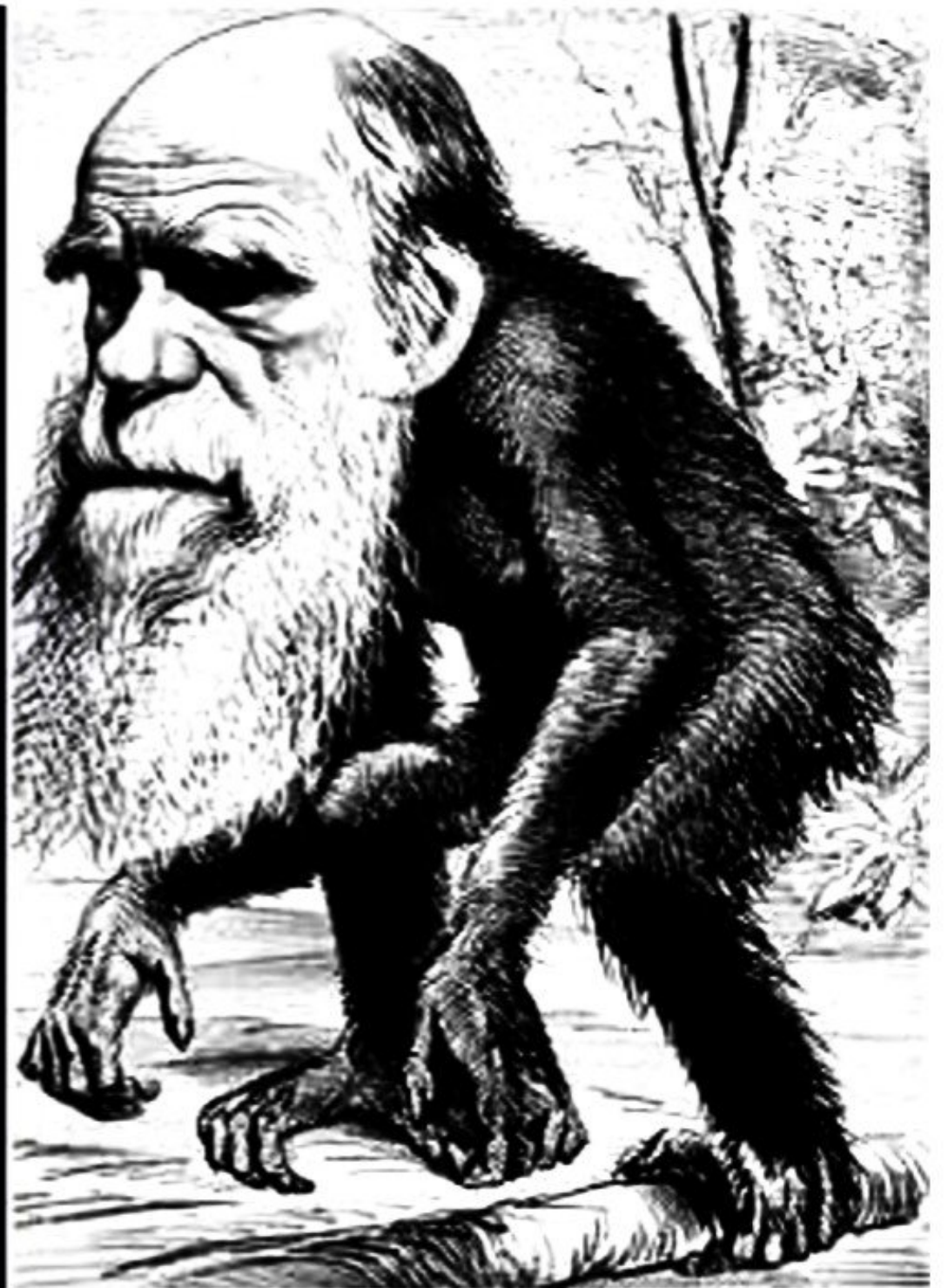
- Geology is an evolving science - the theory of plate tectonics was just accepted in the 1960's.
- Plate tectonics is the unifying theory in geology.



- Although geologists treat it as a law - plate tectonics is still and will likely remain a theory...

Geology is an extremely controversial science - the theory of evolution (paleontology) is central to geology.

Geology seeks to understand the origin of our planet and our place in the Universe - answers to these questions are also posed outside of the realm of science.



# History of Early Geology

**Catastrophism** (James Ussher, mid 1600s) - He interpreted the Bible to determine that the Earth was created at 4004 B.C. This was generally accepted by both the scientific and religious communities. Subsequent workers then developed the notion of catastrophism, which held that the Earth's landforms were formed over very short periods of time.

**Uniformitarianism** (James Hutton, late 1700s) - He proposed that the same processes that are at work today were at work in the past. Summarized by "The present is the key to the past." Hutton, not constrained by the notion of a very young planet, recognized that time is the critical element to the formation of common geologic structures. Uniformitarianism is a basic foundation of modern geology.

# Geologic Time

**Relative Dating:** Putting geologic events into proper order (oldest to youngest), but without absolute ages. We use a number of principles and laws to do this:

**Law of Original Horizontality** - Sedimentary units and lava flows are deposited horizontally.

**Law of Superposition** - the layer below is older than the layer above.

**Principle of fossil succession** - life forms succeed one another in a definite and determinable order and therefore a time period can be determined by its fossils.

**Law of Cross-cutting Relationships** - A rock is younger than any rock across which it cuts.

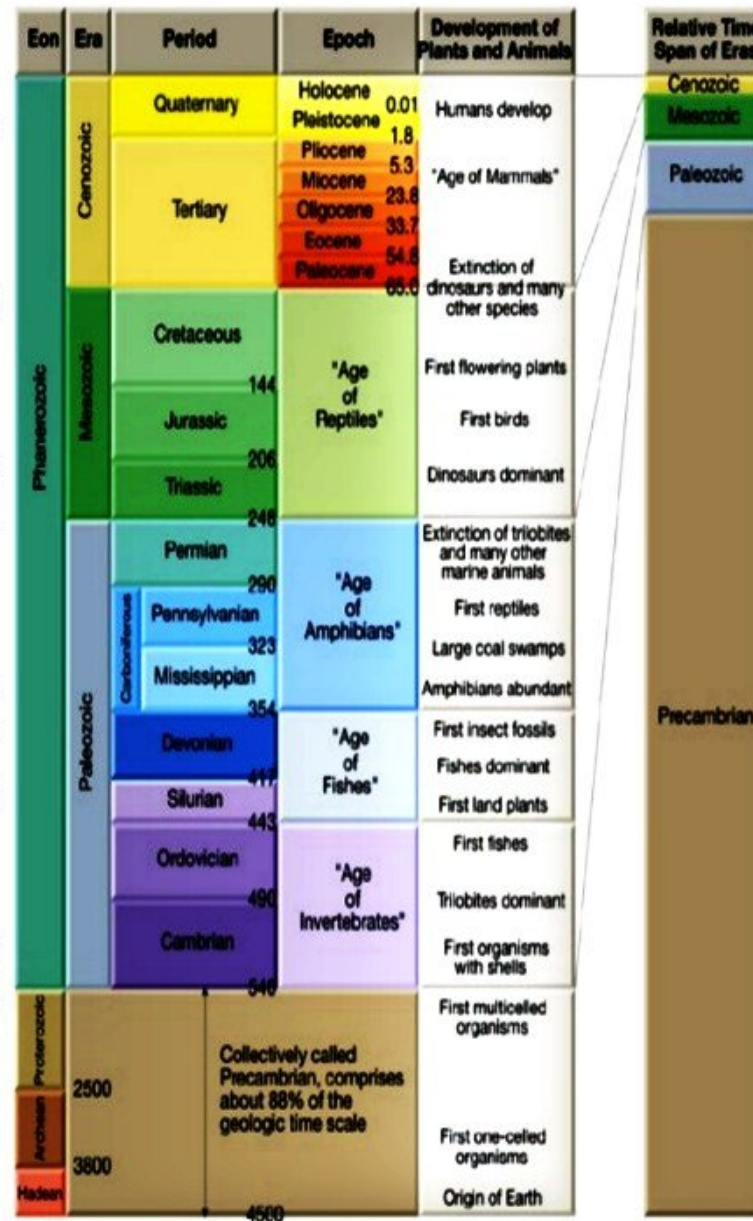
# Geologic Time

**Absolute (Radiometric) Dating:** Using radioactive decay of elements to determine the absolute age of rocks. This is done using igneous and metamorphic rocks.

<b>Parent</b>	<b>Decay Product</b>	<b>Half-Life (billion years)</b>
Aluminum-26	Magnesium-26	0.00072 (720,000 years)
Uranium-235	Lead-207	0.71
Potassium-40	Argon-40	1.3
Uranium-238	Lead-206	4.5
Thorium-232	Lead-208	14
Rubidium-87	Strontium-87	47
Samarium-147	Neodymium-147	106

# Geologic Time

- The concept of geologic time is new (staggering) to many nongeologists.
- The current estimate is that the Earth is ~4,600,000,000 (4.6 billion) years old.
- As humans we have a hard time understanding the amount of time required for geologic events.
- We have a good idea of how long a century is. One thousand centuries is only 100,000 years. That huge amount of time is only 0.002% of the age of the Earth!
- An appreciation for the magnitude of geologic time is important because many processes are very gradual.



- Geologic time is divided into different types of units.
- Note that each Eon, Era or Period represents a different amount of time.
- The change in periods is related to the changing character of life on Earth and other changes in environment.
- The beginning of the Phanerozoic represents the explosion of life.
- The time before the Phanerozoic is commonly referred to as the Pre-Cambrian and represents over 4 billion years of time. The Phanerozoic eon (abundant life) represents only the last 13% of Earth time.

