NAME: _____ **Chapt 13 : Geologic History Lesson Packet**

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

a. **Earth's history** has been constructed using the position of **FOSSILS** in layers of bedrock. Absolute (yields age) and Relative dating (no age but oldest vs. youngest) methods are used.
b. **The oldest rock is 4.2 billion years (absolute dating).** There were **no fossils** present during the **Precambrian (90%)** of Earth's history because organisms were **soft bodied.**
c. **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 but NO FOSSILS

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

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

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

*The **end of each era** coincides with a **MASS EXTINCTION**. (Ex: Dinosaurs extinct 65mya due to Asteroid)*

d. **Index fossils** marked with **letters on page 9 ESRT** are present in different layers of rocks in NYS. The time **periods** they existed can be found using the **period column** on **page 8.**
e. **NYS** is **missing parts of our rock record** due to **uplift (**mountain building and plateaus) followed by **weathering and erosion.** See **NY Rock record** column on **pg. 8**. Example: Permian time period is missing!

1.) What are **THREE time periods** where we are lacking a **rock record** in NYS?

2.) During what time **periods** did the Eurypterid live? _____

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

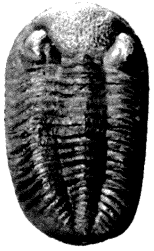
_____

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

5.) When did the following **Eras begin and end**? What organisms became extinct after the first two?
   a. Paleozoic: _____ - _____ Extinction of :
   b. Mesozoic :_____ - _____ Extinction of:
   c. Cenozoic: _____ - _____ Extinction of ? _____ ☹!

6.) During which **period** were dinosaurs first existent on earth? _____

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? _____
Which 5 cities could one find this fossil?
_____

9.) What was responsible for first forming oxygen in the oceans? _____

10.) During which **Epoch** were the earliest humans on earth? _____

11.) List the following in order of oldest→ youngest: Dinosaurs, Trilobites, Ammonoids, Corals, Mammals

Name: _____ Date: _____ Period: _____

The Geologic History of New York State

Refer to pages 8 and 9 of you reference tables to answer the following questions.

1. What are the three eras of the Phanerozoic Eon?
    1. _____
    2. _____
    3. _____

2. During which Epoch did humans first appear? About how many years ago was this?
    1. _____
    2. _____

3. What are the three periods of the Mesozoic Era?
    1. _____
    2. _____
    3. _____

4. During which three periods did dinosaurs live?
    1. _____
    2. _____
    3. _____

5. What two important geologic events took place during the Triassic Period?
    1. _____
    2. _____

6. About how many years ago did the first insects appear?
    1. _____

7. About how many years ago is the estimated origin of the Earth and Solar System?
    1. _____

8. How old are the oldest known rocks? From which Eon are they thought to be from?
    1. _____
    2. _____

9. During which period was the Acadian Orogeny?
    1. _____

10. How many years ago did the dinosaurs go extinct?
    1. _____

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. Sedimentary rocks are deposited in **flat layers**
2.) **Law of inclusions**- inclusions, such as the pebbles in a piece of conglomerate are older than the rock itself
3.) **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
4.) **Law of folding**- tilts/folds in rocks are younger than the rocks themselves. (You must first make a rock to fold it!)
5.) **Unconformities-** are "gaps" in the rock record. This happens when **uplift** of the land followed by **weathering and erosion** takes place. You'll often see this represented as a squiggly line in a geologic cross section map because all sedimentary rock is deposited in flat layers.
6.) 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***

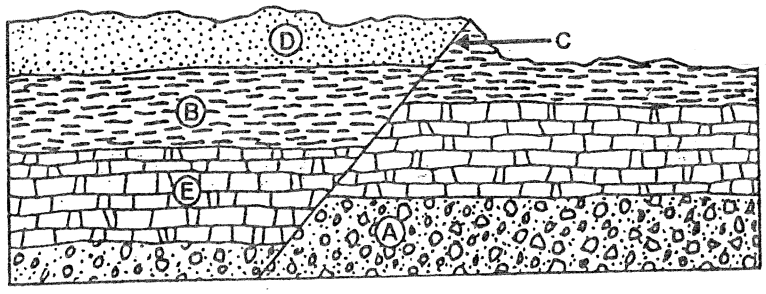
"Geologic Events" in Geologic Cross sections include:

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!)

1. _____ (oldest)
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____ (youngest)

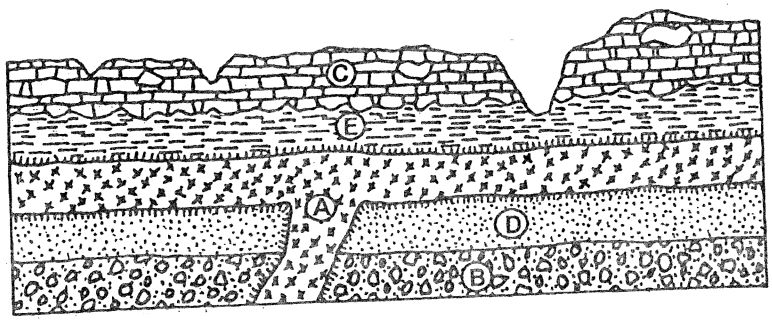
1.



Practice 2:

1. _____ (oldest)
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____ (youngest)

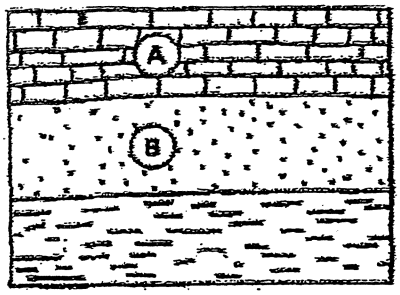
2.



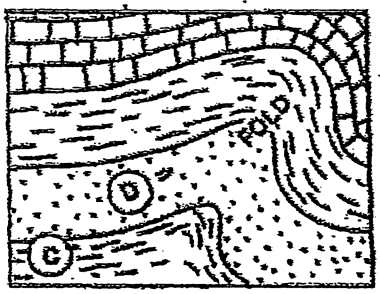
Name _____ Date _____ **REVIEW EXERCISE 18**

DETERMINING WHICH IS OLDER

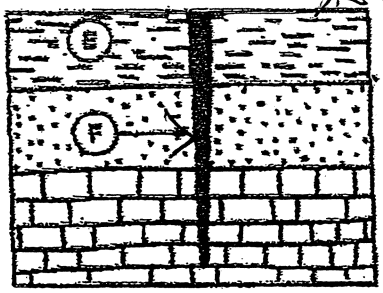
In each of the figures below there are two features that are labeled with a letter. Using the principles of geologic dating, determine which lettered feature in each figure is older. Write the letter in the spaces under each figure.



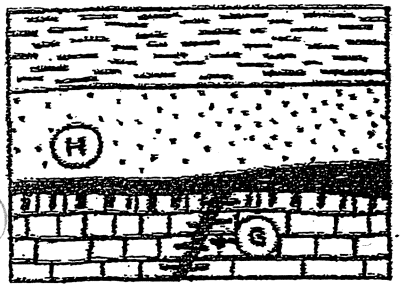
1. _____



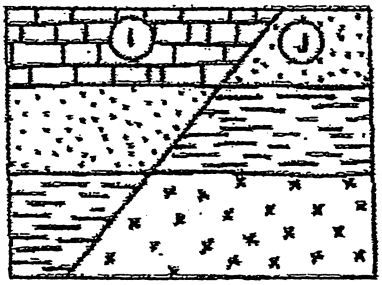
2. _____



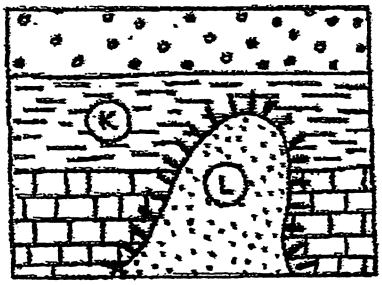
3. _____



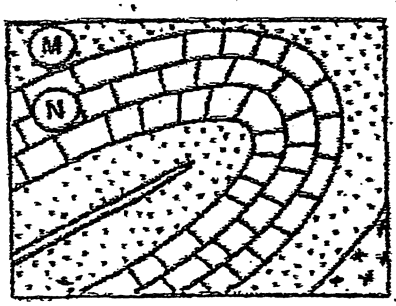
4. _____



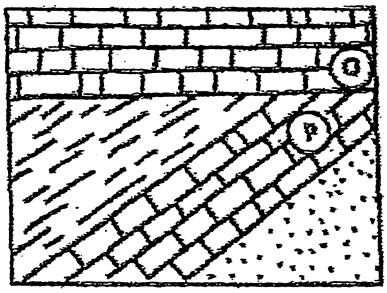
5. _____



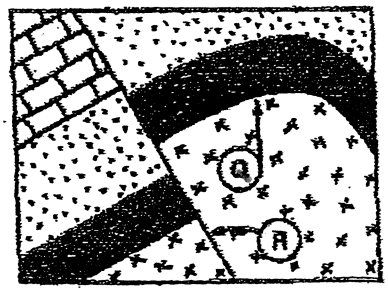
6. _____



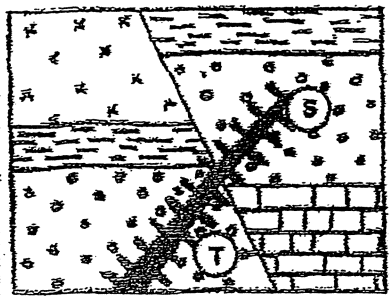
7. _____



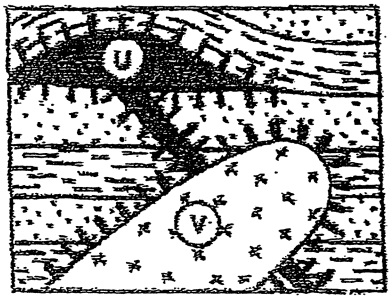
8. _____



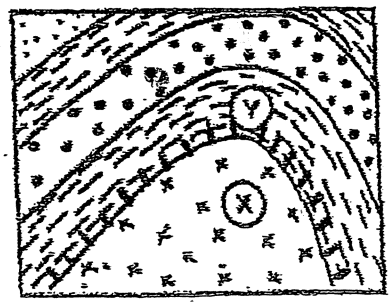
9. _____



10. _____



11. _____



12. _____

Using the Correlation Method to Date Rock Layers

What is "<u>Correlation?</u>"

- *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")

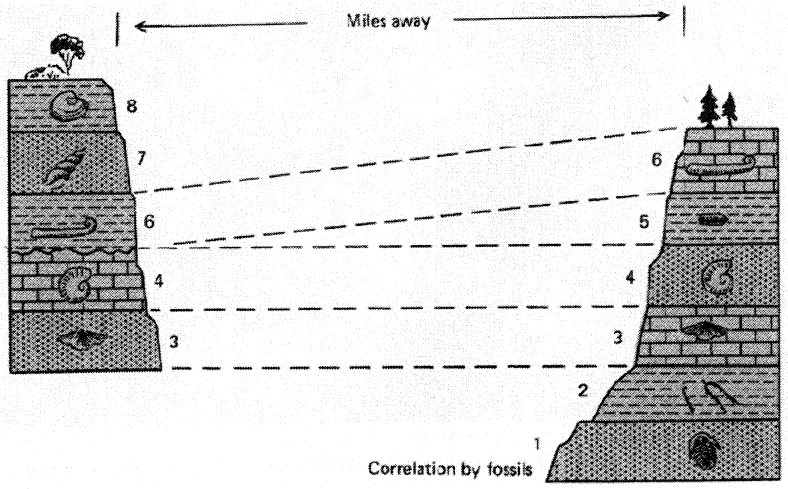
When can we use correlation to get a relative age of a rock group?

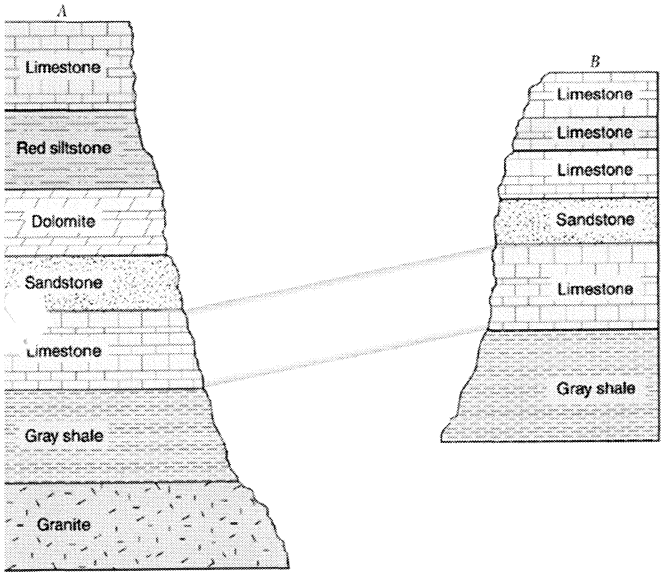
1.) When there are <u>index fossils</u> present (letters pg 8-9 ESRT):

Index Fossils are:

a. Lived for a short period of time
b. Wide Spread Geographically
c. Easily Recognizable

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





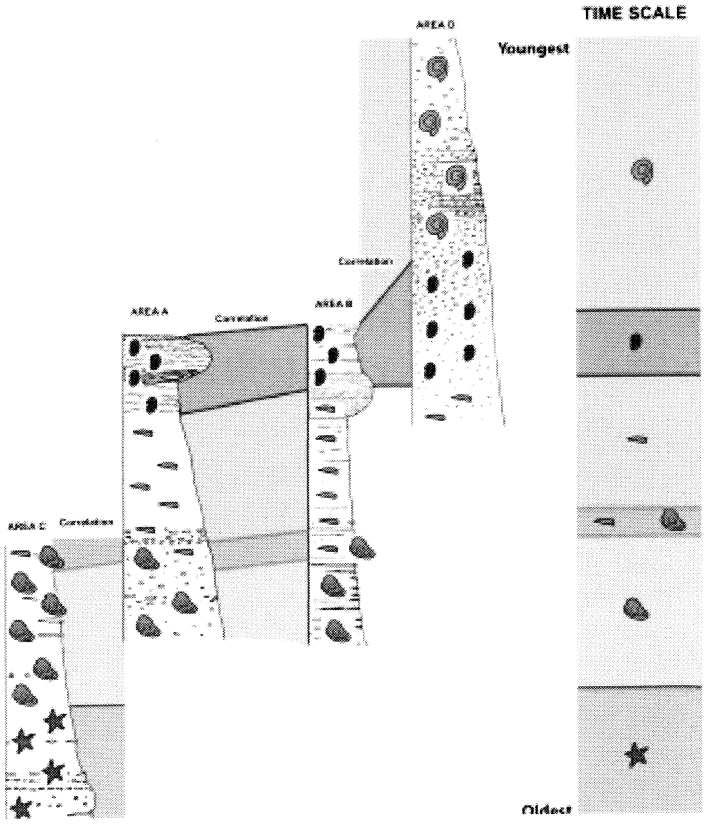
2.) When there are similarities in rock sequences or in exposed bedrock continuity of layers: <u>*features and type*</u> of rock

a. if rock layers continued across a valley (ex: similar rock layers found on both sides of the Hudson river).

b. Looking at the picture to the left, both rock sequences are *similar in order*, but are from two different locations. Perhaps the limestone pictured is the same relative age.

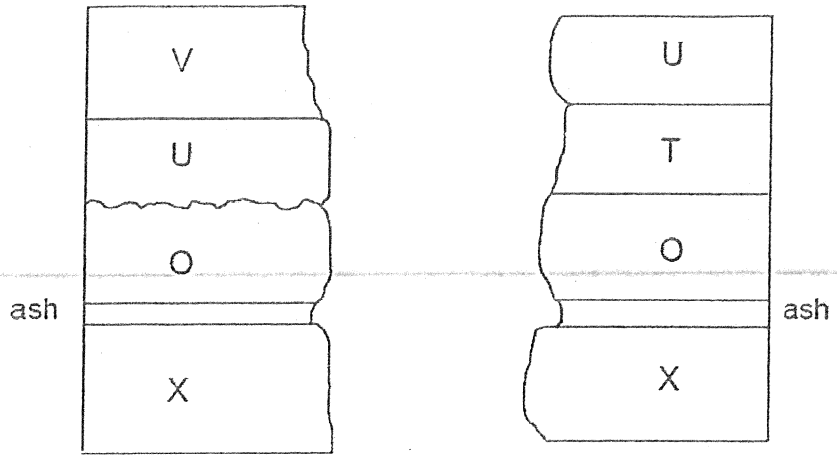
***3.)* Volcanic Ash also serves as an important feature because the ash from an eruption will cover a large area in a geologically short amount of time. (Sounds similar to an index fossil right?)**

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*!



Name _____ Period _____

ROCK CORRELATION PRACTICE



Youngest _____

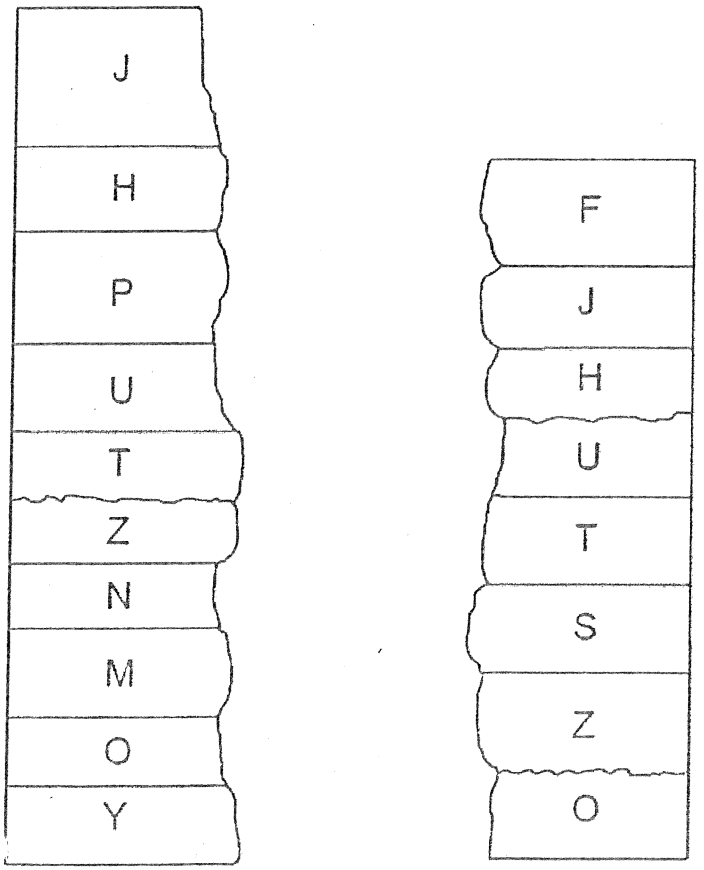
_____

_____

_____

_____

Oldest _____



Youngest _____

_____

_____

_____

_____

_____

_____

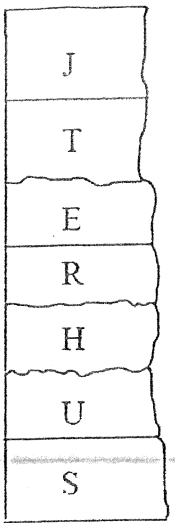
_____

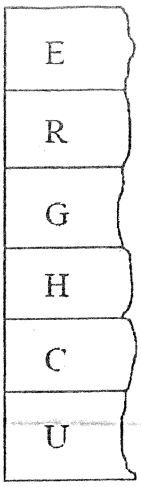
_____

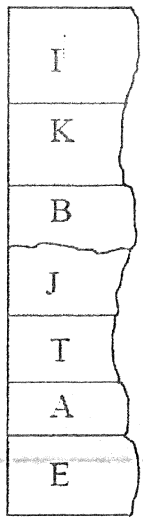
_____

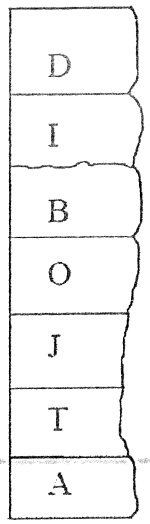
_____

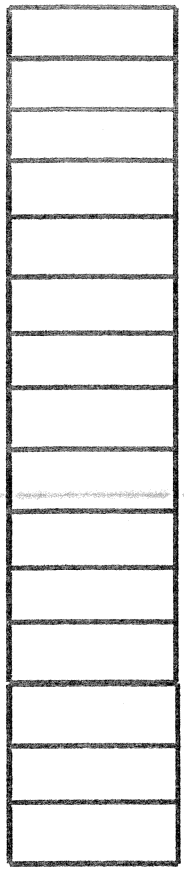
Oldest _____

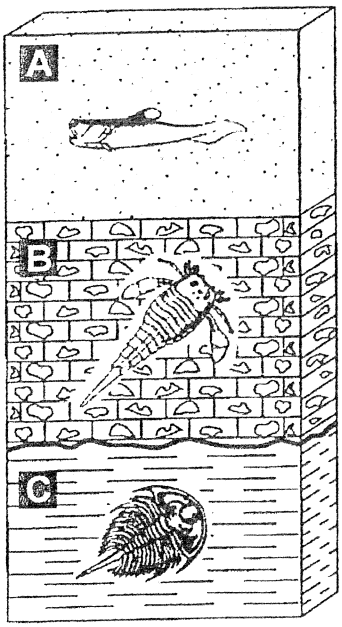


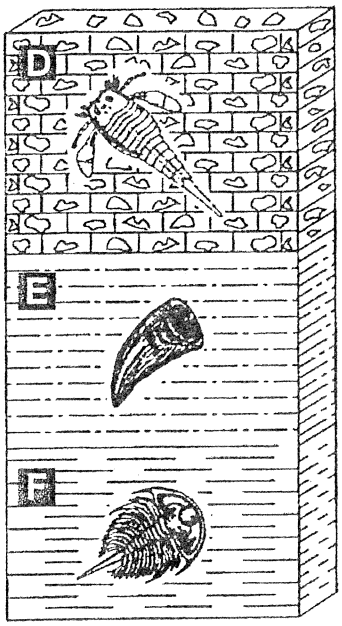


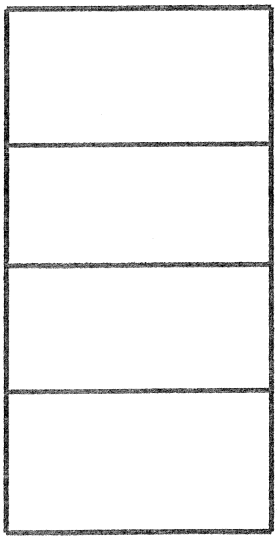






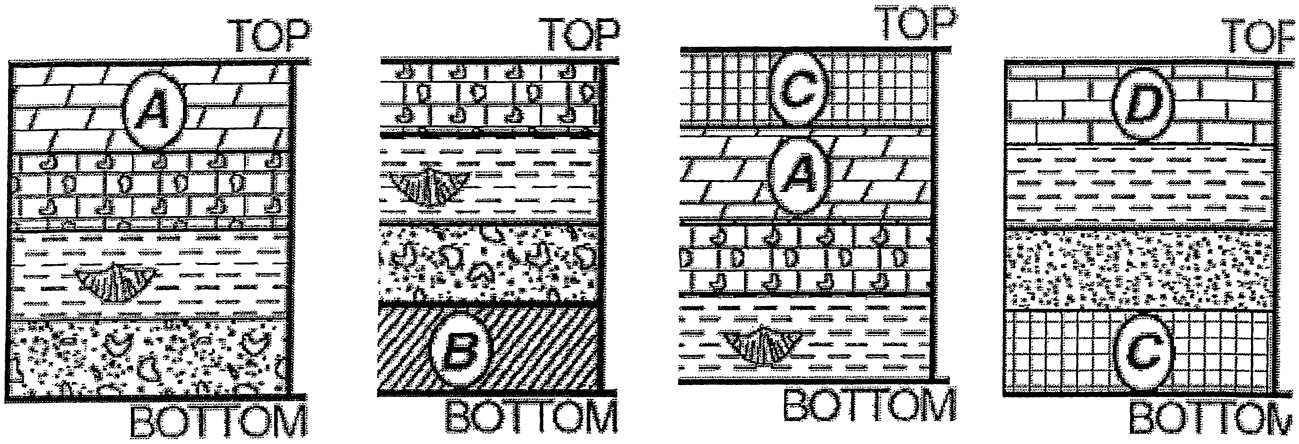




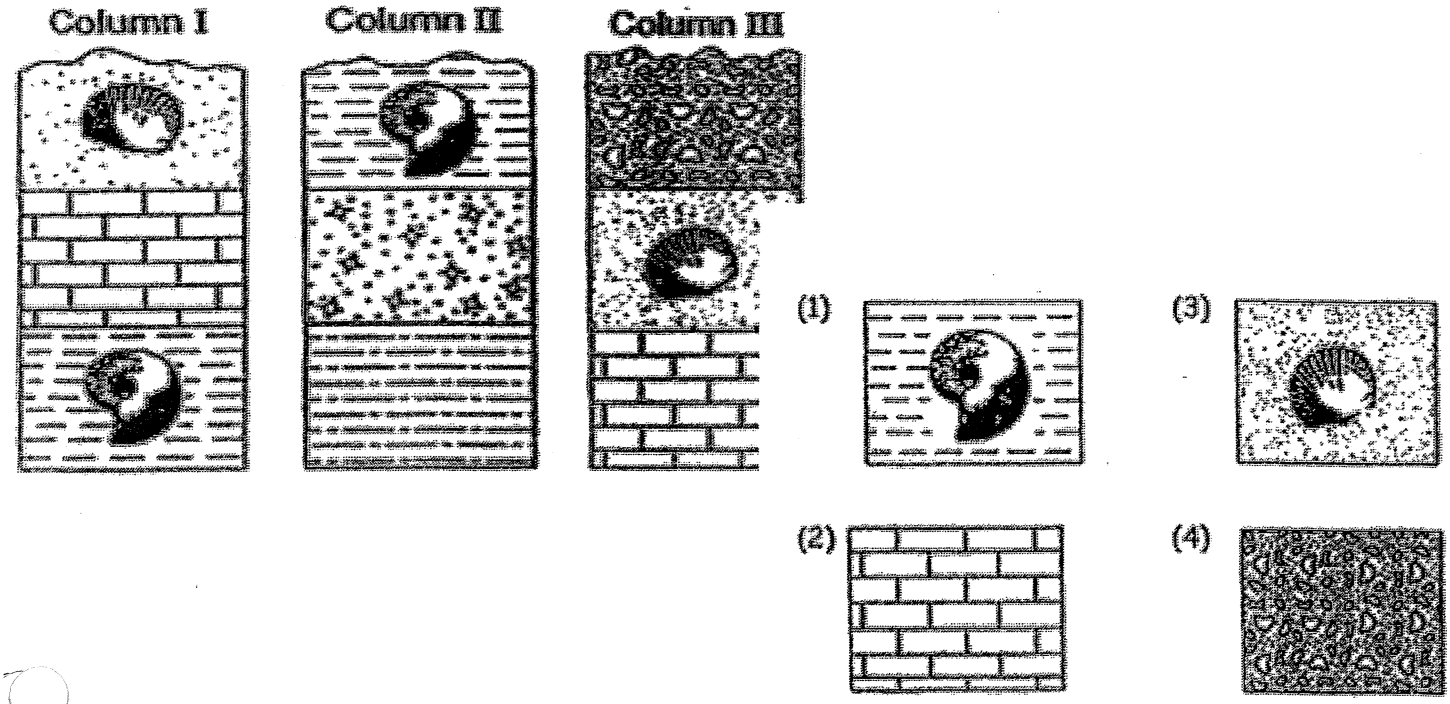


Sketch the layer

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!?

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.

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}

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

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? _____

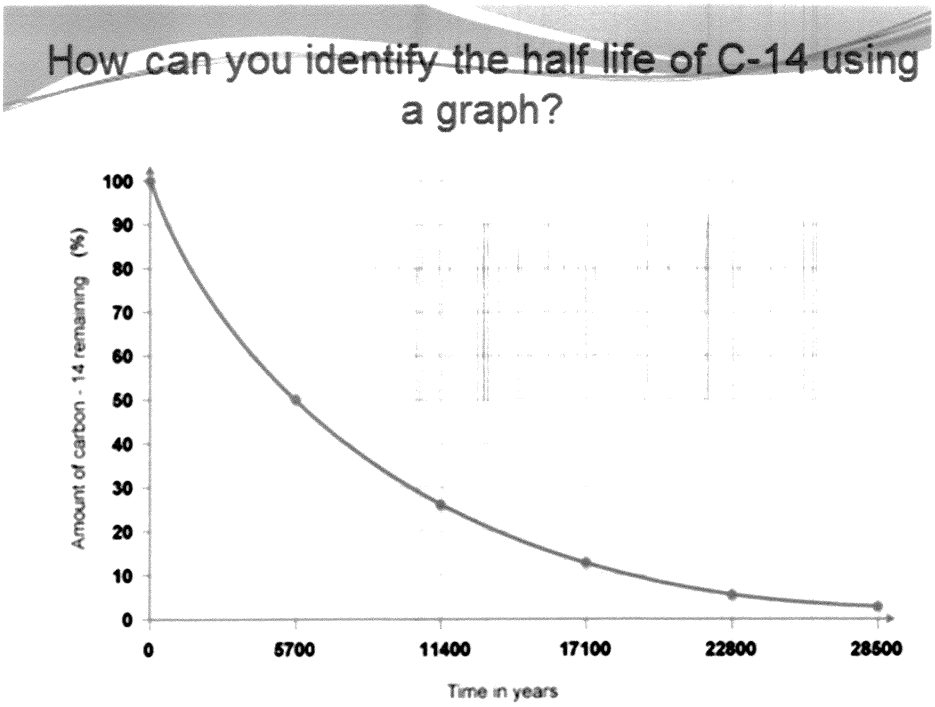
Step 2: How much K-40 (parent isotope) was originally in the rock? If you have 7.5 g of K-40 and 52.5 of Ar-40 ***they must add up to the original amount of the parent= 60 g***

- ***Mass Remaining K-40*** ***Time***

60	0
30	1.3 billion
15	2.6 billion
7.5	?

Radio Active Decay Graphically and with Visuals

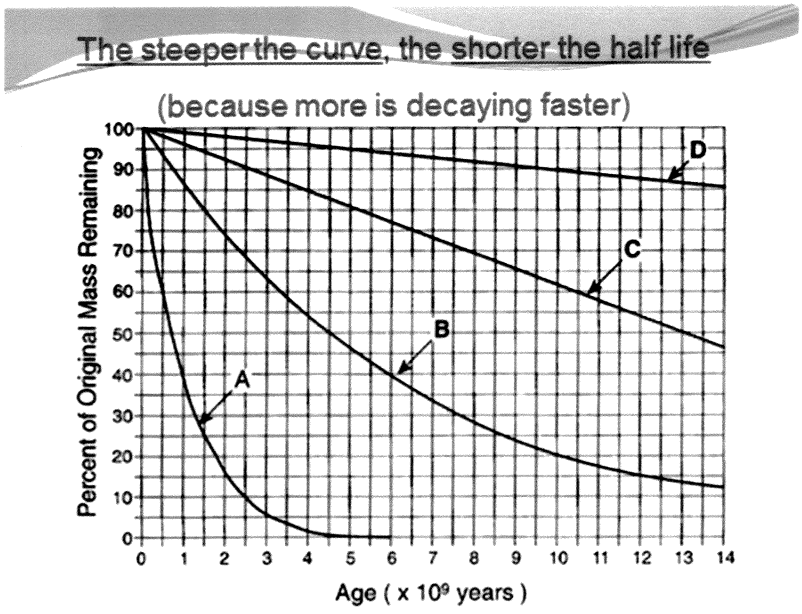
1.) To identify the half-life graphically, always find where **50% of the remaining isotope intercepts the graph.** Mark in on the diagram to the right.



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.



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.