NAME: _____ Chapt 13 : Geologic History Lesson Packet

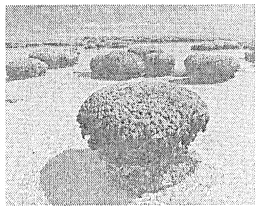
NYS Geology ESRT Pg. 3 (Rock types and ages) and 8-9 (Geologic Record and Time Frame)

Key Concepts

a. **Earth's history** has been constructed using the position of _____ in layers of bedrock.

b. Two methods geologists use to date rocks/fossils and events are **absolute dating** which yields a numerical _____and **Relative dating** which orders strata and tectonic events into _____ vs. _____.

c. **The oldest rock is _____ billion years old.** There are very limited _____ remains from the **Precambrian Eon (90% off** Earth's history) because organisms were **soft-_____.**



d. **On pg. 8-9 of ESRT geologic time is broken down into 4 main time frames:**

1.) **Precambrian Eon** (ancient life): 90% of our record. Only fossils of _____ (pictured right)

ERAS:

2.) **Paleozoic (oldest)**: First fossils w/ _____ parts.
Era of Fishes & Insects....Pangea forms!

3.) **Mesozoic (middle)**: Era of Reptiles and _____, Pangea breaks up!

4.) **Cenozoic (now):** Era of _____, Last advance and retreat of glaciers

*The **end of each era** coincides with a_____ _____!*
End of Mesozoic was the end of the _____ ☹

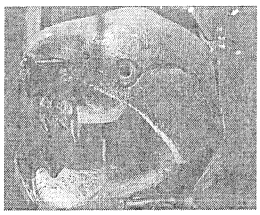
Time is further broken down into periods, and then epochs on page. 8

INDEX FOSSILS- A species from an animal group that existed for a short period of time, geologically speaking

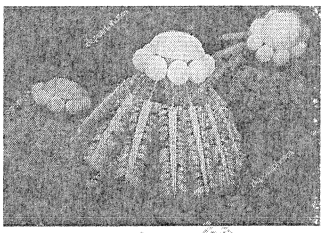
e. The following are some of the animal and plant groups displayed on page 9 of the ESRT: Nautoloids, Trilobites, Ammonoids, Crinoids, Corals, Reptiles, Dinosaurs, Mammals, Eurypterid, Placoderm fish... The position in which these vertical bars extend, depict the approximate time these organisms appear in the rock record, and the time in which they disappear, or go _____. For example, Trilobites appeared in the rock record during the early _____ but went extinct at the end of the _____.

←Eurypterids

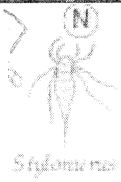
Placoderm Fish→



Graptolites→



f. Marked as _____ **on page 9 ESRT, index fossils** are found in different layers of rocks within NYS geology. The time periods, and estimated ages they existed can be found using the **timeline** on **page 8 of the ESRT.**



g. NYS is missing parts of the rock and sediment record due to _____(mountain building and plateaus) followed by _____**and erosion.** The NYS Rock record column on **pg. 8** displays these time gaps. Example: Rock from the Permian time period is missing!

ESRT pg 3, 8-9 work.

1.) For which time periods is NYS missing parts of the rock record?

For which time periods is NYS missing part of the sediment record?

2.) During which time **periods** did Eurypterids live? _____ to _____

3.) In what **city or cities** in NYS could one find the Eurypterid fossil? (use pg. 3 with pg 8-9)

_____

4.) During which time **ERA** were Trilobites dominant? _____

5.) When did the following **Eras begin and end, numerically**?

a. Paleozoic: _____ - _____
b. Mesozoic :_____ - _____
c. Cenozoic: _____ - _____

6.) During which **period** did dinosaurs first evolve? _____ at the end of which period did they go extinct ?_____

7.) During which **period** did the Atlantic Ocean first form due to the separation of North America and Africa?

8.)What index fossil is this?_____ It belongs to this group of animals:_____
What **Era** did this live? _____ From which Period? _____What major **NYS LANDSCAPE** Region could one find this fossil (hint: use pg. 2 in combination with pg. 3 of ESRT)?

_____

Which 5 cities could one find this fossil?

_____

8.) Which organisms were responsible for first forming the oxygen in the oceans, which later combined with iron to form rusted red iron oxide layers on the ocean floor? _____, When did this occur? _____

9.) During which **Epoch** were the earliest humans on earth? _____, how long ago was this, according to the timeline? _____

10.) List the following in order of oldest→ youngest in terms of their existence on earth: Dinosaurs, Trilobites, Ammonoids, Corals, Mammals

11.) About how many years ago did the first insects appear? _____

12.) How many years ago is the estimated origin of the earth and solar system? _____

13.) At what numerical age did the dinosaurs go extinct? _____

Intro to Relative Dating

Name _____ Date _____ REVIEW EXERCISE 18

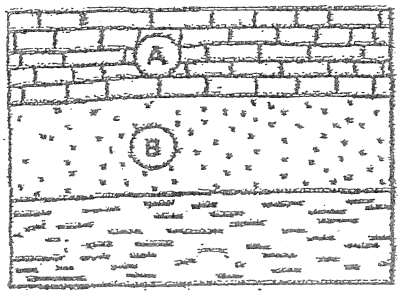
DETERMINING WHICH IS OLDER

In each of the figures below there are two features that are labeled with a letter. Using the principles of geologic dating, determine which lettered feature in each figure is older. Write the letter in the spaces under each figure.

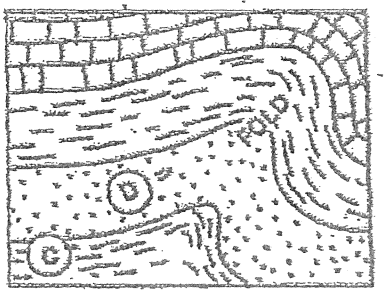
contact = metamorphism due to Igneous Intrusion/Extrusion

* Careful!!

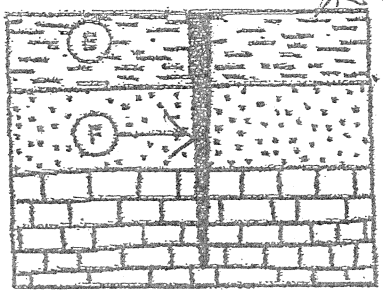
F = a Crack within the the Strata



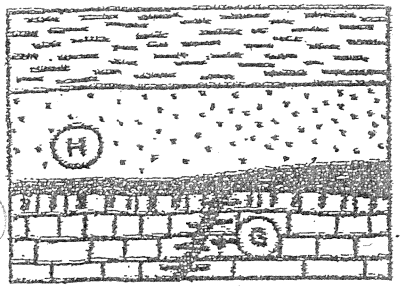
1. _____



2. _____

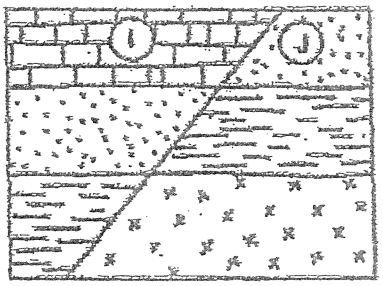


3. _____

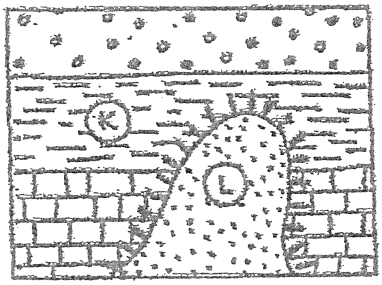


4. _____

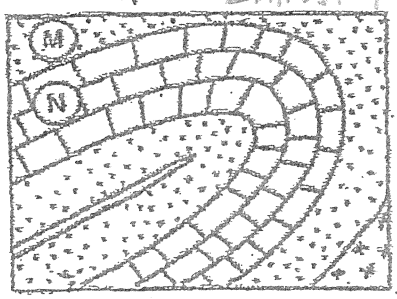
G = IGNEOUS Intrusion



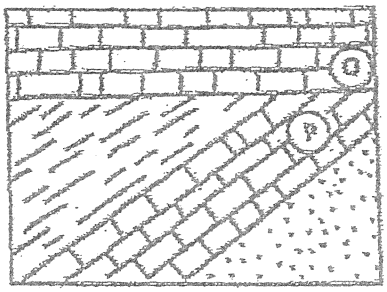
5. _____



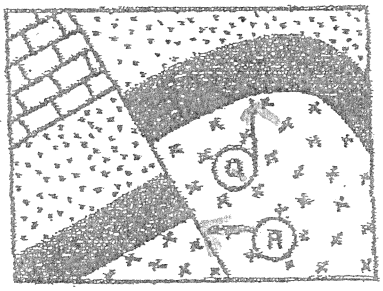
6. _____



7. _____

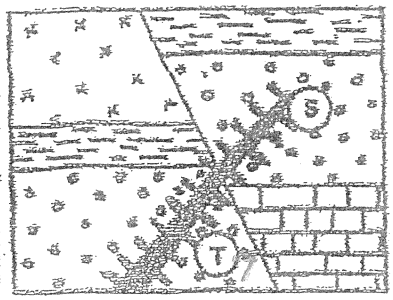


8. _____

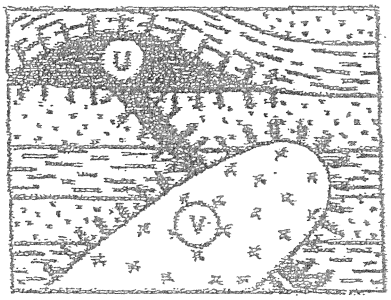


9. _____

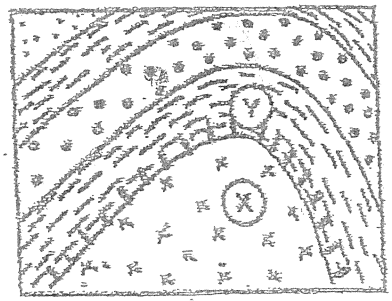
R = Fault
Q = Fold



10. _____



11. _____



12. _____

T = Fault
S = Intrusion

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Relative Dating/Order of Events Key Concepts: *Use pg 6-7 of ESRT to identify rock symbols used on the cross sections*

1.) **Law of Superposition**- Oldest is on the bottom, and youngest layer is on the top.
2.) **Law of Original Horizontality**- Sedimentary rocks are formed in **FLAT LAYERS,** unless they are disturbed tectonically
3.) **Law of inclusions**- inclusions, such as the pebbles in a piece of conglomerate are older than the rock itself
4.) **Law of crosscutting**- anything that cuts across layers of rock is younger than the rocks that it has intruded into.
Ex: Faults and Igneous Intrusions
5.) **Law of folding**- tilts/folds in rocks are younger than the rocks themselves. (You must first make a rock to fold it!)
6.) **Unconformities-** are buried erosional surfaces, or "gaps" in the rock record. This happens when **uplift** of the land followed by **weathering and erosion** takes place, and new rock layers are deposited over long periods of time. You'll often see this represented as a "squiggly line" in a geologic cross section map to denote that this is not a normal flat deposited layer.
7.) If **contact metamorphism occurs due to an igneous intrusion**, a sedimentary rock will turn into its metamorphic counterpart (ex: sandstone→quartzite). *"Tick marks" on cross sections mean **contact metamorphism***

"Geologic Events" in Geologic Cross sections include:

1.) Deposition of rock layer _____
2.) Submergence (when the land sinks underwater so deposition can occur)
3.) Faulting
4.) Folding
5.) Uplift (due to plate tectonics: ie: mountain building/orogeny due to convergent plate boundaries)
6.) Weathering and erosion (This causes an unconformity)
7.) Igneous Intrusion and Contact Metamorphism

Practice 1: Event: (always start with Oldest→Youngest layer or event!)

8_____ (youngest)

7_____

6._____

5._____

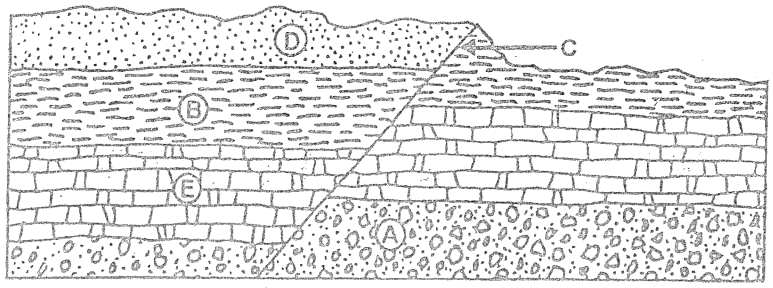
4._____

3._____

2._____

1._____ (youngest)

1.



Practice 2:

11. _____ (youngest)

10. _____

9. _____

8. _____

7._____

6. _____

5. _____

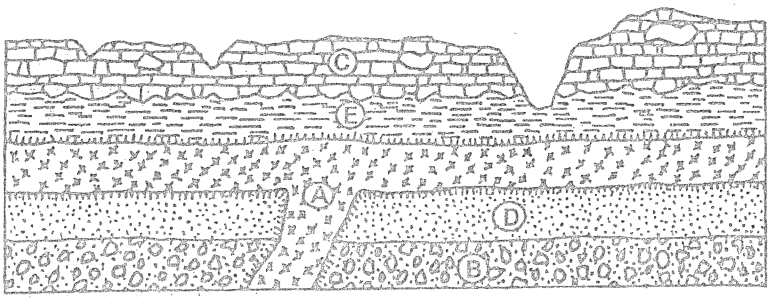
4. _____

3. _____

2. _____

1. _____(oldest)

2.

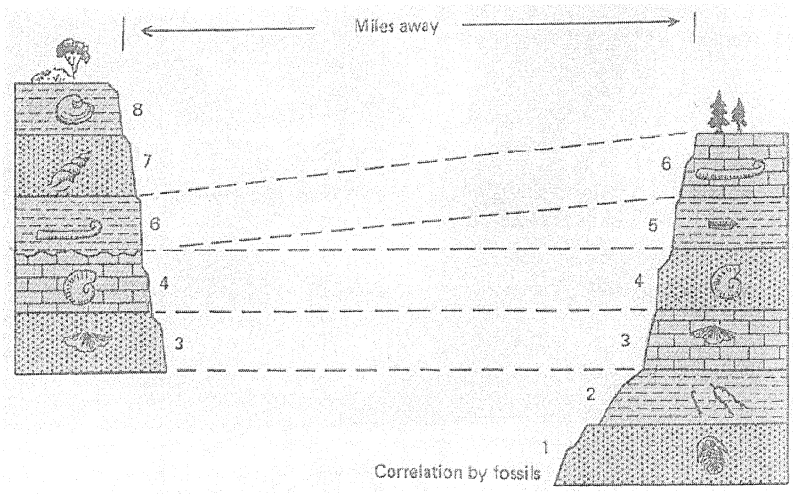


Using the Correlation Method to Date Rock Layers

What is "Correlation?"

- *Correlation is using rocks (or geologic events like faulting) from different regions to show they are relatively the same age (* *relative age is the apparent age such as "from the middle-Devonian , or "this sandstone is older than that layer of shale")*

When can we use correlation to get a relative age of a rock group?



1.) When there are index fossils present (letters pg 8-9 ESRT):

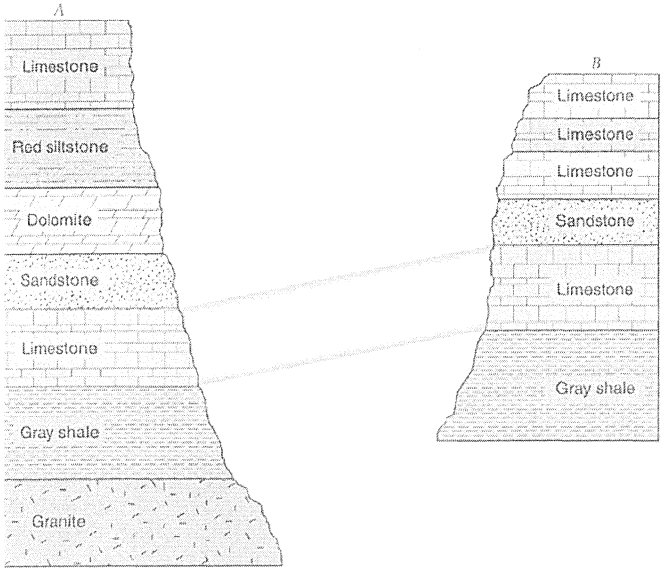
Index Fossils are useful because :

a.

b.

c.

General relationship with fossils and rocks: *The age of a fossil is relatively the age of the rock layer it is embedded in*



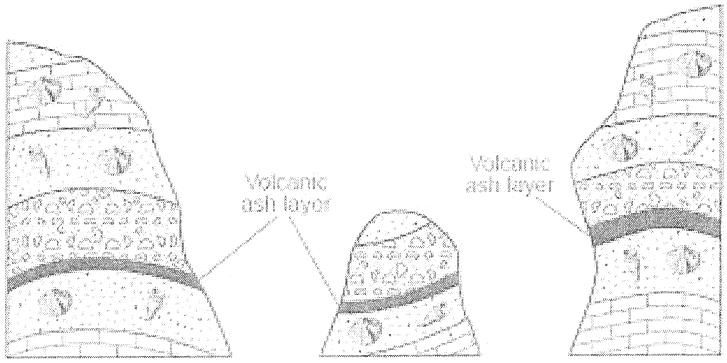
2.)When there are similarities in rock sequences or in exposed bedrock (at cliffs, or other rock outcrops from road blasting):

if rock layers continued across a valley, like similar rock layers found on both sides of the Hudson river, you could match layers by thickness and composition to yield an approximate age that was the same.

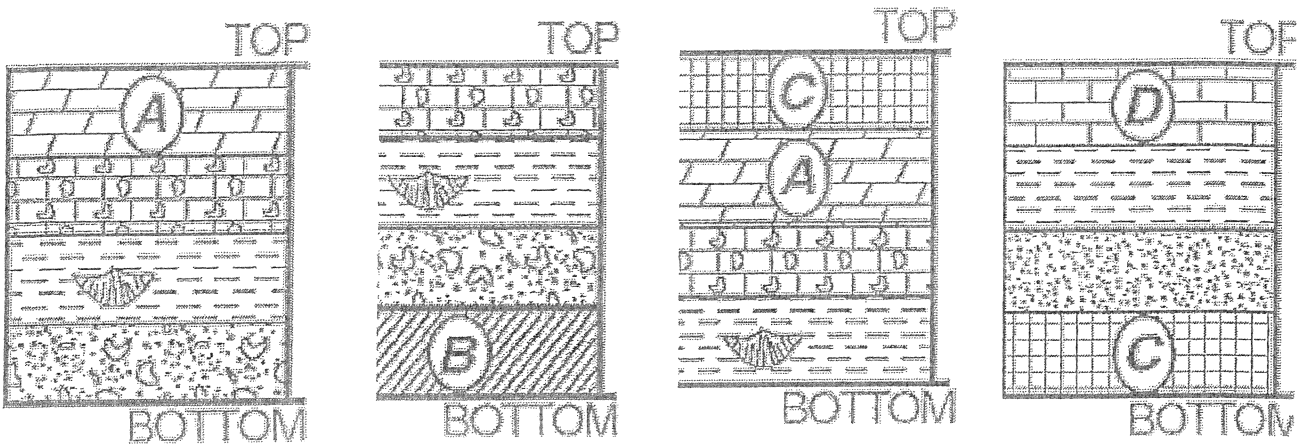
3.) Similarities in the Rocks. This is only useful in small areas where rocks are separated from one another. Similarities include appearance, color, composition, and the ordering of the rock sequence (layers).

***4.)* Volcanic Ash also serves as an important feature because the ash from an eruption will cover a large area in a geologically short amount of time. (Sounds similar to an index fossil right?)**

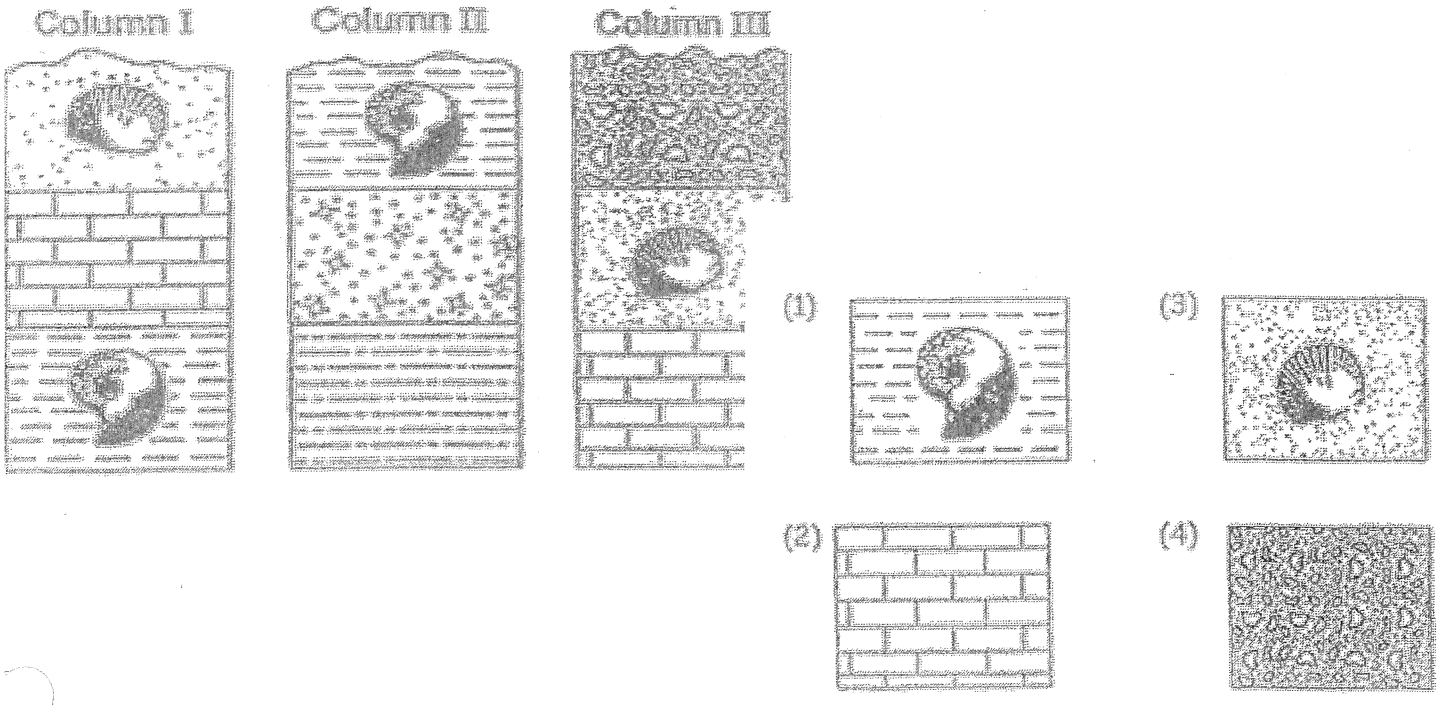
Example: **Dinosaur bones** were scattered all across the globe in the same rock layers in which a thin deposit of **volcanic ash** was found. Using this ash, scientists were able to correlate that the dinosaur bones were from the same time period. Absolute dating methods were later used to yield a date of 65 million years ago! *Thus, today we know the dinosaurs went extinct due to volcanic eruptions that occurred after a large scale meteorite struck earth*!



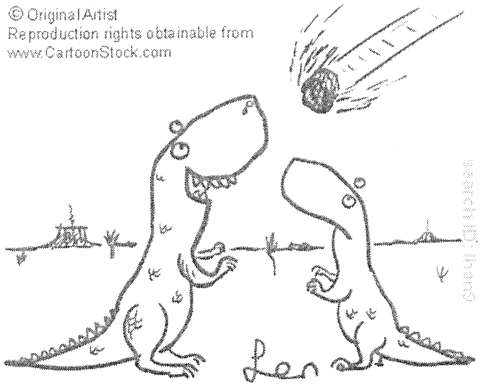
1. Use the index fossils and matching rock layers to determine the oldest layer in all four columns.



2. Rock layers in outcrops located several miles apart. Two different index fossils are shown. What is the youngest layer ?



ABSOLUTE DATING (YIELDS A TIME!) Example: The Dinosaurs went extinct 65 mya! How do we know that!?



"Ooh, look! A shooting star. Make a wish."

Using the RADIOACTIVE DECAY RATE (time) **of elements.** Elements exist in several varieties. These varieties are called Isotopes

For example: Carbon-12 (most common) and Carbon-14

Radioactive dating is using the known **half-life** of an isotope and comparing it to the amount between the **parent (radioactive Isotope)** to the **daughter isotopes (disintegration product)** to find the absolute age

PG. 1 ESRT Has all radioactive **decay rates** in **HALF LIVES**

***Half Life Definition**: The time required for half of the atoms in a given isotope to decay Example: Carbon 14's half life is 5.7x10³ years (5,700 years).*

Key Understanding: Look at page 1 ESRT for Radioactive Decay. Carbon 14 will decay into Nitrogen 14. HALF, or 50% of the carbon 14 will decay into Nitrogen 14 after ONE half life (5,700 years). Similarly if we used Uranium 238, it will decay into Lead 206. After one half life (4.5 billion years), the sample will have 50% Uranium and 50% lead 206.

Decay Rates/Half Live's:

- **Are NOT changed by:** T, P, mass or quantity of the sample
- **have been the same throughout all of Earth's History** (never changes/always same length of time) Which is why it is reliable

Radioactive Decay Data

RADIOACTIVE ISOTOPE	DISINTEGRATION	HALF-LIFE (years)
Carbon-14	$^{14}C \rightarrow {}^{14}N$	5.7×10^3
Potassium-40	$^{40}K \rightarrow {}^{40}Ar$, $^{40}K \rightarrow {}^{40}Ca$	1.3×10^9
Uranium-238	$^{238}U \rightarrow {}^{206}Pb$	4.5×10^9
Rubidium-87	$^{87}Rb \rightarrow {}^{87}Sr$	4.9×10^{10}

Problems:

1.) **A fern fossil that originally contained 50 (g) of C-14 now only contains 12.5(g) of C-14.** ***Approximately how many years ago was this fern part of the living environment?***

- Step 1: What is the half life of C-14? 5,700 years
- Step 2: Make a chart of Mass remaining Vs. Time from start to finish

Mass remaining C14(g)	Time/Age
50 g	0 years
25 g	5,700 years
12.5 g	? years

2.) **An igneous rock contains 7.5 (g) of K-40 and 52.5 grams of Ar-40 How old is the rock?**

Step 1: half life of K-40? _____

Step 2: How much K-40 (parent isotope) was originally in the rock? If you have 7.5 g of K-40 and 52.5 of Ar-40 ***they must add up to the original amount of the parent= 60 g***

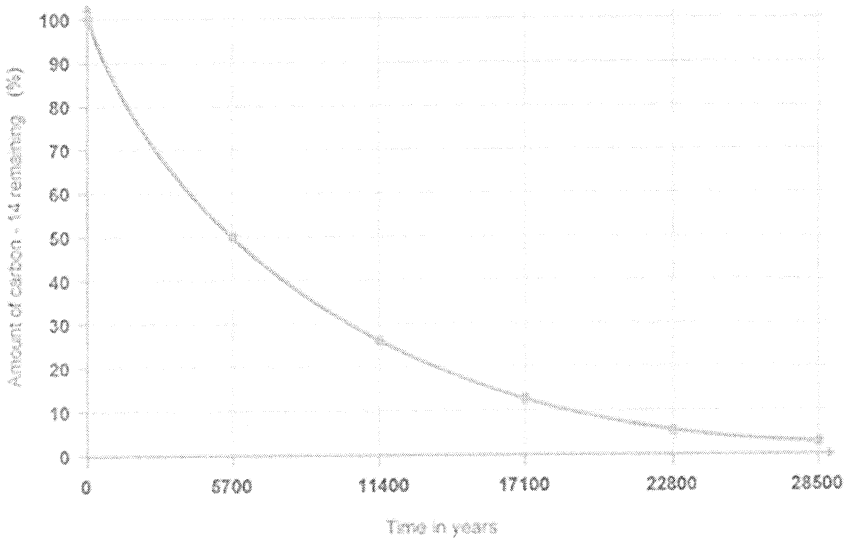
- *Mass Remaining K-40* *Time*

60	0
30	1.3 billion
15	2.6 billion
7.5	?

Radio Active Decay Graphically and with Visuals

1.) To identify the half-life graphically, always find where **50% of the remaining isotope intercepts the graph.** Mark in on the diagram to the right.

How can you identify the half life of C-14 using a graph?



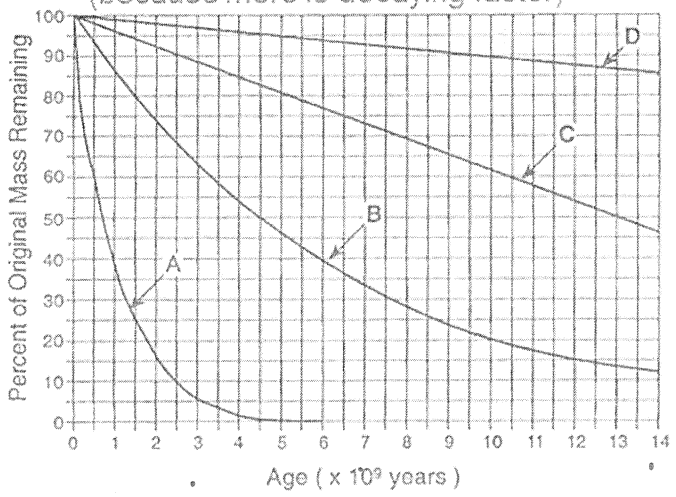
a. After TWO half lives, how much of the original C14 is left? _____ Mark this on the graph and label 2 half-lives.

b. How many years have elapsed by the time 3 half-lives have gone by? _____Mark this on your graph.

c. What is C-14's decay product? _____What would this graph line look like with ongoing time? Pencil it in to show what it would look like.

The steeper the curve, the shorter the half life

(because more is decaying faster)



2.) Can you identify which one of these isotopes represents the decay rate of Uranium 238?

Steps:

Find the 50% (half remaining line)
Which isotope has the same half-life of _____ years as Uranium 238?

Answer: _____

Prepare a visual representation to show the decay rate of Uranium 238 with 4 half-lives'. Include the percentages of each of the parent and daughter isotopes. Uranium238 will be shaded black/blue, and Lead206 white.