**Earth History Notes Part 1 – Fossils & Relative Age**

**The Principle of Uniformitarianism**

* Uniformitarianism is the idea that the same geologic processes shaping the Earth today have been at work \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Earth’s history.
* To explain Earth’s history, most scientists supported the principle of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* Catastrophism is the principle that geologic change occurs suddenly.
* The science involved with the study of past life is called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_-.
* Paleontologist study \_\_\_\_\_\_\_\_\_\_\_, which are the remains of organisms preserved by geologic processes.

**How do fossils form?**

* Fossils are the preserved remains or traces of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ things.
  + Fossils provide evidence of how life has \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ over time.
  + Fossils also help scientists infer how Earth’s surface has changed.
  + Fossils are clues to what past \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ were like.
* Most fossils form when living things die and are buried by sediments. The sediments slowly harden into rock and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ the shapes of the organisms.
* Fossils are usually found in sedimentary rock.
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_rock is the type of rock that is made of hardened sediment.

**What are the different kinds of fossils?**

* Fossils found in rock include petrified fossils, molds and casts, carbon films, and trace fossils.
* Other fossils form when the remains of organisms are preserved in substances such as tar, amber, or ice.
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Fossils
  + A fossil may form when the remains of an organism become petrified.
  + Petrified means “turning to stone”
  + Petrified fossils are fossils in which \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ replace all or part of an organism.
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + A mold is a \_\_\_\_\_\_\_\_\_\_\_\_ area in sediment in the shape of an organism or part of an organism.
    - A mold forms when the hard part of the organism such as a shell, is buried in sediment.
  + A cast is a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the shape of an organism.
    - Water carrying dissolved minerals and sediment may seep into the empty space of a mold. If the water deposits the minerals and sediment there, the result is a cast.
* Carbon films
  + An extremely thin coating of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ on rock.

HOW DOES A CARBON FILM FORM?

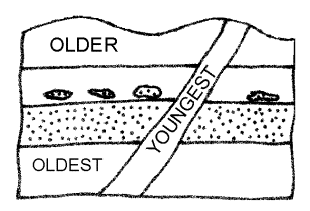
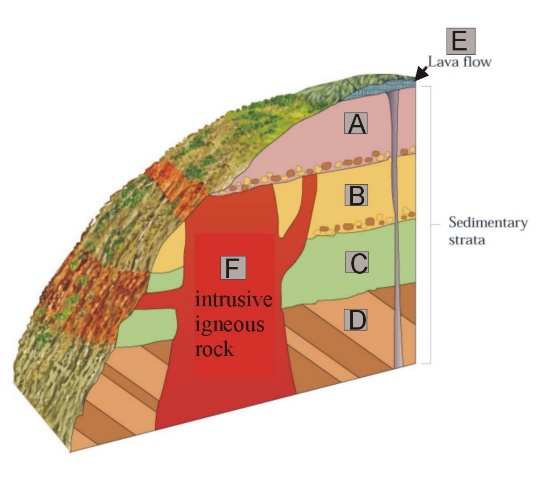
* + When sediment buries an organism, some of the materials that make up the organism can become \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. These gases escape from the sediment, leaving carbon behind. Eventually, only a thin \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of carbon remains.
* Trace fossils
  + Trace fossils provide evidence of the activities of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ organisms.
  + A fossilized \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is on example of a trace fossil.
  + Other examples of trace fossils include the trails that animals followed or the burrows that they lived in.
* Preserved Remains (premineralized remains)
  + Some processes preserve the remains of organisms with little or no change.
    - Some remains are preserved when organisms become trapped in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
    - Ancient organisms also have been preserved in amber. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is the hardened resin, or sap, of evergreen trees.
    - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is another way in which remains can be preserved.

**What do fossils tell about how organisms have changed over time?**

* The fossil record provides evidence about the history of life on Earth. The fossil record also shows that different groups of organisms have changed over \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* The fossil record reveals a surprising fact: fossils occur in a particular order.
  + Older rocks contain fossils of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ organisms. Younger rocks contain fossils of more complex organisms.
  + In other words, the fossil record shows that life on Earth has \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, or changed.
* The fossil record provides evidence to support the theory of evolution.
* A scientific \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is a well-tested concept that explains a wide range of observations.
* Evolution is the gradual change in living things over long periods of time.
* The fossil record shows that millions of types of organisms have evolved.
  + But many others have become extinct.
  + A type of organism is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ if it no longer exists and will never again live on Earth.
* Paleontologists use fossils to build up a picture of Earth’s environments in the past.
* Fossils also provide evidence of Earth’s climate in the past.
* Scientists can use fossils to learn about changes in Earth’s \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**How do geologists determine the relative age of rocks?**

* When you look at a rock containing a fossil, your first question may be, “How old is it?”
* The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of a rock is its age compared to the ages of other rocks.
* The relative age of a rock does not provide its absolute age
  + The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of a rock is the number of years since the rock formed.
* The position of Rock Layers
  + Geologists use the law of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to determine the relative ages of sedimentary rock layers.
  + According to the law of superposition, in horizontal sedimentary rock layers the oldest layer is at the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. Each higher layer is younger than the layers below it.
  + To determine the age of most sedimentary rocks, scientists study the fossils they contain.
  + How would a geologist find the relative age of a rock?
    - By observing the rock’s position in relation to the rock layers above and below it.
* Other clues to Relative Age
  + Clues from Igneous Rock
    - Igneous rock forms when magma or lava harden.
    - Lava that hardens on the surface is called an \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. The rock layers below an extrusion are always older than the extrusion.
    - The magma cools and hardens into a mass of igneous rock called an \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
    - An intrusion is always younger than the rock layers around and beneath it.



* + Clues from Faults
    - A fault is a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in Earth’s crust. Forces inside Earth cause movement of the rock on opposite sides of a fault.
    - A fault is always \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ than the rock it cuts through. To determine the relative age of a fault, geologists find the relative age of the most recent rock layer through which the fault slices.
* Gaps in the Geological Record
  + The geologic record of sedimentary rock layers is not always complete.
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ slowly builds layer upon layer of sedimentary rock.
  + Some of these layers may erode away, exposing an older rock surface.
  + Then deposition begins again, building a new rock layer.
  + The surface where new rock layers meet a much older rock surface beneath them is called an \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + An unconformity is a \_\_\_\_\_\_\_\_\_\_\_\_\_\_ in geologic record.
  + An unconformity shows where some rock layers have been lost because of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + Unconformities show where an old, eroded surface is in contact with a newer rock layer.

**How are index fossils useful to geologists?**

* If a type of organism existed for only a short period of time, its fossils would show up in a limited range of rock layers. These fossils are called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ fossils.
* Index fossils are fossils that are found in the rock layers of only one geologic age, and can be used to establish the \_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the rock layers.
* To date rock layers, geologists first give a relative age to a layer of rock at one location.
* Then they can give the same age to matching layers of rock at other locations.
* Certain fossils, called index fossils, help geologists match rock layers.
* To be useful as an index fossil, a fossil must be widely \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and represent a type of organism that existed only briefly.
* Index fossils are useful because they tell the relative ages of the rock layers in which they occur.

**The Trilobite**

* One example of an index fossil is a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* Trilobites were a group of hard-shelled animals whose bodies had three distinct parts.
* They evolved in shallow seas more than \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ million years ago.