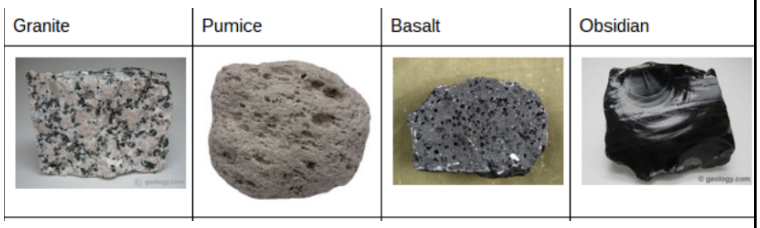
Earth History Notes

Learning Objective: Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's history.

The Earth is approximately **4.6 billion** years old.

ROCK CYCLE – 3 Types of Rock

Type of Rock	How it is formed	Picture
Sedimentary	**formed when sediments (like sand or gravel) get deposited, compacted, and cemented together**	
Igneous	**magma (lava) cools**	
Metamorphic	**sedimentary rock that undergoes a lot of heat and pressure**	 Fig 1: Metamorphic rock

TWO TYPES OF GEOLOGIC DATING

RELATIVE	ABSOLUTE
Used to determine if one thing is younger or older than another.	Determines approximately how many years old something is. (Usually, a range of millions of years)
TOOLS	**TOOLS**
• Law of superposition • Use of index fossils • Correlation of rock layers	• Radiometric Dating – Carbon 14 Dating – Potassium-Argon Dating – Uranium-Series Dating – Uranium-Lead Dating

These two methods are used **together** to help us piece together the puzzle that is the History of our Earth.

Earth History Notes

RELATIVE DATING

Definition: **a method of dating rock layers and fossils by comparing them to each other**

RELATIVE DATING TOOLS:

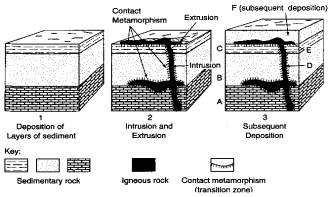
Law of Superposition: **sedimentary rock layers form in flat layers with the oldest on bottom and the newest on top**

Things that can happen after the sedimentary layers form…….

- Folded Rock: **rock layers are older than folds found in them (rock layers formed flat then folded)**

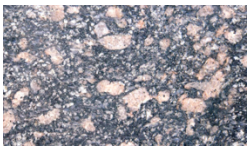
- Faults: **a crack or fracture in the Earth's crust where rocks on either side have moved past each other; rocks layers formed, an earthquake happened, and broke the layers (fault**

- Law of Crosscutting: **a method used to determine how old something is using the atoms in the rock or fossil**

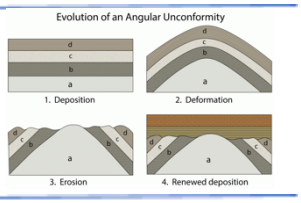


  - Igneous Intrusion: **cut through the rock**
  - Igneous Extrusion: **spread out on top**

- Law of Inclusion: **rocks found within the layers of other rocks are older than the rocks that surrounds them**

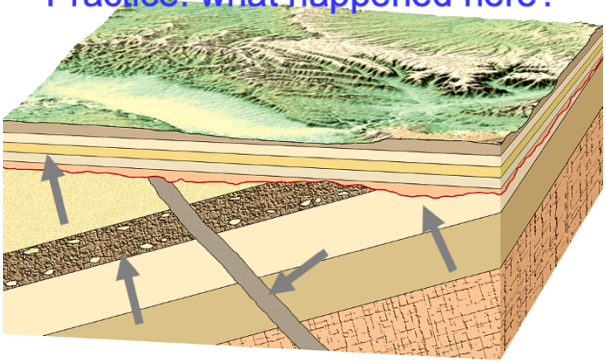


- Unconformity: **when a new sedimentary rock layer is formed on top of an eroded surface**



Instructions: Label the arrows with the words in the word bank. Some arrows may have more than one word that applies.

Practice: what happened here?



Word Bank:

Unconformity
Law of Superposition
Law of Crosscutting
Igneous Intrusion
Erosion
Law of Inclusion

Earth History Notes

ABSOLUTE DATING

Definition: **a method used to determine how old something is using the atoms in the rock or fossil**

- USES **numbers** (IN MILLIONS OF YEARS)
- ONLY WORKS FOR **igneous** ROCKS AND SOME **fossils**
    - DETERMINES THE SPECIFIC AGE OF A **fossil**
    - LOOKS AT **chemical** PROPERTIES

HOW ABSOLUTE DATING WORKS:

1.	**magma / lava** cools and radioactive elements are incorporated into the minerals
2.	These elements begin to **decay** at a known rate starting when the rock cools
3.	We can **measure** how much of the element is left
4.	These measurements tell us how much **time** has passed since the rock was **formed**

Carbon-14 Dating

- Used to date **organic** substances
- Scientists measure the **radiocarbon** in the fossil to determine its **age**
- Can only date specimens up to about **60,000** years old

Potassium-Argon Dating

- Scientists determine the **age** of the rock surrounding the **fossil** to determine the fossil's age.
- Used only for **inorganic** substances like rocks and minerals
- Scientists measure the amount of **argon** in the rock to determine its **age**
- Dates rock 60,000 years old and **older**

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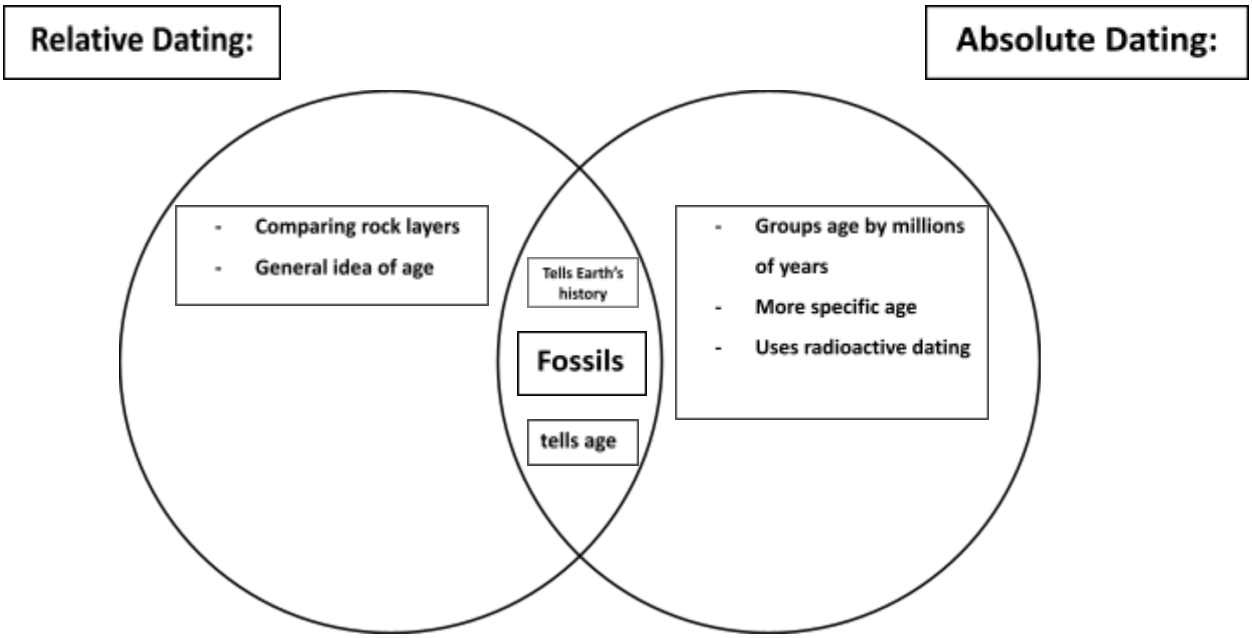
Uranium-Series Dating

- Used to date calcium **carbonate** deposits, found in caves or the shells of some marine fossils
- Can provide age **estimates** for materials that range from a **few thousand years to several hundred thousand years**

Uranium-Lead Dating

- **U-238** dating is often used for dating rocks and minerals with ages in the billions of years, like Earth
- **U-235** dating is employed for materials with ages ranging from tens of millions to billions of years
- Used most frequently to date **igneous** rock

USING RELATIVE AND ABSOLUTE DATING TOGETHER:



WHAT IS A FOSSIL?

Definition: **evidence in a material, like rock, that shows the presence of a plant or animal from an earlier period in time**

- EACH TYPE OF FOSSIL PROVIDES UNIQUE INFORMATION ABOUT **past** LIFE FORMS AND THE HISTORY OF THE **earth**

Earth History Notes

THINK. PAIR. SHARE :

Why don't fossils exist in most igneous or metamorphic rock?

Directions: Think about your answer to this question and write it here. Then, turn to someone next to you and share it with them.

Fossils mostly exist in sedimentary rock because igneous rocks are formed directly from magma / lava; and metamorphic rocks have been under such high heat and high pressure (some even squashed or stretched too) that fossils usually cannot survive these such conditions.

MATCH THE EXAMPLES TO THE DIFFERENT TYPES OF FOSSILS

Body Fossils

Plant Fossils

Trace Fossils

Molds and Casts

THE FOSSIL RECORD

Definition: **a record of all known fossils and their relative ages**

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INDEX FOSSILS

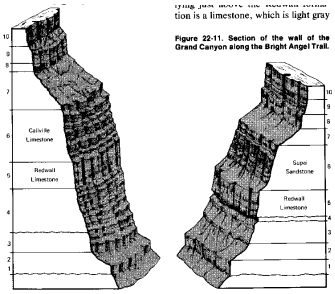
Definition: A fossilized organism that is used to help determine **age** of rock layers or geological strata

- *THESE FOSSILS ARE USEFUL FOR RELATIVE DATING BECAUSE…*

What makes a good index fossil?	**1. Widespread** **- they are found all over the world** **2. Abundant** **- there were a lot of them when they lived** **3. Distinctive** **- they are easy to recognize, even in small pieces**

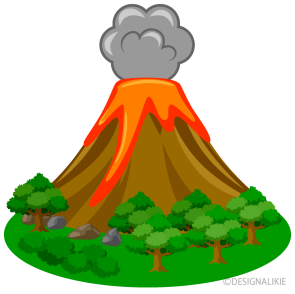
CORRELATION

Definition: **matching** similar rock layers in different location to **formed** at the **same** time



Volcanic Ash Falls are another way to correlate rock layers over a large area

ASH IS A GOOD INDICATOR BECAUSE IT:



- has **distinct characteristics**
- can be **deposited**
- occurs at one, **geologically brief, time**
- can be dated using **radiometric dating**