Evolution of Landforms

Geologic Time and Fossils

How do we know Earth's History?

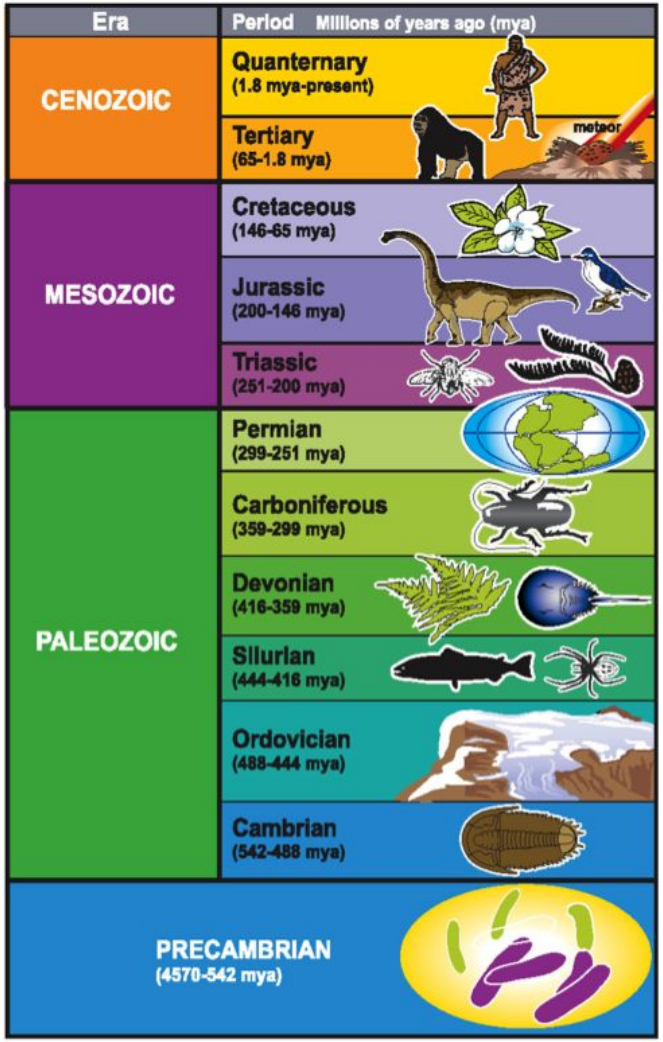
Scientists study rocks, fossils, & other natural evidence for clues about Earth's history

- Fossil: traces or preserved remains of living things from long ago

  Dinosaur bones, footprints

  - Give information about the organism (often extinct, but not always!)
    - Allows us to have some idea about what they looked like and how they behaved
  - Exist in many different forms:
    - shells, bones, teeth
    - impressions or other evidence of an organism preserved in rock
    - actual organism (or part of one) can be preserved

Geologic Time Scale



Precambrian Era

- The Precambrian Era is Earth's first era of time. It began with the creation of the Earth around 4.6 billion years ago.
- 5 major events occurred during this era: (1) the formation of the Sun and light, (2) the creation of the Earth, (3) the creation of the atmosphere through volcanic out-gassing, (4) the creation of the oceans, and (5) the creation of life.
- Began with simple life forms such as bacteria and simple algae.
- There was a rise of simple organisms such as jellyfish and sea worms by the end of the era.
- Few fossils because the life forms were soft-bodied and had no hard skeleton.

Paleozoic Era

- Began with the early invertebrates, such as trilobites and brachiopods; continued to develop early vertebrate fish, then arachnids and insects; later came the first amphibians, and near the era's end the reptiles became dominant.
- Early land plants included simple mosses, ferns, and then cone-bearing plants.
- By the end of the era, seed plants were common.
- The mass extinction that ended the era caused most marine invertebrates as well as amphibians to disappear.

Mesozoic Era and Cenozoic Era

- Mesozoic Era
  - Reptiles were the dominant animals of this era, including the various dinosaurs.
  - Small mammals and birds also appeared.
  - Toward the end of the era, flowering plants appeared and the kinds of mammals increased.
  - The mass extinction that ended the era caused the dinosaurs to become extinct.
- Cenozoic Era
  - New mammals appeared while others became extinct.
  - The diversity of life forms increased.
  - Flowering plants became most common.
  - Humans are also part of the most recent period of this era.

How can we see changes in life and the environment?

- Fossil record: Millions of fossils have been collected and observed. Certain fossilized organisms could only live in specific environments or under particular climate conditions. Extinction of life forms as well as how and when new life-forms appeared is part of the fossil record.
- Tree rings
  - See overall weather patterns in an area: rings vary in size depending on how much the tree grows that year—dry years=thin rings, good rainfall/weather=thick ring

How can we see changes in life and the environment?

- Ice cores
  - Greenland & Antarctica—ice/snow has built up into thick layers called glaciers (can be taller than skyscrapers)
  - Ice core: cylindrical sample that shows layers of snow/ice that have built up for thousands of years
  - Analyze air trapped in the ice to learn how the atmosphere has changed—can indicate temperature, volcanic activity, etc.

What are original remains?

Original remains: fossils of organism's actual bodies/body parts (RARE!!!); also called preserved fossils

- ➢ Found in airtight/small places that prevent decay
  - Ice: one of the best preservers—frozen mammoth body found in Siberia with bone, muscle, skin, and hair still in place
  - Amber: tree sap/resin, a sticky substance that flows in trees like syrup and protects the tree by trapping insects.
  - Tar: animals get trapped in pools of tar and are preserved—Saber-tooth tiger skull.
- ➢ Fossils are direct evidence of forms of life (like dinosaurs)

How are fossils formed?

In rocks → conditions must be “just right”—must be preserved before it decays

- Body parts are replaced by minerals (turned to stone)
- Most organisms die and decompose without leaving fossils

Hard parts (shells, bones, teeth) decompose slowly more likely to become fossils

Form in sedimentary rock

- Organism is buried in sediment; sediment becomes rock
  - Heat/pressure in igneous and metamorphic rock can destroy fossils
- Not all fossils are original remains but are impressions/traces, made of rock

What are the 4 types of fossils?

Different environmental conditions form different fossils

- Molds & Casts
  - Mold: forms when sediments bury an organism and the sediments change into rock; the organism decays leaving a hole in the rock in the shape of the organism.
  - Cast: forms when a mold is filled with sand or mud that hardens into the shape of the organism.
- Petrified fossil: forms when minerals soak into the buried remains, changing them into rock.
  - Ex: petrified wood: stone fossil of a tree

What are the 4 types of fossils?

- Carbon film: forms when organisms (or parts) are pressed between layers of soft mud or clay that hardens, squeezing almost all the decaying organism away leaving the carbon imprint in the rock. Shows details of soft parts rarely seen in other types of fossils.
- Trace fossils: evidence of organism's presence—Footprints, trails, animal holes

Change Over Time Geologic Evidence

Different kinds of fossils are:

Mold: a hollow area in sediment in the shape of an organism or part of an organism; formed when the organism makes an indentation that turns to rock over time

www.ammonoid.com

Cake mold

Change Over Time Geologic Evidence

Cast: a solid copy of the shape of an organism; made by filling in a mold with minerals that later turn to rock.

Change Over Time Geologic Evidence

Petrified fossil: minerals replace all or part of an organism

en.wikivisual.com

You can see the rings.

www.alaska.edu

Change Over Time Geologic Evidence

Carbon film: an extremely thin coating of carbon on rock; made when an organism is squeezed by rock until only carbon remains

www.geology.ohio-state.edu

Change Over Time Geologic Evidence

Trace fossil: evidence of activities of ancient organisms; may be tracks, burrows, nest, or trail

Fossil burrow

Fossil tracks

Change Over Time Geologic Evidence

Preserved Remains

Amber: a hardened resin, or sap, of evergreen trees; organisms that get trapped in the sticky substance becomes part of the rock

pixdaus.com

www.ambermine.com

Change Over Time Geologic Evidence

Frozen remains: organisms caught in ice or snow

Adult mammoth

flickr.com

Frozen baby mammoth

What does sedimentary rock tell us about Earth's past?

- Sedimentary rock show relative age.
  - Relative age: the age of an event or object in relation to other events or objects.
    - In past—fossils, rocks, etc. were used to reconstruct the Earth's past (no technology)
- Sedimentary rock forms in layers
  - oldest layer = bottom (think about it—if it formed first, it will be on bottom)
  - youngest layer = top
  - This is called the Law of Superposition: each rock layer is younger than the one below it.
  - Called relative age because we don't know exactly when each layer formed

What are index fossils?

Fossils in sedimentary rock can offer clues to Earth's past.

- Fossils can tell the age of the rock: organism lived when the rock layer formed
  - index fossils: fossils of common organisms that lived in many areas during a specific span of time—used to determine age of rock layers
    - Ex: a type of shellfish (I. labiatus) lived from 144 million to 65 million years ago, so if you find it's fossil, you know that rock layer is between 144 and 65 million years ago.

How do we know absolute age?

Absolute age: the actual age of an event or object; determined through radioactive dating.

Half-life: time it takes for half of the atoms in a radioactive sample to "break down"

- Different elements = different half-lives.
- Uranium and C-14 are 2 of the most commonly used to date rocks because they have long half-lives (C-14's half-life is 5730 years, uranium is 704 million years)
- Radioactive dating works best with igneous rocks