

# Earth Science

## Notes 12-1

- I. **Relative Age** = age of an object compared to the ages of other objects. Can tell the order of events, but does not tell exact age in years.
- A) **Uniformitarianism** = theory that states that gradual geological processes that occur today happened the same way in the past.
  - B) **Law of Superposition** = The law that a sedimentary rock layer is older than the layers above it and younger than the layers below it if the layers are not disturbed.
  - C) **Principle of original horizontality** = sedimentary rock will remain in horizontal layers if left undisturbed. This happens because gravity pulls sediments flat and parallel to each other. If disturbed, scientists look for clues to determine the original order of layers.
  - D) **The Cross Cutting Law** – any feature that cuts across rock layers is younger. This could be magma flows or faults.
  - E) **The Law of Inclusions** = If one rock body contains fragments of another rock body it must be younger than the fragments of rock it contains. OR...The **inclusions** (rock nuggets) are older than the rocks which contain them.

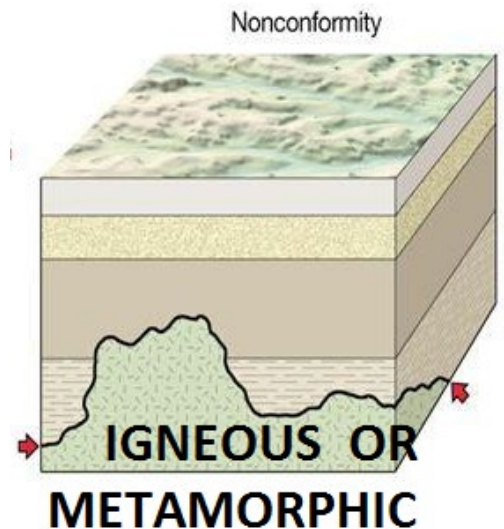
### 1] WAYS ROCK LAYERS GET DISTURBED:

- a) **fault**-a break in the Earth's crust where pieces slide past each other
- b) **intrusion**-molten rock that squeezes into existing rock and cools
  1. Sill- magma seeps in between layers of rock (horizontal magma flow)
  2. Dike- magma breaks a crack through several layers (vertical magma flow)
- c) **folding**-when rock layers bend and buckle from Earth's internal forces
- d) **tilting**-when internal forces in the Earth slant rock layers
- e) **non-deposition** – when rock layers are not made in an area (but are in other areas)

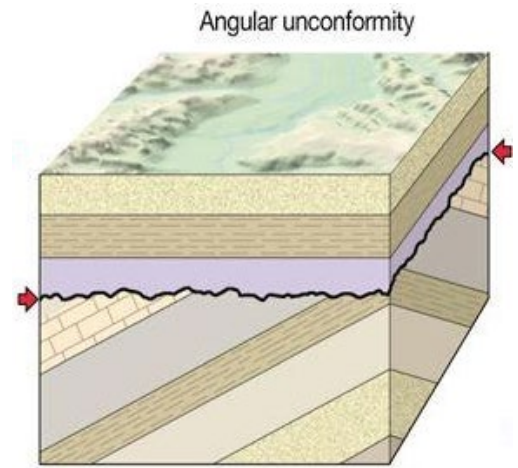
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- D) **Unconformity** = The break in the geologic record created when rock layers are eroded or when sediment is not deposited for long periods of time.

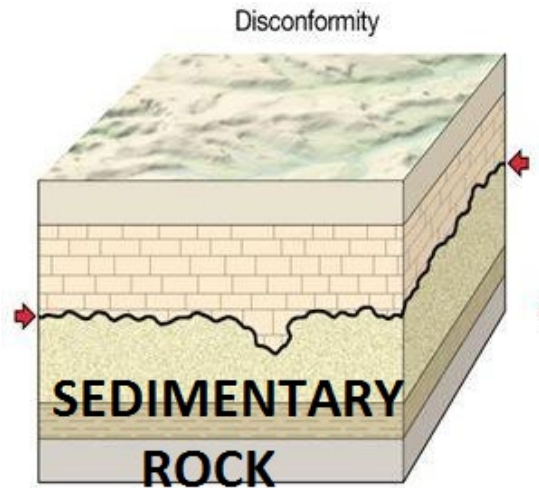
- 1) **Nonconformity** = sedimentary rock layers form on top of eroded metamorphic or igneous rock. The eroded rock represents missing time.



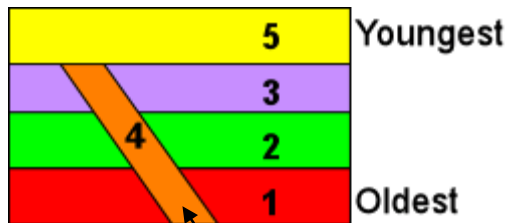
2) **Angular Unconformity** = rock layers tilt, erode flat, and then have sedimentary rock layers form on top of them. The eroded rock represents missing time.



3) **Disconformity** = sedimentary rock layers form on top of eroded sedimentary rock. The eroded rock represents missing time.



E) **Law of crosscutting relationships** = The principle that a fault or intrusion of rock is younger than any other body of rock that it cuts through.



Intrusion = Magma injected in rock and cooling forming rock.

# 8<sup>th</sup> Science

## Notes 12-2

II. Fossils = the remains of animals or plants that lived in a previous geologic time.

A) Paleontology = The study of fossils

1) Fossils mostly found in sedimentary rock because sediment covers the organism and prevents decay. Igneous and metamorphic rock forming processes destroy the organic structures. Fossils in rock can form if organism is buried immediately after death and the hard parts become preserved as rock forms around them.

B) Interpreting the Fossil Record

1) Shows us clues to the Earth's geologic history

a) Climate changes are seen by marine fossils found on land. This shows that the area was once under oceans. (Michigan was under water for 300 million years laying down our salt, gypsum, dolomite, as well as Petoskey stones (our state stone) which are fossilized coral.

b) Shows how living things have evolved over time

C) Ways to make a fossil:

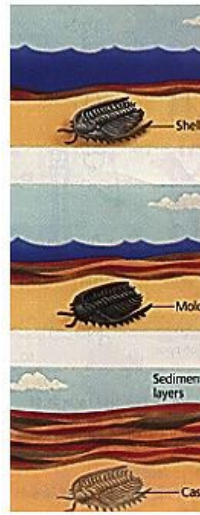
- 1) buried under sediment in ocean
- 2) buried in mud / mudslide / landslide on land
- 3) buried in volcanic ash
- 4) buried in snow/ glacier ice
- 5) buried in tar pit
- 6) buried in tree sap (amber)
- 7) buried in hot sand of desert (mummification)

D) Types of fossils

- 1) Mummification = Form in dry places where decomposing bacteria cannot live.
- 2) Amber = fossils form when insects land on a tree and get covered in sap which hardens. Sometimes DNA can be extracted (Jurassic Park?)
- 3) Tar seeps/asphalt = fossils form when an organism fell into an asphalt/tar pit while trying to drink the water above it. Creature is then preserved. (Le Brea asphalt/tar pit in LA, California)
- 4) Freezing = Frozen fossils form when organisms from the last ice age died and froze, slowing down the decay process.
- 5) Petrification = Petrified fossils form when pores in wood, bones, or shells fill with dissolved minerals (silica, calcite, pyrite) and crystallize over time
- 6) Imprints = When original organic material partially decays, leaving behind a carbon film



- 7) Mold = A mark or cavity made in a sedimentary surface by a shell or other body part.  
Cast = A fossil that forms when sediments fill in the cavity left by a decomposing organism.

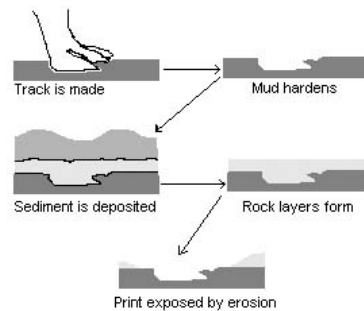


8) Coprolites = Fossilized dung can preserve information about what the animal ate



9) Gastroliths = Stones that were used in the digestive tract of some dinosaurs. (Like the stones in a bird's gizzard) They reveal that the dinosaur was a plant eater.

10) Trace fossil- A fossilized mark that is formed in soft sediment by the movement of an animal (foot prints, burrows, boring, etc.)



E) Index Fossil = A fossil that lived during a relatively short geological time that can be used to find the absolute date of the rock layer it is found in.



**Ammonites** Mesozoic Era (245 to 65 mya)

**Trilobites** Paleozoic Era (540 to 245 mya)

# Notes 12-3

III. **Absolute Age** = The ACTUAL age of an object in years

Absolute Dating Method:

1) **Radiometric Dating**-- a dating method that compares parent isotopes with daughter isotopes  
 more parent = younger  
 more daughter = older

a) **radioactive decay**-- the process in which a radioactive isotope breaks down into a stable isotope

b) **isotope** -- an atom with the same number of protons as other atoms, but a different number of neutrons

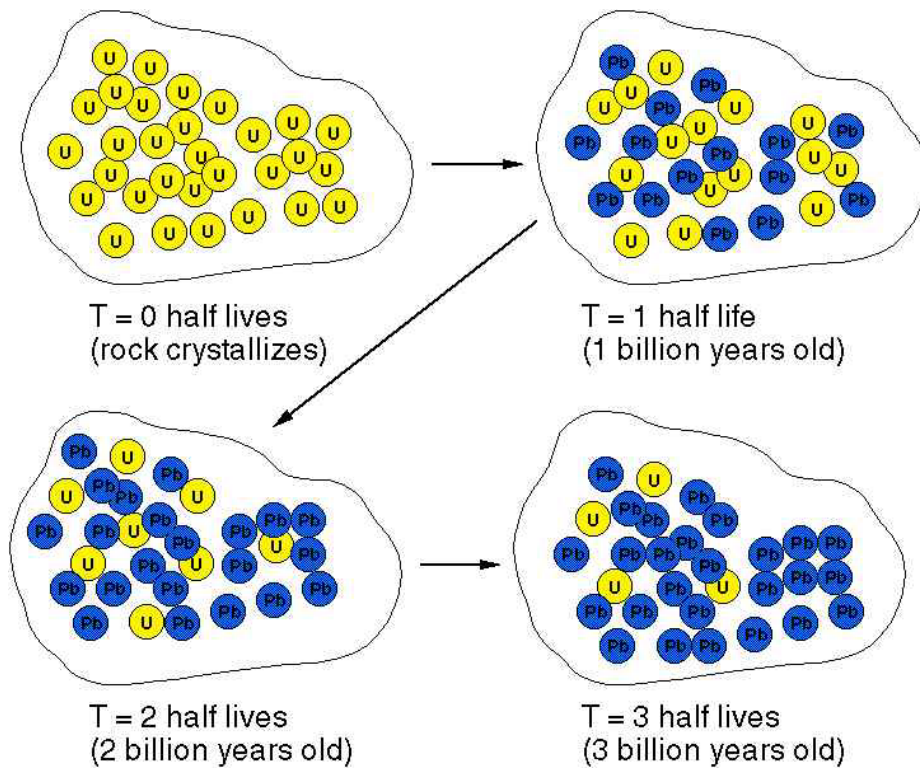
(1) **parent isotope** -- the unstable radioactive isotope

(2) **daughter isotope**-- the stable isotope produced after a radioactive decay

c) **half-life** -- the time it takes one half of the parent material to decay into daughter material

d) types of radiometric dating

Parent Isotope	Daughter Isotope	Half-life	Effective range
Carbon-14	Nitrogen-14	5730 years	less than 70,000 years
Uranium-235	Lead-207	704 million	10 mill - 4.6 bill
Uranium-238	Lead-206	4.5 bill	10 mill - 4.6 bill
Potassium-40	Argon-40	1.25 billion	50,000 - 4.6 bill
Thorium-232	Lead-208	14 bill	up to 200 mill
Rubidium-87	Strontium-87	48.8 bill	10 mill - 4.6 bill



# I EVIDENCE OF THE PAST 6-1

name \_\_\_\_\_ hr \_\_\_\_\_

A **Fossils**- a trace or imprint of living things that are preserved in rock

1] **Relative dating**- any method of determining whether an event or object is older or younger than other events or objects

2] **Absolute dating** — a method of measuring the age of fossils in years

a) **Radiometric dating** — using radioactive elements' 1/2 life to come up with a date range

b) Types – radio carbon, uranium- lead, potassium argon

B **Geologic time scale** — the standard method used to divide earth's long natural history into manageable parts based on significant events (like extinction, appearance of new organism, formation of mountain chains or oceans, ice age, or widespread volcanic eruptions.)

1] **Era** — major time division (4)

a) **Precambrian**

b) **Paleozoic**

c) **Mesozoic**

d) **Cenozoic**

2] **Period**- a division of an era

3] **Epoch**- a division of a period

C The changing Earth

1] **Pangaea** — all continents formed one landmass ("all earth")

2] **Plate tectonics** — large pieces of earth's crust "float" moving the continents around over time

3] Rapid changes- create **extinctions** (species dying out)

4] Slow changes — allow for **adaptations** (animals changing to survive)

# II ERAS OF GEOLOGIC TIME 6-2

A **Precambrian**- 4,600 mya — 543 mya (4.6Bya-543mya)

1] 4600 million years ago Earth forms

2] 3800 million years ago crust hardens

3] 3500 million years ago = first **prokaryotic** (no nucleus) life forms

a) single-celled, **photosynthetic** (make food from the sun), cyanobacteria

b) released O<sub>2</sub> into atmosphere

c) created ozone layer (O<sub>3</sub>) which blocked UV rays

4] 2500 m.y.a

a) first **eukaryotic** (nucleus and other organelles) life forms

b) animal like (ate their food) like an amoeba

5] Ended with explosion of multicellular ocean life (Cambrian explosion)

B **Paleozoic** — ("ancient life") 543 -248 mya

1] Sponges, corals, snails, clams, squid, trilobites, fish, sharks

2] Ferns, club moss, horsetails, and conifers appear on land toward the end of era

3] Wingless insects, salamander-like amphibians during middle, followed by winged insects and reptiles by the end of the era

4] Ends in largest mass extinction in history (90% of all species because of ice age?)

C **Mesozoic** (middle life) 248 -65 mya

1 "Age of reptiles"

2 Dinosaurs dominate for 150 million years

3 Pangaea broke up

4 Dinosaurs, mammals, birds, flowers

5 Ended with mass extinction 65 m.y.a. (asteroid)

D **Cenozoic**- 65mya- present

1 Age of mammals

2 Horse, monkeys, whales, cats, bears, hominids, humans, mammoths, sabertooth

3 Several ice ages (glaciers)

### **III HUMANS AND OTHER PRIMATES 6-3**

A **Primate**- group of mammals that include humans, apes, monkeys, lemurs who have **opposable** thumbs (can grab things) and 3-d binocular vision

1 First primate (45 mya)

2 Chimps and humans separate (30-5 mya)

3 **Hominid** – primate characterized by **bipedalism**- (walk on 2 legs), longer back limbs (legs), and lack of a tail

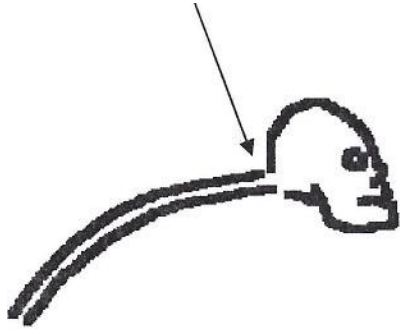
APE SKELETON



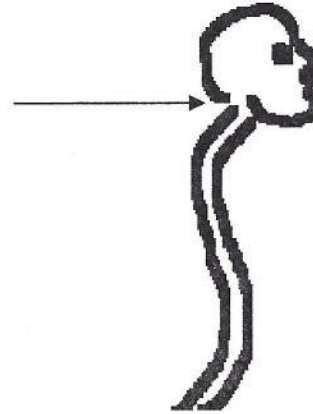
HOMINID SKELETON



C Shaped spine  
Narrow hip bones  
Slanted forehead  
Foramen magnum in back of skull



S shaped spine to act as a shock absorber  
broad hip bones to support organs  
flat, vertical forehead  
Foramen magnum under skull



## B Hominids through time

### 1 Earliest, 6-7 mya in Africa

#### a Australopithecines

- (1) Used stone tools
- (2) Walked on 2 legs (no opposable toe)
- (3) Flatter forehead (larger brain)
- (4) Humanlike jaws and teeth and feet
- (5) "Lucy" 3.2 mya (Australopithecus afarensis)

#### b Global hominids

- (1) Homo habilis — 2 mya
- (2) Homo erectus — 1 mya — 300,000
- (3) Homo Neanderthal — 400,000- 30,000
- (4) Homo Sapien (wise man)
  - (i) Art
  - (ii) Religion
  - (iii) Extensive tools