

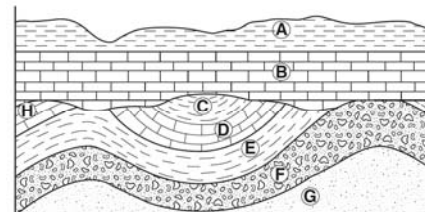
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# GEOLOGIC HISTORY NOTES

Log onto YouTube and search for [jocrisci channel](#).

## GEOLOGIC HISTORY DIAGRAMS (Video 6.1)

1. Given a geologic cross section, you must be able to recognize folding, faulting, intrusions, unconformities, and tilting
2. What two characteristics make a fossil an index fossil?
3. What is the principle of superposition?
4. Given a geologic cross section, you must be able to use relative dating to construct an age sequence (oldest to youngest)
5. What is an unconformity and what does it represent?



## RADIOMETRIC DATING (Video 6.2 ESRT 1d)

1. Given the proportions of the original isotope and the decay product, you must be able to calculate the age of the rock
  - a. A sample of wood that originally contained 100 grams of carbon-14 now only contains 25 grams of carbon-14. Approximately how many years ago was this sample part of a living tree?
2. Carbon 14 cannot be used to date an igneous rock from the Mesozoic Era. Give two (2) reasons explaining why.

## GEOLOGIC TIME SCALE/GEOLOGIC MAPS (Video 6.3 ESRT 2, 3b, 8a, 8b, 8c)

1. The geologic time scale is a record of the major events in the history of the earth. By studying fossils, we have learned that life on this planet has undergone two major changes.
  - a. What are the two eons on the Geologic Time Scale?
  - b. How many millions of years ago did the Paleozoic Era begin?
  - c. During what period did the following first appear on Earth:
    - i. Earliest fish
    - ii. Eurypterids
  - d. During what period did the Acadian Orogeny occur?
  - e. During what period was the Palisades Sill intruded?
  - f. For what periods is the rock record completely preserved in New York State?
  - g. During which Epoch did the advance and retreat of the last continental ice occur?
2. Given a location in New York State, you must be able to determine its age in years, the eon, era, period, and epoch it belongs to, the rock type, and the fossil content
  - a. During which period were the rocks at each of the following cities formed?
    - i. Albany
    - ii. Binghamton
  - b. What kinds of rocks can be found at the following cities?
    - i. Niagara Falls
    - ii. Elmira

# Geologic History Facts

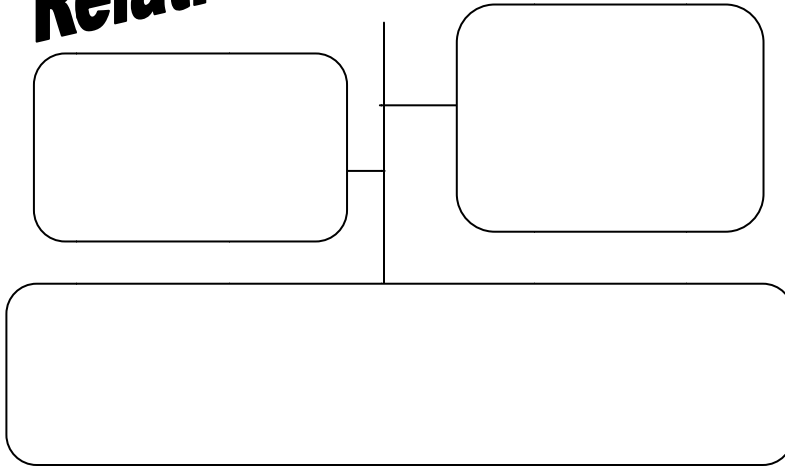
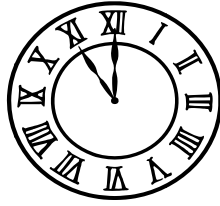
- Video 6.1**
1. In undisturbed strata, the bottom layer is / older (law of superposition)
  2. Sedimentary rocks are ALWAYS deposited in / horizontal layers and underwater (original horizontality)
  3. Any fault, fold, intrusion, that disrupts another layer is / always younger than the rock layer
  4. Contact metamorphism occurs when / molten rock partially melts the rock around it
  5. If an intrusion has no contact meta. (bald) on top it is / older and was an extrusion
  6. If an intrusion has contact meta. (hairs) on top it is / younger than the rock layer above it
  7. An unconformity was caused by / erosion and weathering (seen as the line that separates crazy layers from straight layers)
  8. Unconformities represent a / gap in the geologic record
  9. Volcanic ash good time marker because / it spreads out quickly over a large area
  10. Index fossils are / found over a wide area **and** existed for a short period of time (found only in one geologic layer on a diagram)
- Video 6.2 ESRT 1d**
11. Radioactive (absolute) dating / compares percentage of unstable atoms to stable atoms to get age of rock
  12. Half life means / the **time** it takes for  $\frac{1}{2}$  the unstable atoms to decay into stable atoms (think hour glass, sand grains)
  13. The half life of a radioactive isotope cannot / be changed No Matter What! Radioactive elements decay forever!
  14. When calculating half using a T or T.O.M. chart remember to / add half life on the time (left) side and divide ( $\div$ ) by 2 on the mass (right) side.
  15. Carbon 14 is used to date / RECENT organic remains (thousands of years ago)
  16. Uranium 238 is used date / old rocks (billions of years ago)
- Videos ESRT 8 a - 8c**
17. Earth is / 4.6 billion years old (that is about when the sun and solar system formed)
  18. Precambrian time period is / 4 billion years long (most of earth's time, only simplest life forms existed)
  19. The geologic timescale is based on / fossil evidence
  20. Most life forms (99%) from the geologic past have / become extinct
  21. The atmosphere formed from / outgassing of volcanoes ( $\text{CO}_2$ ,  $\text{N}_2$ ,  $\text{H}_2\text{O}$ )
  22. Asteroid impacts are thought to cause / mass extinctions (dinosaurs died 65 mya)
- Vid 6.3 ESRT 2 & 3b**
23. Landscapes are determined by the / climate, bedrock, and geologic structures
  24. Plateaus are classified by / high elevations and horizontal bedrock
  25. Humid (wet) landscapes have / smooth, rounded slopes (think around here)
  26. Arid (dry) landscapes have / steep slopes with sharp angles (think Grand Canyon)

# Geologic History

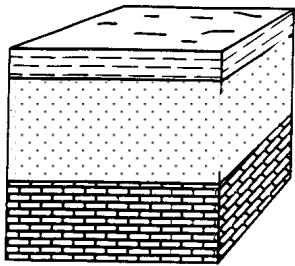
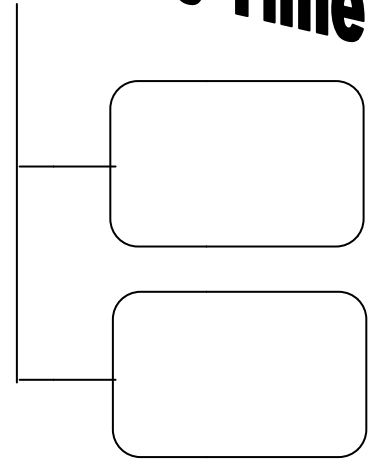
Fact(s) to memorize: 1 - 4



## Relative Time



## Absolute Time



Law of Superposition:

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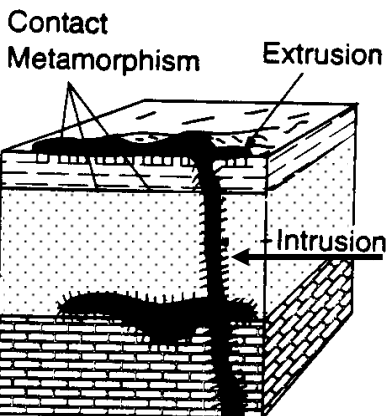
Original Horizontality:

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Uniformitarianism:

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Cross Cutting:

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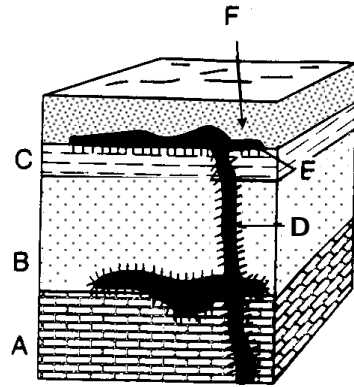
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Sequence of events:

- A) \_\_\_\_\_
- B) \_\_\_\_\_
- C) \_\_\_\_\_
- D) \_\_\_\_\_
- E) \_\_\_\_\_
- F) \_\_\_\_\_



### ROCK CORRELATION

Intrusion \_\_\_\_\_

Extrusion \_\_\_\_\_

Folds, faults, tilting \_\_\_\_\_  
\_\_\_\_\_

Unconformity \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Volcanic Ash Falls \_\_\_\_\_  
\_\_\_\_\_

Overtuned \_\_\_\_\_  
\_\_\_\_\_

Index Fossil \_\_\_\_\_

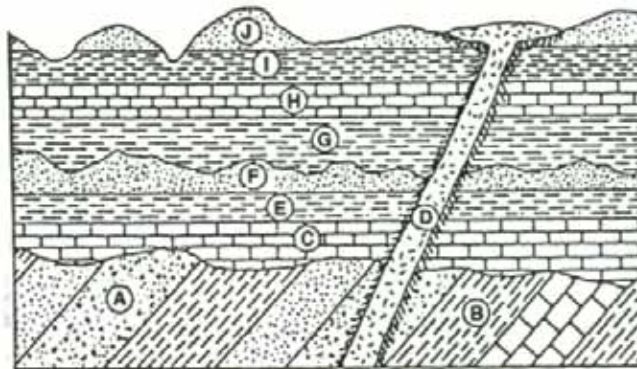
2 things that  
make a good  
index fossil { \_\_\_\_\_  
\_\_\_\_\_



Sequence of Events Practice

Circle the oldest rock layer in the table below, based on the diagram.

H	G	E	C
A	B	J	F
E	D	D	H
D	J	A	D
I	C	I	J
B	C	B	I
A	F	E	F

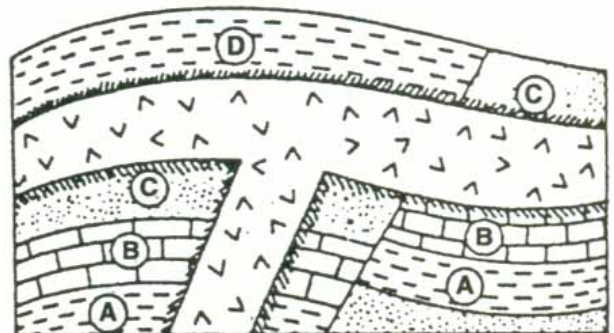


Key

- Sedimentary Rock
- Igneous Rock
- Contact Metamorphism

True or False: (T) or (F) Answer the following based on the diagram to the right

Rock layer C is older than rock Layer D	
The intrusion is older than rock layer A and older than the fault	
Rock layer B is limestone	
The intrusion is older than rock layer C and younger than the fault	
Folding of rock layers occurred prior to the igneous intrusion	
The intrusion is younger than rock layer D and younger than the fault	
The intrusion is older than rock layer B and older than the fault	
The igneous intrusion is the youngest rock layer shown	



Key

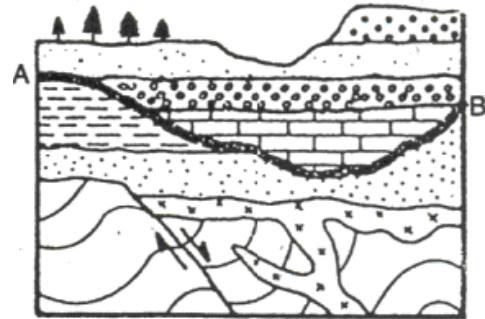
- Igneous Intrusion
- Sedimentary Rocks
- Contact Metamorphism

1. What process most directly caused the formation of the feature shown by line AB in the geologic cross section in the diagram to the right?

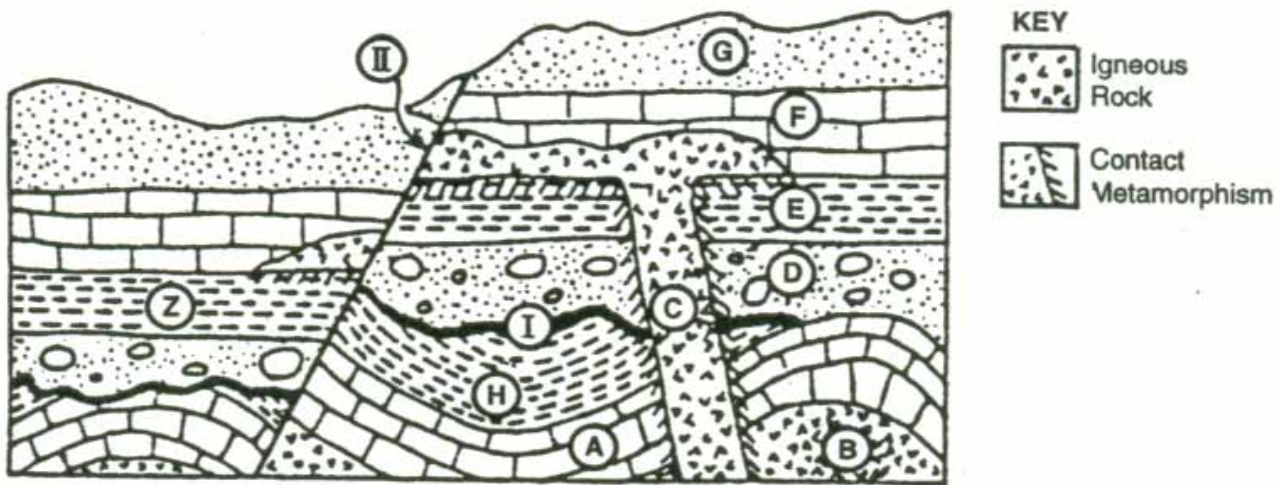
\_\_\_\_\_

2. What is the name given to this formation?

\_\_\_\_\_



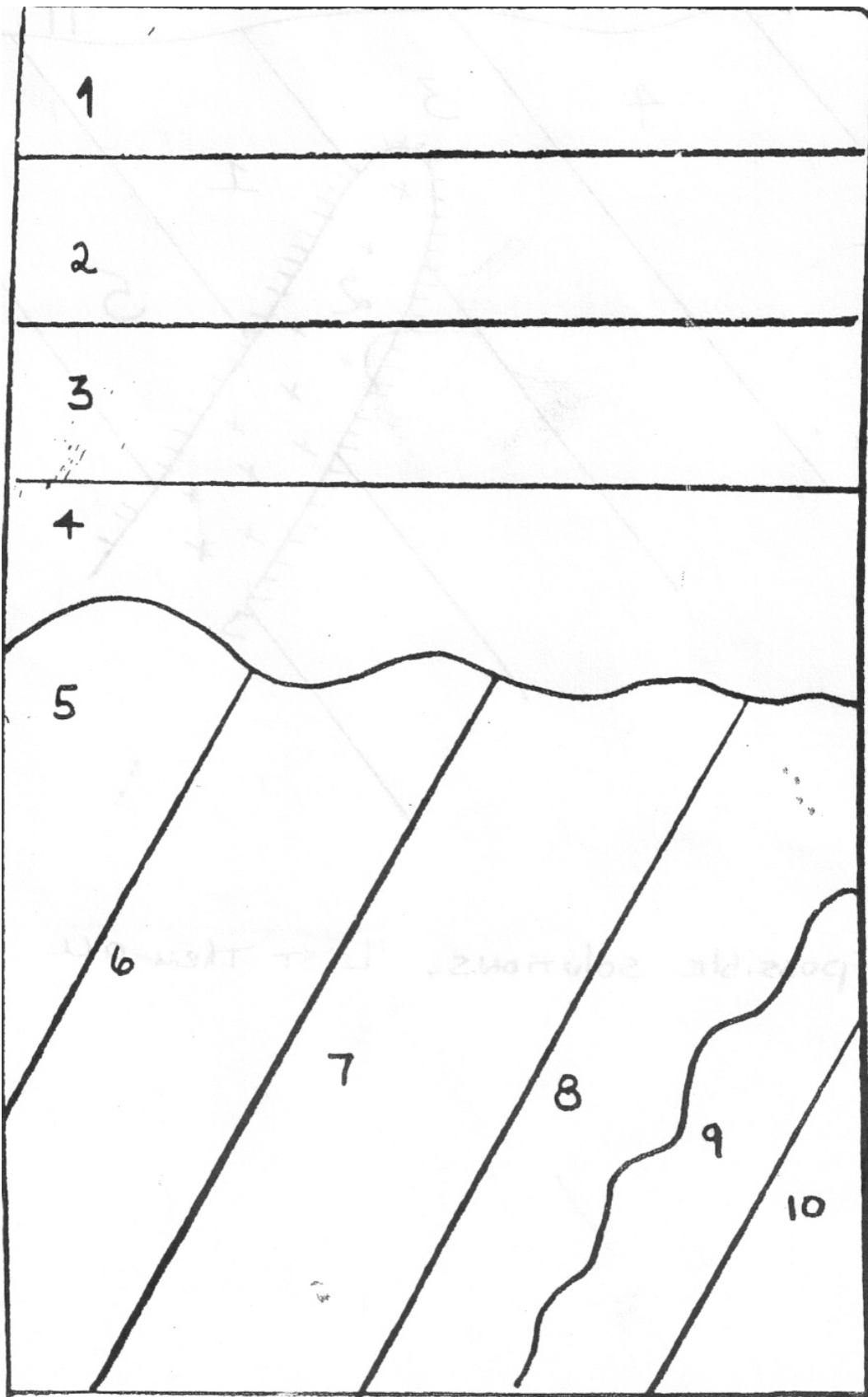
Use the diagram below to complete following questions. The rock layers were not overturned.



3. Rock layer A is younger than rock layer \_\_\_\_\_
4. Rock layer Z represents the same rock layer as \_\_\_\_\_
5. In which rock layers are fossils least likely to be found? \_\_\_\_\_ & \_\_\_\_\_
6. Would rock layer C be considered an intrusion or an extrusion? \_\_\_\_\_
7. Upon examination of rock layer C, would you infer the size of the crystals to be small in size or large in size? \_\_\_\_\_
8. Name the sedimentary rock layer G. \_\_\_\_\_
9. Name the sedimentary rock layer A. \_\_\_\_\_
10. What metamorphic rock would be found in layer E at the site of contact metamorphism? \_\_\_\_\_
11. What metamorphic rock would be found in layer A at the site of contact metamorphism? \_\_\_\_\_
12. What metamorphic rock would be found in layer D at the site of contact metamorphism? \_\_\_\_\_

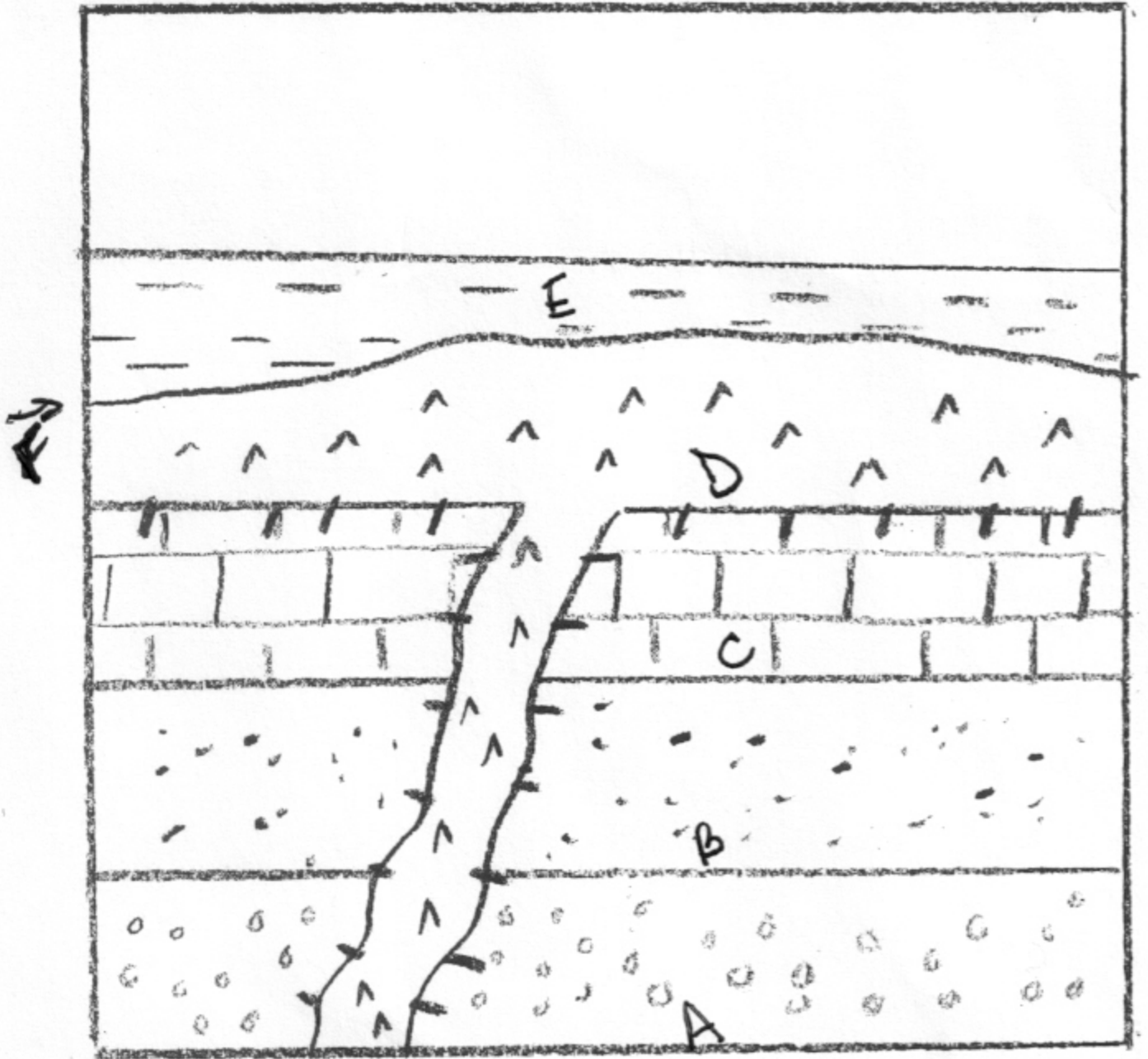
Fact(s) to memorize: 1 - 11



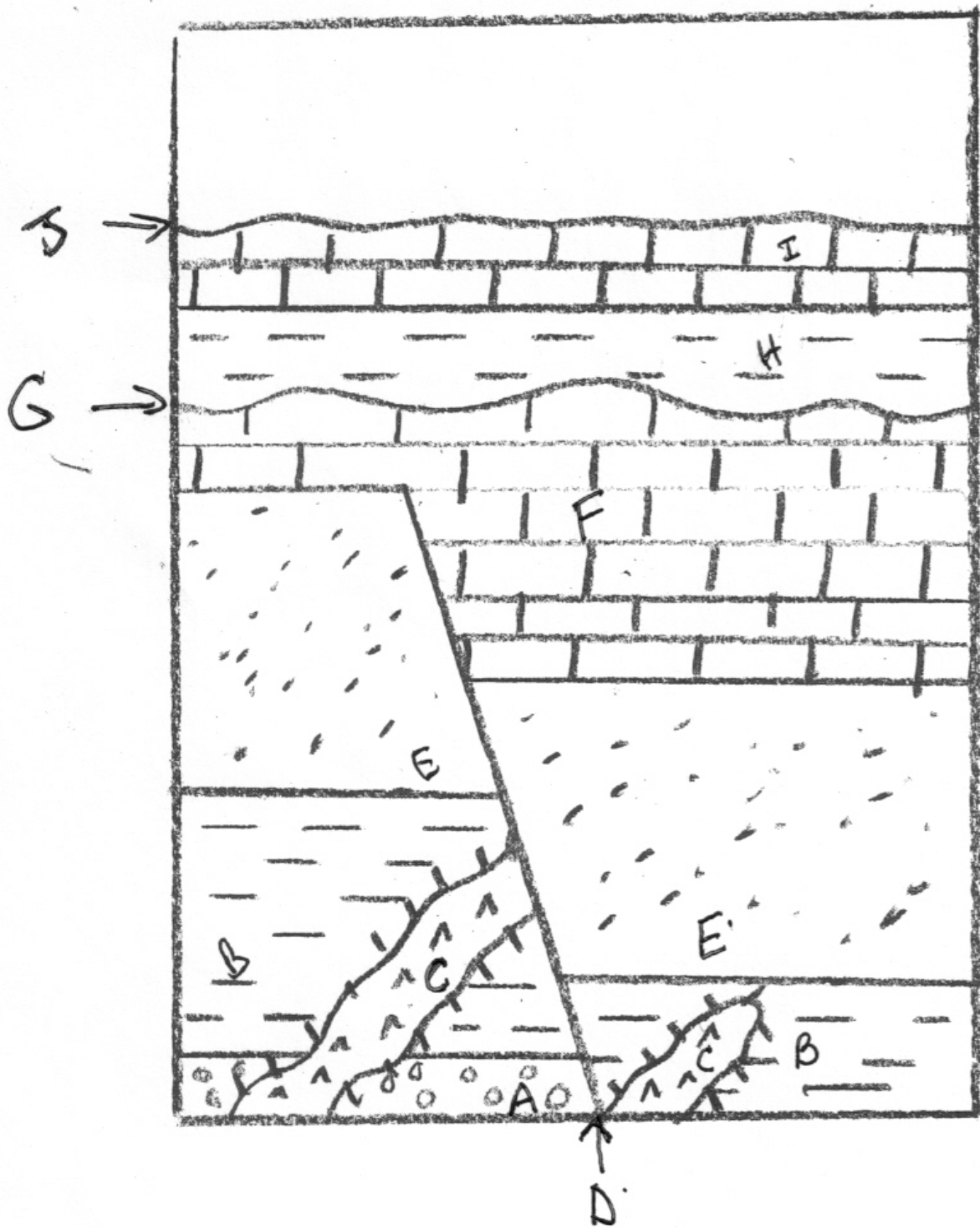


Put these events in order from oldest to youngest:

Put these events in order from oldest to youngest:



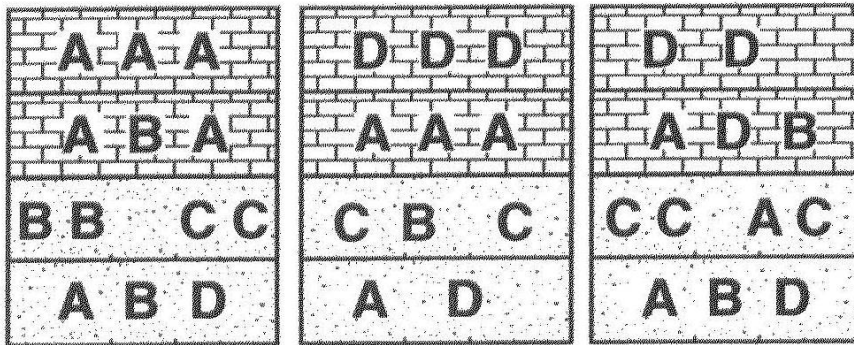




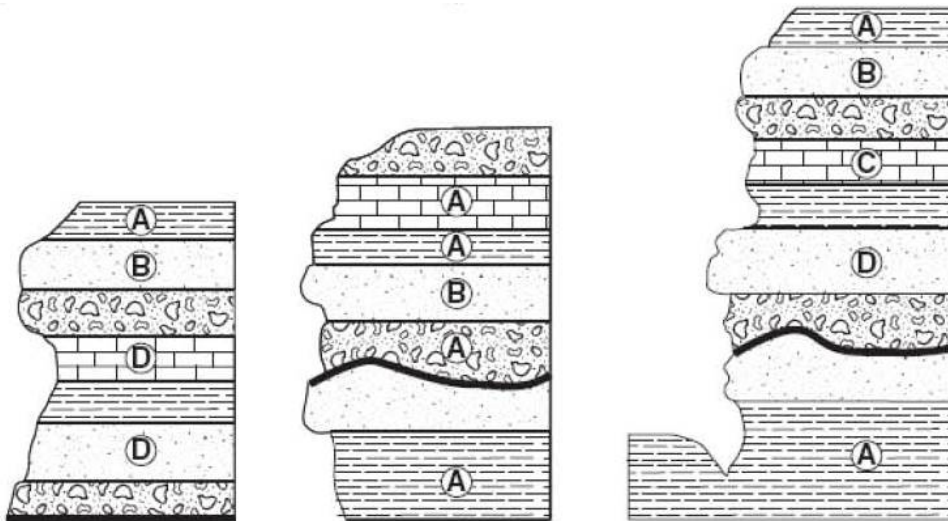
Put these events in order from oldest to youngest:

## Index Fossil and Rock Correlation

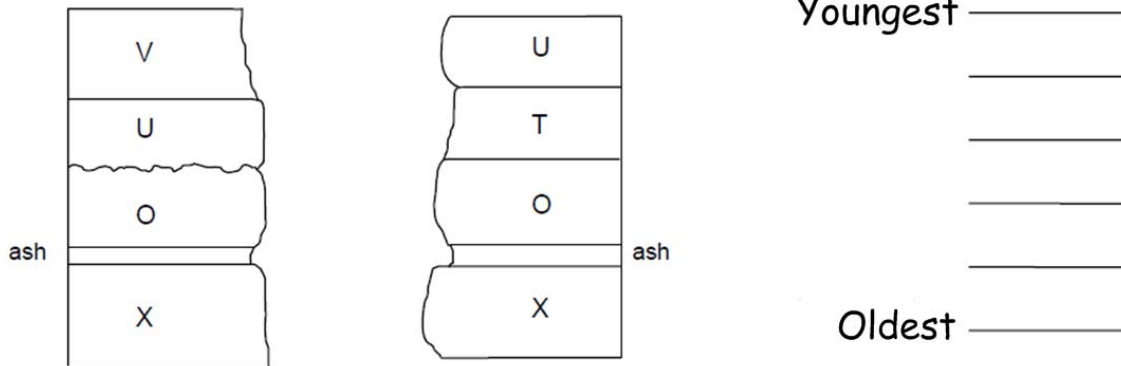
1. Circle the index fossil:



2. Circle the index fossil:

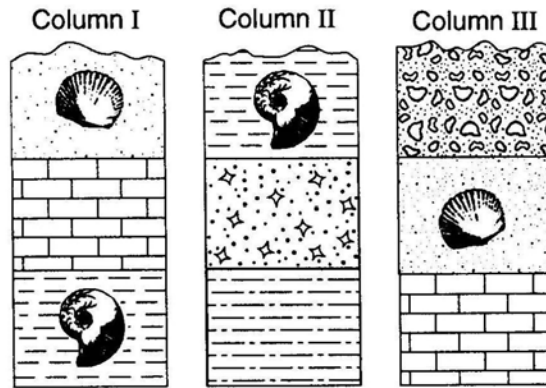


3. Match the layers and put them in order from oldest to youngest:

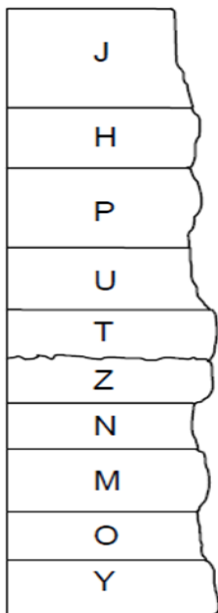


## Index Fossil and Rock Correlation

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



5. Put the layers in order:



Youngest \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

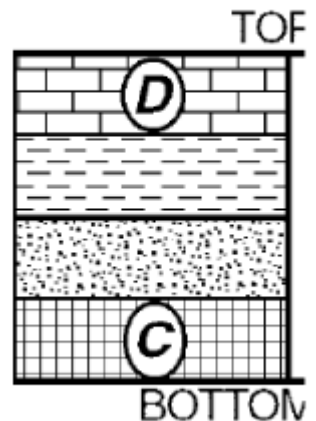
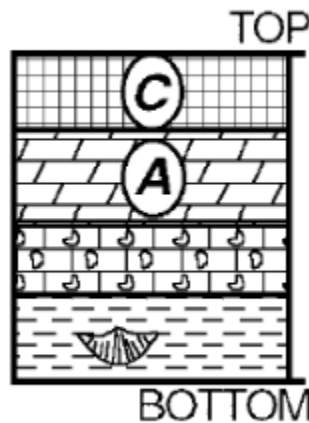
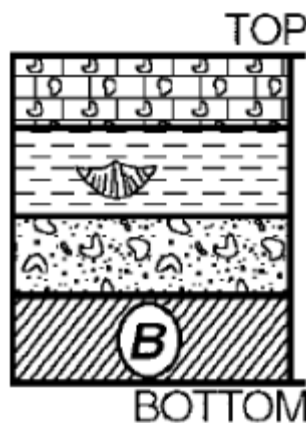
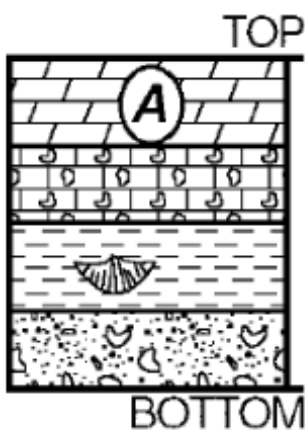
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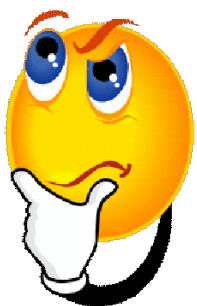
\_\_\_\_\_

Oldest \_\_\_\_\_

6. Use the index fossils and matching rock layers to circle the oldest layer of all four columns.



Fact(s) to memorize: 11 - 16



ABSOLUTE TIME:  
RADIOACTIVE DATING





Half life - \_\_\_\_\_  
\_\_\_\_\_

Decay Product \_\_\_\_\_

ESRT Front cover

Radioactive Isotope	Decay product	Half – life (years)
Carbon - 14	Nitrogen <sup>14</sup>	5,700
Potassium - 40		
Uranium – 238		
Rubidium - 87		

1. The table to the right gives information about the radioactive decay of carbon-14. Part of the table has been left blank. Fill in each of the blank spaces and the answer the following questions.

Half-life	Mass of Original C-14 Remaining (grams)	Number of Years
0	1	0
1	$\frac{1}{2}$	5,700
2	$\frac{1}{4}$	11,400
3	$\frac{1}{8}$	17,100
4		
5		
6		

- What is the percentage of original C-14 remaining after 2 half lives?
- What is the percentage of decay product after 3 half-lives?
- As the amount of decay product increases, what happens to the amount of the original isotope?

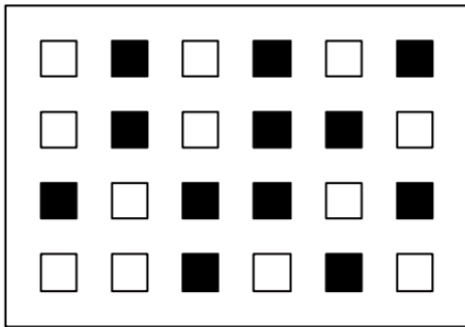
# HALF-LIFE PROBLEMS

1. An isotope of cesium (cesium-137) has a half-life of 30 years. If 1.0 g of cesium-137 disintegrates over a period of 90 years, how many g of cesium-137 would remain?
2. Actinium-226 has a half-life of 29 hours. If 100 mg of actinium-226 disintegrates over a period of 58 hours, how many mg of actinium-226 will remain?
3. Sodium-25 was to be used in an experiment, but it took 3.0 minutes to get the sodium from the reactor to the laboratory. If 5.0 mg of sodium-25 was removed from the reactor, how many mg of sodium-25 were placed in the reaction vessel 3.0 minutes later if the half-life of sodium-25 is 60 seconds?
4. The half-life of isotope X is 2.0 years. How many years would it take for a 4.0 mg sample of X to decay and have only 0.50 mg of it remain?
5. Selenium-83 has a half-life of 25.0 minutes. How many minutes would it take for a 10.0 mg sample to decay and have only 1.25 mg of it remain?
6. The half-life of Po-218 is three minutes. How much of a 2.0 gram sample remains after 15 minutes?

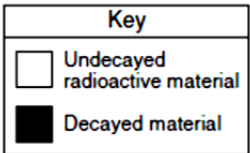
## HALF LIFE QUESTIONS

- How old is a fossil that has radioactively decayed through 4 half-lives of carbon-14?  
 (1) 5,700 years      (2) 17, 100 years      (3) 22,800 years      (4) 28,500 years
- In the diagram below, how many boxes should be shaded to represent the additional decayed material formed during the second half-life?  
 (1) 12      (2) 6      (3) 3      (4) 0

**Radioactive Sample After First Half-Life**

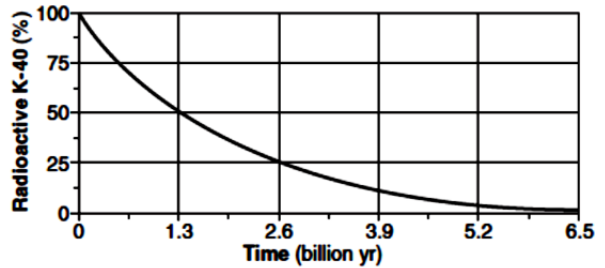


Half-life of  $4.6 \times 10^9$  years



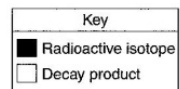
- In the diagram to the right, analysis of a basalt rock sample shows that 25% of its radioactive K-40 remained undecayed. How old is the basalt?  
 (1) 1.3 billion years    (2) 2.6 billion years  
 (3) 3.9 billion years    (4) 4.6 billion years

The graph below shows the rate of decay of the radioactive isotope K-40 into the decay products Ar-40 and Ca-40.



- A sample of wood found in an ancient tomb contains 25% of its original carbon-14. The age of this wood sample is approximately?  
 (1) 2,800 years      (2) 5,700 years      (3) 11,400 years      (4) 17,100 years
- Which diagram to the right best represents the percentage of this radioactive isotope sample that will remain after two half-lives.

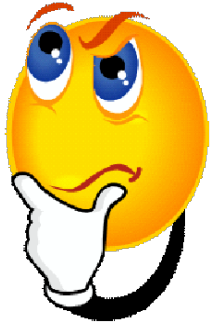
Sample before decay



Which diagram best represents the percentage of this radioactive isotope sample that will remain after 2 half-lives?



Life on Earth:



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## Geologic Time Scale

## ESRT pages 8 & 9

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Reviewing the Geologic History of New York State:

1. What is the estimated time of origin of Earth? \_\_\_\_\_
2. Name the two eons. \_\_\_\_\_ and \_\_\_\_\_
3. Name the longest Eon. \_\_\_\_\_
4. Approximately how long did the Precambrian last? \_\_\_\_\_ millions of years
5. Name the three Eras in the Phanerozoic eon. \_\_\_\_\_  
\_\_\_\_\_
6. Name the two Eras in the Precambrian eon. \_\_\_\_\_  
\_\_\_\_\_
7. Name the three periods that were during the Mesozoic era? \_\_\_\_\_  
\_\_\_\_\_ and \_\_\_\_\_
8. How many millions of years ago was the beginning of the Mesozoic? \_\_\_\_\_
9. How many millions of years ago was the end of the Silurian? \_\_\_\_\_
10. What is the division of the Geologic time scale based on? \_\_\_\_\_
11. Name the two epochs that the Neogene period is separated in to.  
\_\_\_\_\_ and \_\_\_\_\_
12. What period is divided into the Pennsylvanian and Mississippian?  
\_\_\_\_\_
13. Name the most recent period. \_\_\_\_\_



# Landscape Regions

Fact(s) to memorize: 23 - 26



Landscapes are determined by \_\_\_\_\_

Mountains (highlands) \_\_\_\_\_

Plateaus \_\_\_\_\_

Lowlands (plains) \_\_\_\_\_

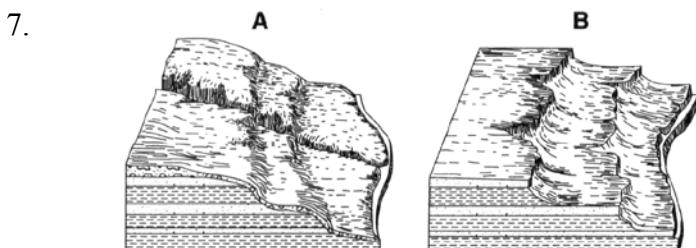
Arid Landscapes \_\_\_\_\_

Humid Landscapes \_\_\_\_\_

- How old are the oldest rocks in New York State? \_\_\_\_\_  
**Hint: Oldest rocks are at the bottom of the bedrock map key; younger as you move up!**
- In what landscape region are the oldest rocks located? \_\_\_\_\_
- In what landscapes region do you live? \_\_\_\_\_
- Complete the following table using the Bedrock Geology of NYS map on page 3 ESRT:

Location	Latitude	Longitude	Landscape Region
Niagara Falls			
Rochester			
Mt. Marcy			
Massena			
Ithaca			

- Find the Finger Lakes. These lakes were created as glaciers scratched the bedrock. Based on the orientation of the lakes from what direction did the glaciers advance? \_\_\_\_\_
- Most of New York State is exposed to the same type of weathering/climate. What is the reason why there is so many different types of landscapes? \_\_\_\_\_



Which landscape, A or B, is located in a humid climate? How can you tell? Which one is arid? Explain.

\_\_\_\_\_



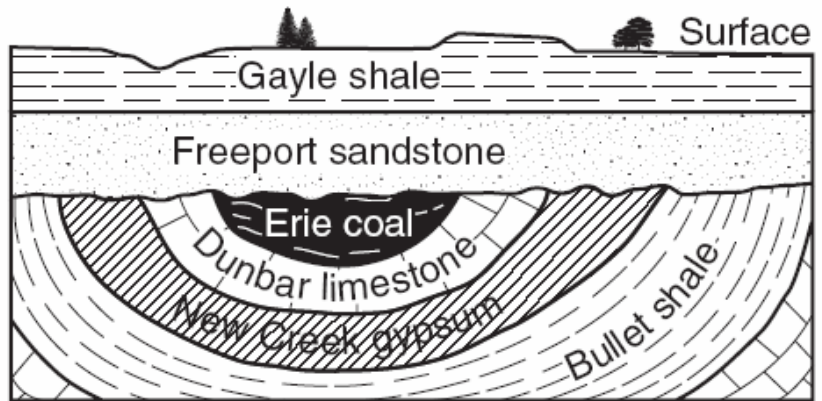
Directions: Please complete the chart and answer all the questions using pages 2 and 3 of your Earth Science Reference Tables.

Landscape Region Name	Age of Bedrock (Silurian, Ordovician)	Bedrock Type (Sedimentary, Igneous, Metamorphic)	Bedrock Names (limestone, shale)	Mountain, Plateau, or Lowlands
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				

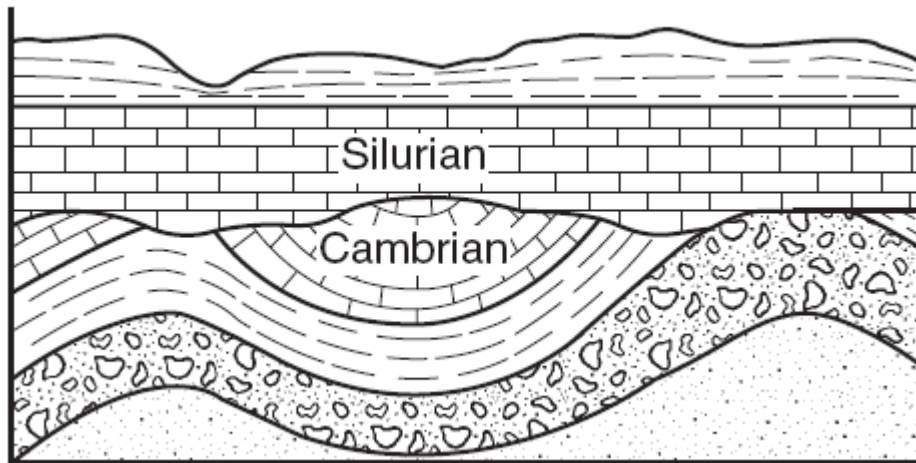
Geologic History Review

Use the picture below to answer questions 1-3.

1. Label the unconformity.
2. Where did the Erie coal come from?
3. What is the grain size of the Bullet and the Gayle shale?



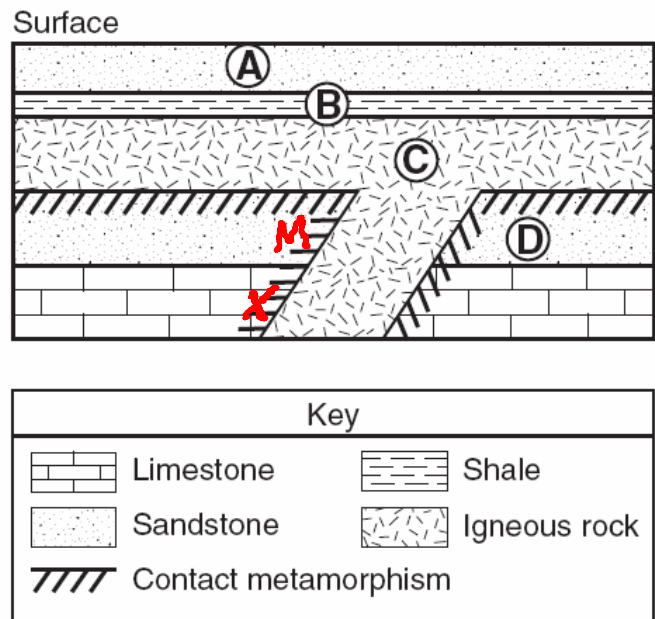
Use the diagram below to answer questions 4-9.



4. Approximately how many million years ago did the unconformity form?
5. Name the nautiloid fossil that could be found in the limestone layer directly above the unconformity.
6. How can you tell from the picture that the conglomerate layer could be from the Precambrian?
7. Label the sandstone layer with an S.
8. What could have caused the bottom four layers to be folded?
9. Label the layer with the largest range in particle size with a C.

Use the diagram below to answer questions 10-15.

10. How can you tell layer C is an extrusion?
11. What is the crystal size of layer C?
12. What is the grain size of layer A?
13. What is the composition of the limestone layer?
14. Name the metamorphic rock at location X.
15. Name the metamorphic rock at location M.



Use the reading passage below to answer questions 16-18.

### Fossil With Signs of Feathers Is Cited as Bird-Dinosaur Link

Paleontologists have discovered in China a fossil dinosaur with what are reported to be clear traces of feathers from head to tail, the most persuasive evidence so far, scientists say, that feathers predated the origin of birds and that modern birds are descendants of dinosaurs.

Entombed in fine-grained rock, the unusually well-preserved skeleton resembles that of a duck with a reptilian tail, altogether about three feet in length. Its head and tail are edged with the imprint of downy fibers. The rest of the body, except for bare lower legs, shows distinct traces of tufts and filaments that appear to have been primitive feathers. On the backs of its short forelimbs are patterns of what look like modern bird feathers.

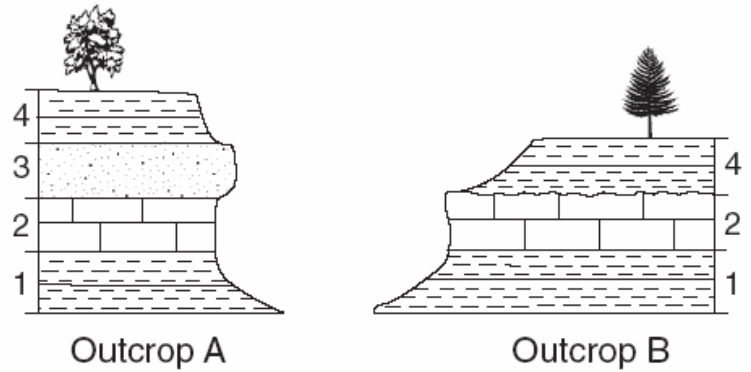
Other dinosaur remains with what appear to be featherlike traces have been unearthed in recent years, but nothing as complete as this specimen, paleontologists said. Etched in the rock like a filigree decoration surrounding the skeleton are imprints of where the down and feathers appear to have been.

The 130-million-year-old fossils were found a year ago by farmers in Liaoning Province in northeastern China. After an analysis by Chinese and American researchers, the fossil animal was identified as a dromaeosaur, a small fast-running dinosaur related to velociraptor. The dinosaurs belonged to a group of two-legged predators known as advanced theropods . . .

excerpted from "Fossil With Signs of Feathers Is Cited as Bird-Dinosaur Link"  
John Noble Wilford  
*New York Times*, April 26, 2001

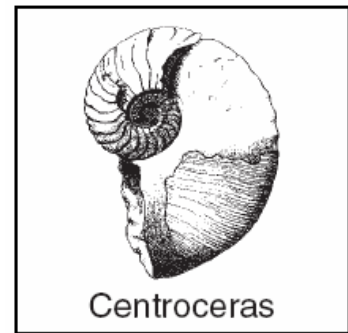
16. What period is the fossil the farmers found from?
17. What type of rocks were these fossils probable found in?
18. Why is the feathered dinosaur NOT considered an index fossil?

19. Explain why layer three is missing from outcrop 2.



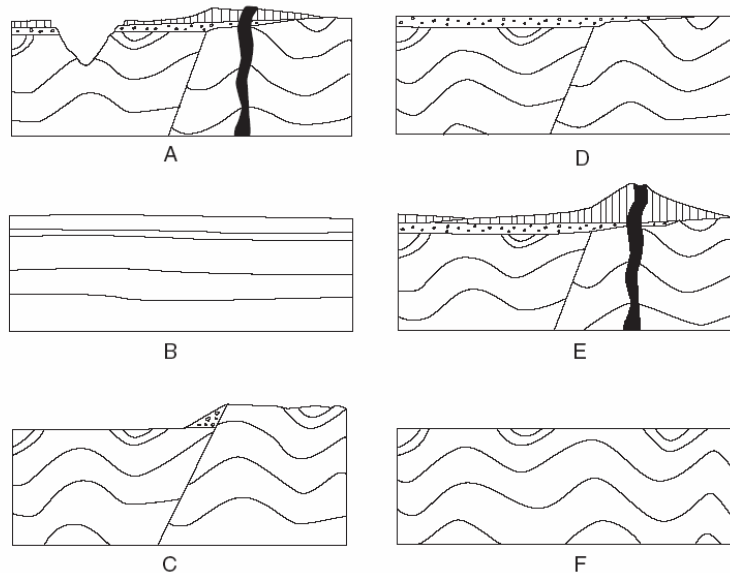
*Use the picture of the fossil to answer questions 20-22.*

20. What geologic period is this fossil from?
21. Name another fossil found in the same bedrock.
22. Where do you think this animal lived when it was alive?



23. Put the following pictures in the correct order.

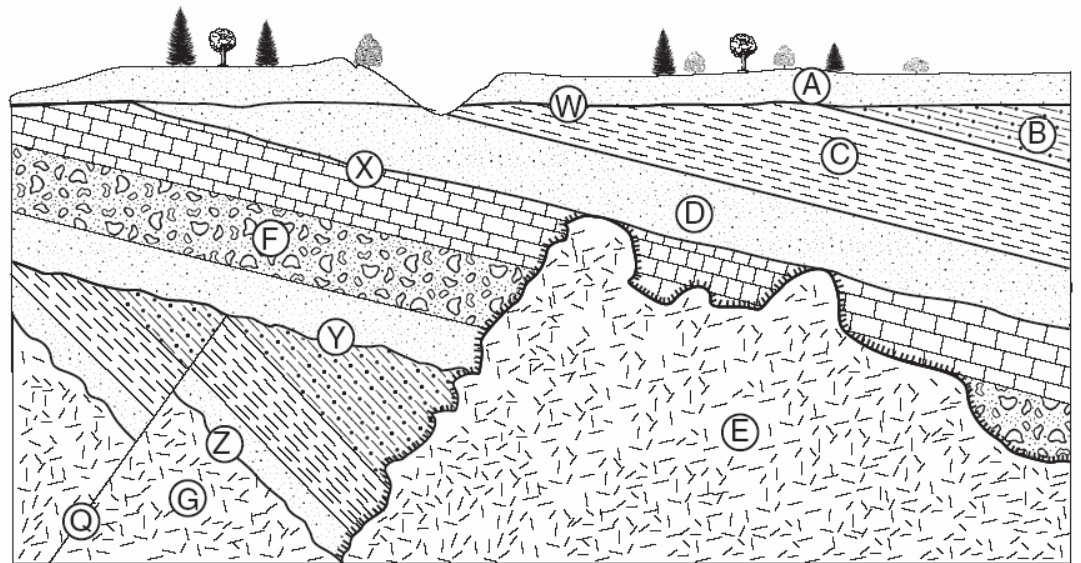
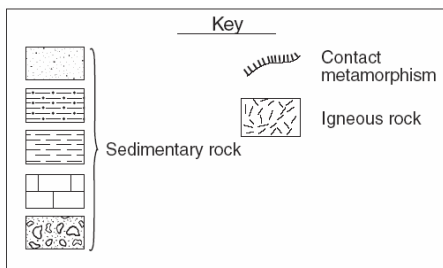
First \_\_\_\_\_



24. Fill in the following chart.

Half-life	Mass of Original Carbon-14 Remaining (grams)	Number of Years
0	1	0
1	$\frac{1}{2}$	5,700
2	$\frac{1}{4}$	11,400
3	$\frac{1}{8}$	17,100
4	$\frac{1}{16}$	
5		
6		
7		

Use the following picture to answer questions 25-30.



25. What caused Q to occur?

26. What caused Y, Z and W?

27. Describe rock E.

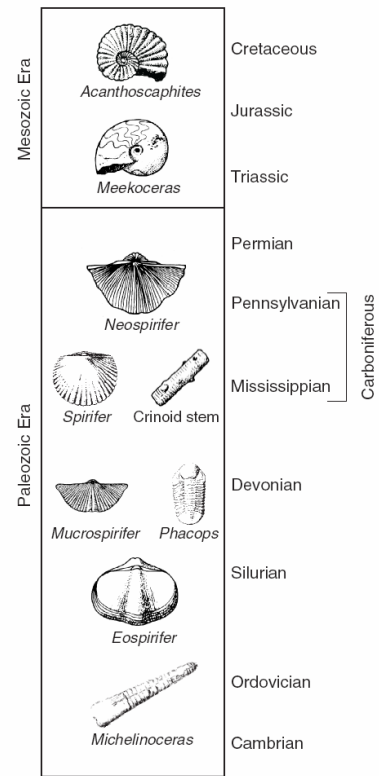
28. Which letter has the greatest range in particle size?

29. Label with a star the layer of rock that is composed of shells?

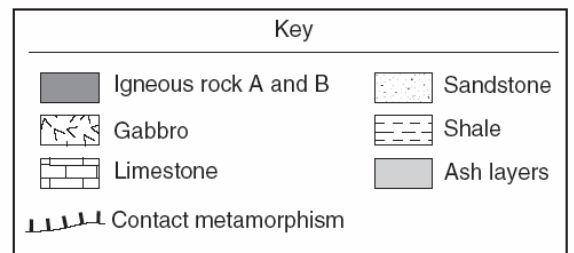
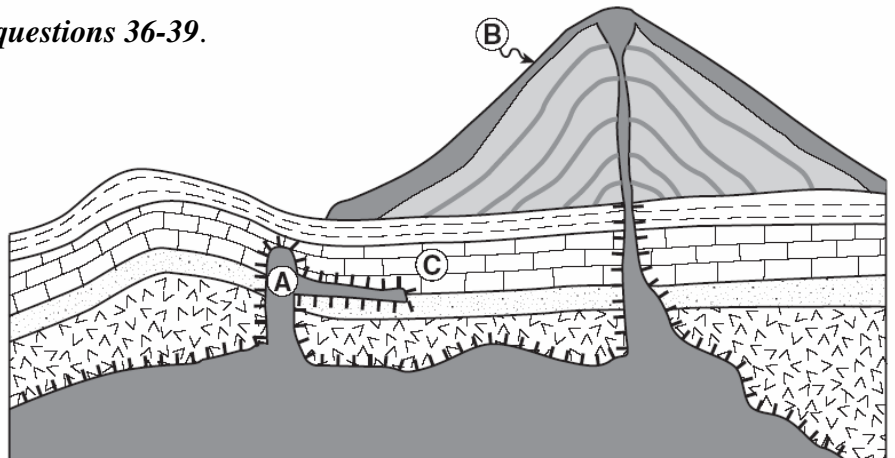
30. Describe another way you can determine this layer is limestone.

Use the picture to the right to answer questions 31-35.

31. Put a ▲ on the right side of the diagram to show when the dinosaurs were abundant.
32. Put a ■ on the right side of the diagram to show when *Platyceras* lived.
33. Put a ● on the right side of the diagram to show when PANGEA broke up.
34. Label where the PRECAMBRIAN would be.
35. Circle the period when you would have seen *Elliptocephala*.

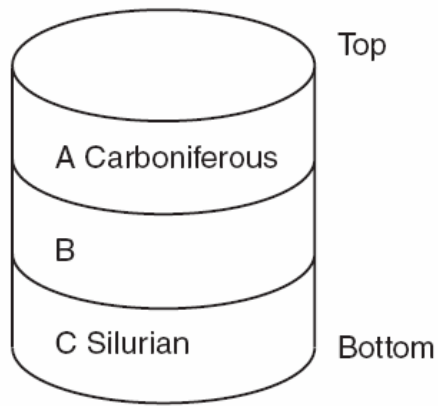


Use the picture below to answer questions 36-39.

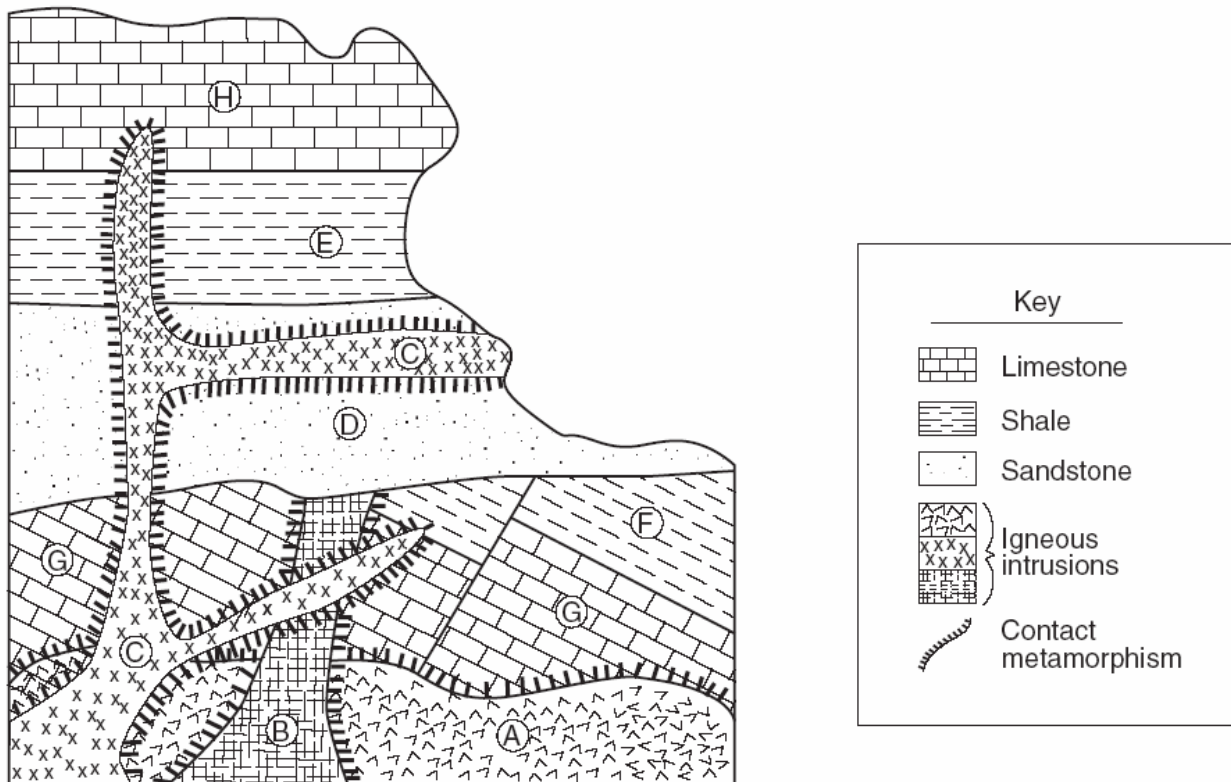


36. How does the crystal size of rock B compare to the size of rock A?
37. Which igneous rock will B probably be?
38. How can you tell this volcano erupted more than once?
39. How can tell igneous rocks A and B are younger than the gabbro?

40. Label the following diagram.



Use the picture below to answer questions 41-45.



I will give you two letters and you need to tell me which occurred first and why.

41. B and C...

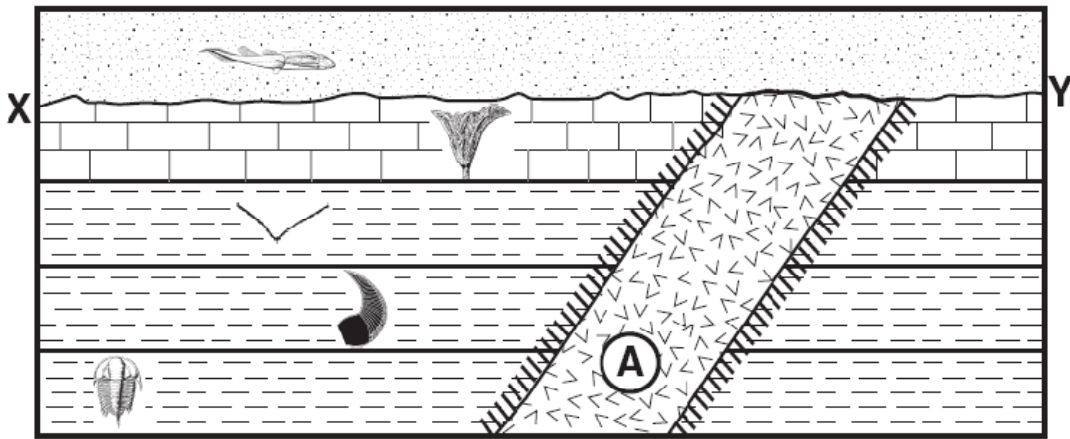
42. A and G...






43. F and D...






44. C and E...

45. C and A...

Base your answers to questions 46 through 50 on the geologic cross section below and on your knowledge of Earth science. The cross section shows New York State index fossils in rock layers that have not been overturned. Rock unit *A* is an igneous intrusion and line *XY* represents an unconformity.



Key	
Index Fossils	
	<i>Bothriolepis</i>
	<i>Ctenocrinus</i>
	<i>Dicellograptus</i>
	<i>Valcouroceras</i>
	<i>Elliptocephala</i>

Key	
Rock Units	
	Sedimentary rocks
	
	
	Igneous rock
	Contact metamorphic rock

46. Based on fossil evidence, determine the geologic period during which the unconformity formed.
47. Identify the coral index fossil that would most likely be found in the same layer as the index fossil *Ctenocrinus*.
48. Each index fossil existed for a relatively short geologic time interval. State *one* other characteristic that each fossil must have to be considered an index fossil.
49. Describe the type of depositional environment in which the fossilized organisms lived.
50. Identify *one* piece of evidence shown in this cross section that indicates that the igneous intrusion, *A*, is older than the sandstone layer.