

THE FINAL TOPIC!!

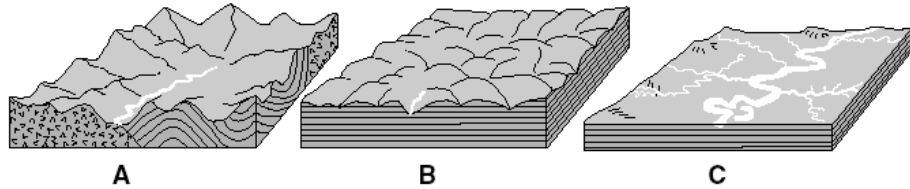
Topic XI -

**Landscapes and
Earth History**

Topic: Landscapes and Earth History

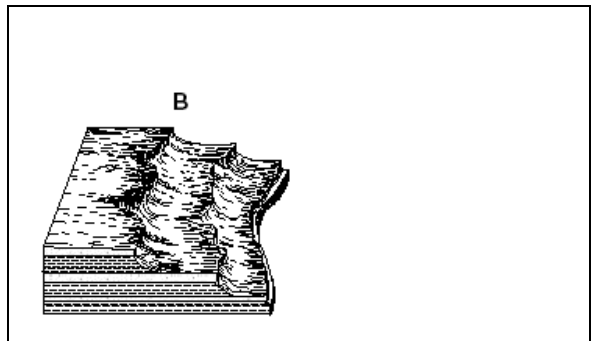
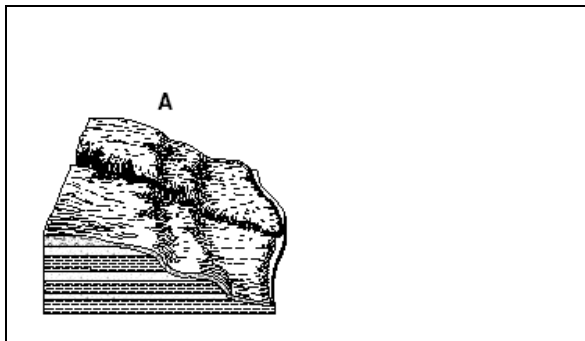
Aim:

1.



	A:	B:	C:
Elevation	<i>high elevations</i>	<i>moderate to high elevations</i>	<i>low elevations</i>
Bedrock Type and Structure	<i>deformed rock structures faulted and folded metamorphic rocks</i>	<i>horizontal layers of sedimentary rocks</i>	<i>horizontal layers of sedimentary rocks</i>

2.



LANDSCAPES REVIEW

1. The Generalized Bedrock of New York State map has a key in the lower left corner of the page. The different types of bedrock are listed in geologic order. The lowest rock symbols represent the oldest rocks while the symbols at the top of the key represent the youngest rocks.
 - a. For the most part, what type of rock (igneous, sedimentary, or metamorphic), _____ makes up most of the surface bedrock NY?
 - b. Which landscape region consists of primarily Silurian age bedrock? _____
 - c. In which landscape region is Albany situated? _____

2. What are the names of two rocks that would be exposed in surface bedrock of New York City? _____

3. Which type of landscape region is located at 43° N and 77° W? _____

4. Long Island doesn't have bedrock underneath it. What does the *ESRT* say about the composition of the land under L.I.? _____

5. Fill in the chart below with the appropriate information.

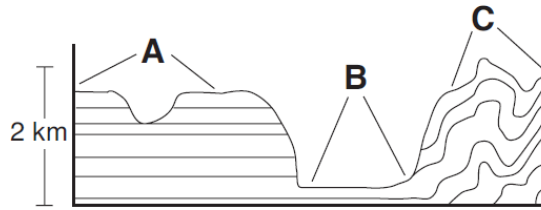
	City or Landscape Feature	Name of Landscape Region	Type of Surface Bedrock Exposed <small>(Igneous, Sedimentary, Metamorphic)</small>	Geologic Period Surface Bedrock Formed During
A	Mt. Marcy			
B	The Finger Lakes			
C	Syracuse			

6. Which feature would most likely indicate the boundary between two landscape regions?
 - (1) deposits of unsorted sediments adjacent to polished and scratched bedrock
 - (2) a sharp change in elevation between two different adjoining bedrock structures
 - (3) a large stream flowing down a long V-shaped valley
 - (4) bedrock containing two distinctly different fossil types

7. During which period of geologic history was the surface bedrock of the Catskills formed?

(1) Cambrian	(3) Devonian
(2) Pleistocene	(4) Triassic

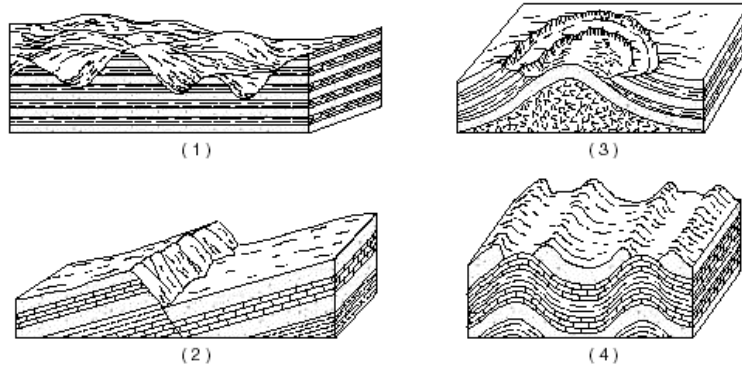
8. The cross section below shows the general bedrock structure of an area containing three different landscape regions, A, B, and C.



(Not drawn to scale)

Which list correctly identifies the type of landscapes represented by letters A, B, and C?

- (1) A = plain, B = plateau, C = mountain
 - (2) A = mountain, B = plateau, C = plain
 - (3) A = mountain, B = plain, C = plateau
 - (4) A = plateau, B = plain, C = mountain
9. In which New York State landscape region would one find metamorphic surface bedrock?
- (1) Adirondack Mountains
 - (2) Hudson-Mohawk Lowlands
 - (3) Allegheny Plateau
 - (4) Tug Hill Plateau
10. Which block diagram best represents a portion of a plateau?



Use the table to answer **questions 11 and 12**.
The table below shows characteristics of four landscape regions A, B, C, and D.

11. Which terms best describe the surface landscapes of A, B, C, and D?
- (1) A—mountains, B—ridges and valleys, C—plateau, D—plain
 - (2) A—plateau, B—plain, C—mountains, D—ridges and valleys
 - (3) A—plain, B—mountains, C—plateau, D—plain
 - (4) A—ridges and valleys, B—plateau, C—plain, D—mountains

Landscape Region	Relief	Bedrock
A	great relief, high peaks, deep valleys	faulted and tilted structure; many bedrock types, including igneous
B	moderate relief, rounded peaks, wide valleys	folded sedimentary bedrock
C	moderate to high relief	horizontal sedimentary bedrock layers
D	very little relief, low elevations	horizontal sedimentary bedrock layers

12. The sharp, angular flat-topped hills (mesas) in landscape region C were most likely produced by a climate that was
- (1) tropical
 - (2) humid
 - (3) dry
 - (4) polar

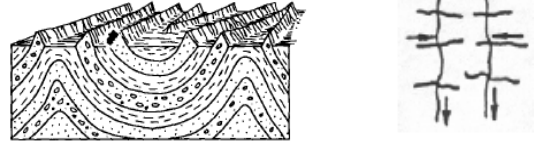
STREAM DRAINAGE PATTERNS

created by different landforms

a. **DENDRITIC**
flatter regions



c. **TRELLIS**
hill-valley systems



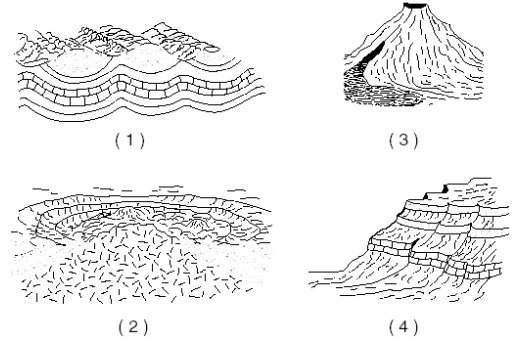
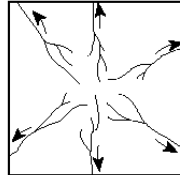
b. **RADIAL**
mountains, volcanoes



d. **ANNULAR**
unevenly eroded mountains

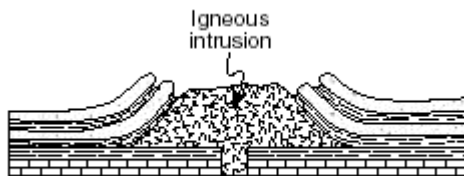


1. The map shows a stream drainage pattern. Arrows show the direction of stream flow. On which landscape region did this drainage pattern most likely develop?

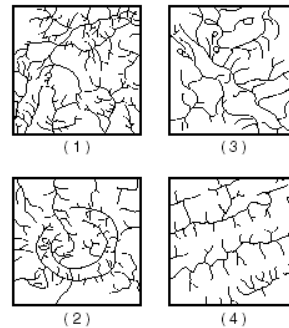


2. The cross section below shows the rock structure of a deeply eroded, domed mountain region.

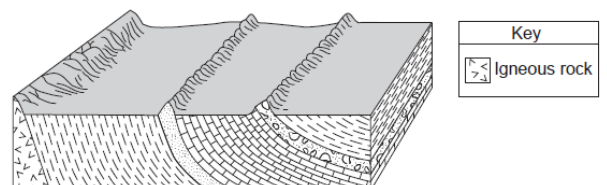
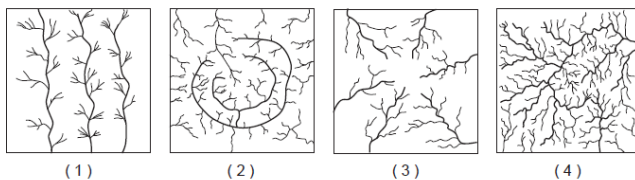
Which map shows the stream drainage pattern that will most likely develop as the bedrock is weathered and eroded from this igneous dome?



(Not drawn to scale)



3. The block diagram to the right shows a landscape region. Which stream drainage pattern would most likely form in this region?



Geologic History of New York Reference Tables Facts

1. Geologic Time Scales are read from the bottom (oldest) to the top (youngest).
2. The Earth is approximately 4,600 million years old (4.6 billion years old).
3. The subdivisions of geologic time are based mainly upon fossil evidence.
4. The Precambrian Eon represents most of Earth's history, but it is rare to find fossils of that time because organisms that existed during that time did not have hard body parts that could fossilize.
5. Most organisms over time have become extinct.
Mass extinctions are thought to be caused by meteorite impact events and/or global climate change.
6. The fossil record supports the theory of evolution:
An increase in the complexity of organisms can be seen in the fossil record.
7. The Earth's atmosphere changed from having no oxygen to an abundance of oxygen as a result of CO₂ gas being released from Earth's interior (**out-gassing from volcanic activity**). The CO₂ was later converted to O₂ by plant photosynthesis.
8. **Index fossils** are remains of organisms that lived for a relatively short period of time but found over a large geographic area.
9. Many of the fossils found in New York State suggest that parts of New York were once a shallow marine environment.
10. There is no rock record in New York for the Permian, Paleogene, or Neogene Periods.
11. An **orogeny** is a major mountain building event.

Geologic History

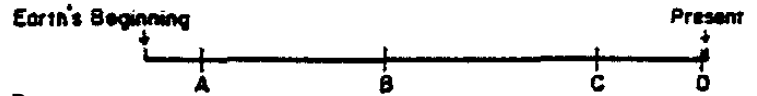
Use the Geologic History of New York State Timeline and the New York State Bedrock and Landscapes maps in the *Earth Science Reference Tables* to answer the questions related to Earth's history.

1. Which time division of Earth's history represents the greatest amount of time? _____
2. Approximately how many millions of years ago did oceanic oxygen enter the atmosphere? _____
3. How many eras are there in the Phanerozoic Eon? _____
4. How many millions of years ago did the Devonian Period begin? _____
5. How long (in millions of years) was the Triassic Period? (some math required here ...) _____
6. In which geologic era did the dinosaurs live? _____
7. In which geologic period did the earliest flowering plants appear? _____
8. What is the most recent epoch called? _____
9. What important geologic event occurred during the Pleistocene? _____
10. During what geologic period did the *Eurypterus* live? _____
11. During which geologic period did the earliest mammals first appear? _____
12. Which organism is the oldest: *Cooksonia*, *Phacops*, or *Coelophysis*? _____
13. How many millions of years ago did the dinosaurs become extinct? _____
14. During which geologic period did the placoderm fish first appear? _____
15. What is the estimated time of the age of the Earth and Solar System in millions of years? _____
16. Name one landscape region in New York where one might find a fossil of *Bothriolepis*? _____
17. Name one crinoid fossil that one might find in or around Syracuse. _____
18. Which characteristics of a fossil would make it useful as an index fossil?

(1) a wide time range and narrow geographic range	(3) a wide time range and wide geographic range
(2) a narrow time range and narrow geographic range	(4) a narrow time range and wide geographic range
19. Scientists believe that a large asteroid struck Earth approximately 65 million years ago. It is often theorized that this event contributed to the

(1) end of the last ice age	(3) evolution of the first birds
(2) breaking up of Pangaea	(4) extinction of the dinosaurs

20. According to the *Earth Science Reference Tables*, approximately when on the timeline did humans first appear on Earth?



- (1) A (2) B (3) C (4) D

21. According to the fossil record, which sequence correctly represents the evolution of life on Earth?

- (1) fish → amphibians → mammals → soft-bodied organisms
 (2) fish → soft-bodied organisms → mammals → amphibians
 (3) soft-bodied organisms → amphibians → fish → mammals
 (4) soft-bodied organisms → fish → amphibians → mammals

22. Which geologic event occurred in New York State at approximately the same time that graptolites were becoming extinct?

- (1) the opening of the Atlantic Ocean (3) the formation of the Catskill Delta
 (2) the Alleghenian Orogeny (4) the intrusion of the Palisades Sill

23. Scientists have inferred that Earth's original atmosphere was formed by the

- (1) outgassing from Earth's interior (3) decay of microorganisms in Earth's oceans
 (2) erosion of Earth's surface (4) radioactive decay of elements in Earth's core

24. Devonian-age fossils found in New York State bedrock, such as *Manticoceras* and *Mucrospirifer*, provide evidence that parts of New York State were once

- (1) covered by extensive lava flows (3) under a shallow sea containing tropical waters
 (2) impacted by comets and asteroids (4) higher in elevation and eroded extensively by glaciers

25. According to plate tectonic theory, during which geologic time interval did the continents of North America and Africa separate, resulting in the initial opening of the Atlantic Ocean?

- (1) Mesozoic Era (2) Proterozoic Eon (3) Paleozoic Era (4) Archean Eon

26. Which group of organisms is inferred to have existed for the *least* amount of time in geologic history?

- (1) trilobites (2) dinosaurs (3) eurypterids (4) placoderm fish

27. Earth's early atmosphere formed during the Archean Era. Which gas was generally absent from the atmosphere at that time?

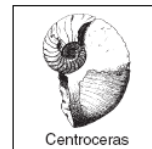
- (1) water vapor (2) nitrogen (3) carbon dioxide (4) oxygen

28. Which sequence shows the correct order of Earth's geologic time intervals from oldest to youngest?

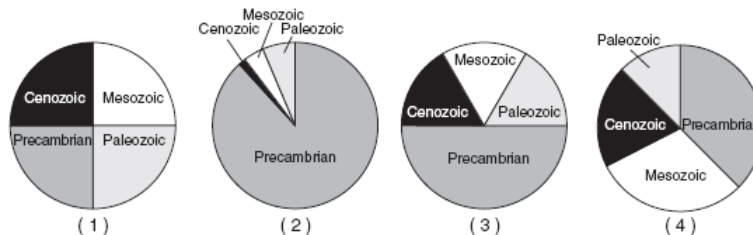
- (1) Archean → Mesozoic → Cenozoic → Paleozoic → Proterozoic
 (2) Archean → Proterozoic → Paleozoic → Mesozoic → Cenozoic
 (3) Cenozoic → Mesozoic → Paleozoic → Proterozoic → Archean
 (4) Cenozoic → Paleozoic → Archean → Mesozoic → Proterozoic

29. The diagram shows a fossil found in the surface bedrock of New York State. Which other fossil is most likely to be found in the same age bedrock?

- (1) *Phacops* (3) *Coelophysis*
 (2) condor (4) *Tetraraptus*



30. Which graph shows the relative duration of geologic time for the Precambrian, Paleozoic, Mesozoic, and Cenozoic times?



Topic:	Earth History
Aim:	

Relative Age Dating:

The Principle of Original Horizontality

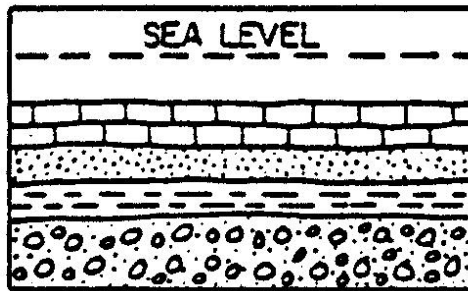
layers of sediment are originally deposited horizontally under the action of gravity

The Law of Superposition

oldest rocks are found at the bottom of a column of undisturbed strata

Basic Strata: As easy as it gets

Remember: we will write the rock name to save time, but really we should write out: **“deposition and formation of (rock name) while submerged”**



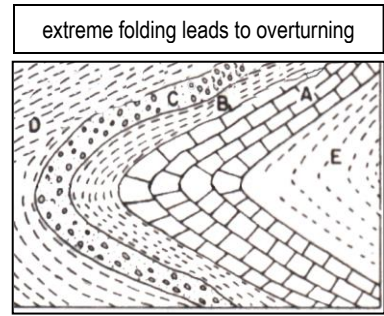
Oldest:	1 _____
	2 _____
	3 _____
Youngest:	4 _____

In addition to putting the layers of rock in order from oldest to youngest (most recent), you will also have to include other geologic events in your list of relative ages. Let's take a look ...

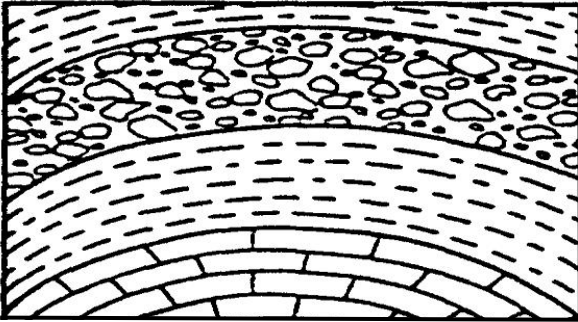
Folding of Layers

Folding is the bending of rock strata as a result of pressure.

Sometimes folding is so intense, **overturning** occurs and older rocks are folded on top of younger rocks.



Example A:



Oldest: 1 _____

2 _____

3 _____

4 _____

Youngest: 5 _____

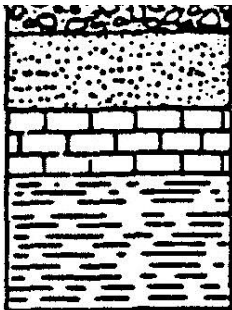
Unconformities

Unconformities are also known as buried erosional surfaces

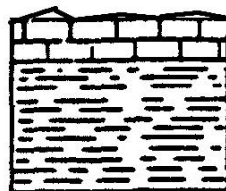
Form as a result of uplift, erosion, submergence (flooding), deposition of new rock layers

Unconformities indicate geologic time gaps – possible missing rock layers / fossil evidence

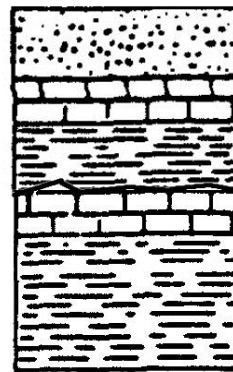
Here's how they form:



Stage 1:
deposition of shale, limestone, sandstone, and conglomerate



Stage 2:
uplift leads to erosion erasing the layers of sandstone and conglomerate from the rock record

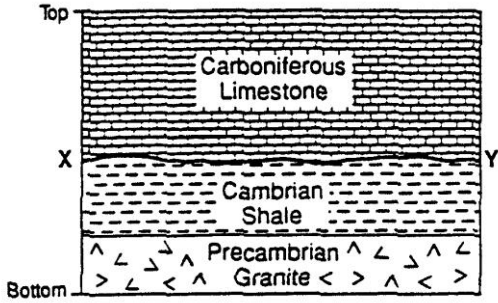


Stage 3:
submergence occurs (flooding) and the more deposition of shale, limestone, and sandstone

unconformity

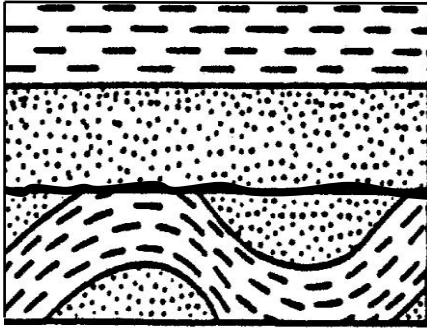
Unconformities (continued)

Example A:



Oldest: 1 _____
 2 _____
 3 _____
 Youngest: 4 _____

Example B:



Oldest: 1 _____
 2 _____
 3 _____
 4 _____
 5 _____
 6 _____
 Youngest: 7 _____

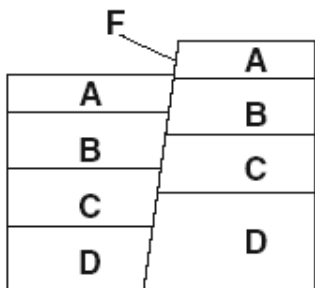
Faulting of Layers

Faults are cracks in bedrock along which there is movement.

Faults are always **YOUNGER** than the rocks they cut through.

Example A:

2. Put the lettered features in order from oldest to youngest.



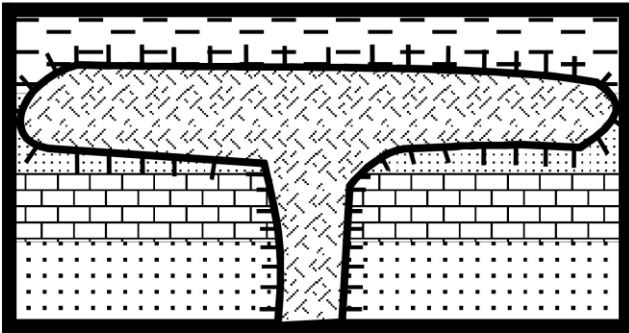
Oldest: 1 _____
 2 _____
 3 _____
 4 _____
 Youngest: 5 _____

Igneous Intrusions

Igneous Intrusions occur when magma is injected into rock layers already present.

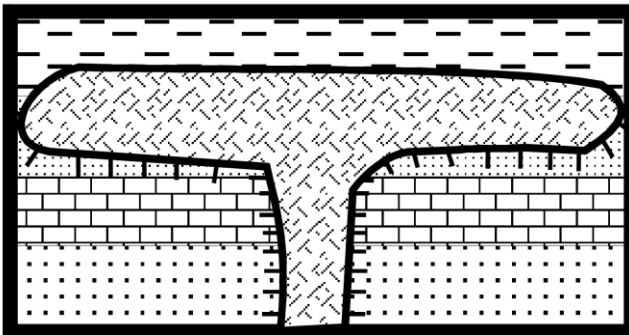
To help determine the relative age of an intrusion, use the evidence of contact metamorphism.

Example A:



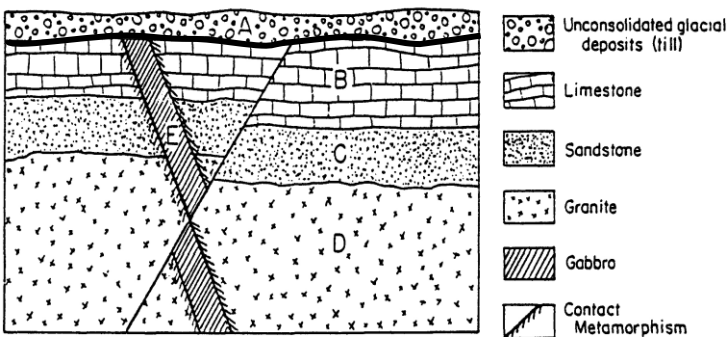
Oldest: 1 _____
 2 _____
 3 _____
 4 _____
 Youngest: 5 _____

Example B:



Oldest: 1 _____
 2 _____
 3 _____
 4 _____
 Youngest: 5 _____

Example C:



Oldest: 1 _____
 2 _____
 3 _____
 4 _____
 5 _____
 6 _____
 Youngest: 7 _____

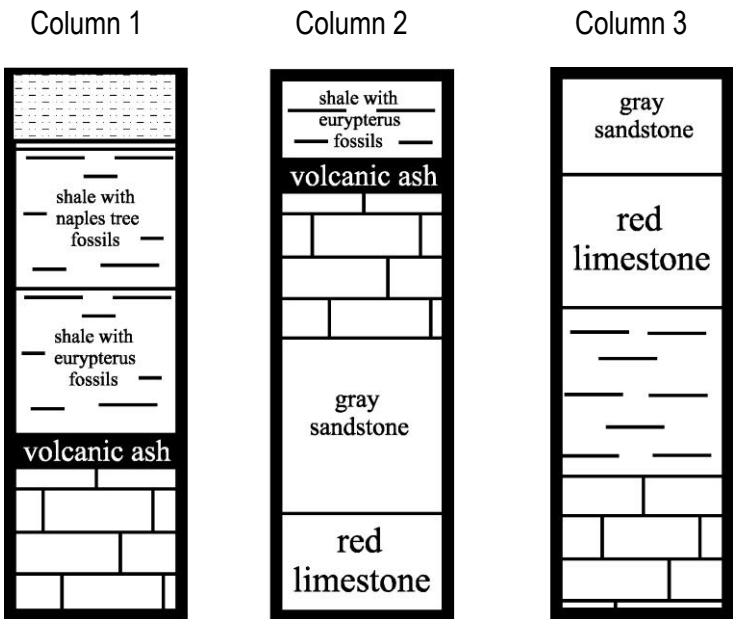
Topic: Earth History
Aim:

Rock Correlation: The matching of similar rock layers from different locations

“Walking the Outcrop” – visually noting similarities in rock types in exposed bedrock (especially in sequence)

Geologic Time Markers- “rapid” events that occur over a large area that can easily be matched up. (unconformities, volcanic ash deposits)

Matching Index Fossils - fossils of organisms that lived for a short time, but found over a large area (*****BEST WAY*****) (found in one row, but in every column)

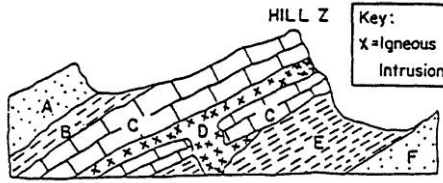


Oldest:	1	_____
	2	_____
	3	_____
	4	_____
	5	_____
	6	_____
	7	_____
	8	_____
Youngest:	9	_____

Relative Age Dating Review

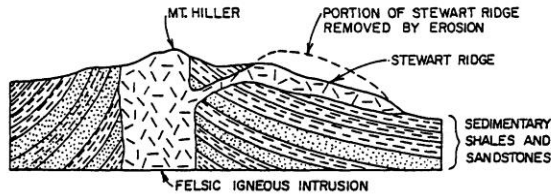
1. Which rock layer is probably the oldest?

- 1 A
- 2 F
- 3 C
- 4 D



2. Which geologic event occurred first?

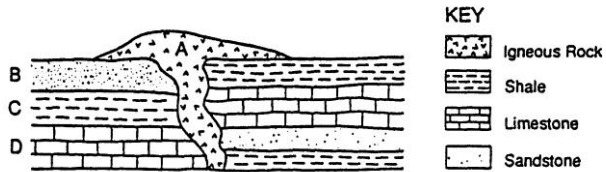
- 1 folding of the shales and sandstones
- 2 deposition of the shales and sandstones
- 3 erosion of part of Stewart Ridge
- 4 intrusion of the felsic igneous rock



3. The diagram below shows a geologic cross section of a portion of the Earth's crust that has not been overturned.

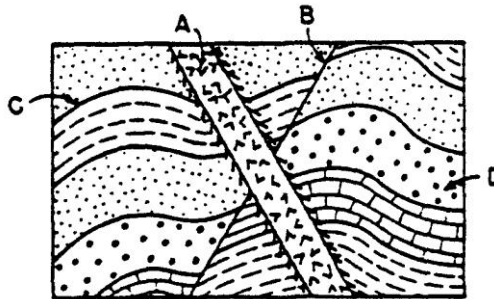
Which rock unit is the youngest?

- 1 A
- 2 B
- 3 C
- 4 D



4. The diagram below represents an exposed rock outcrop. Which geologic event occurred last?

- 1 the intrusion of A
- 2 the fault along line B
- 3 the fold at C
- 4 the deposition of gravel at D



5. A buried erosional surface (unconformity) always indicates that

- 1 part of the geologic record has been destroyed
- 2 a new form of life has appeared
- 3 a type of animal has become extinct
- 4 a series of lava flows have occurred

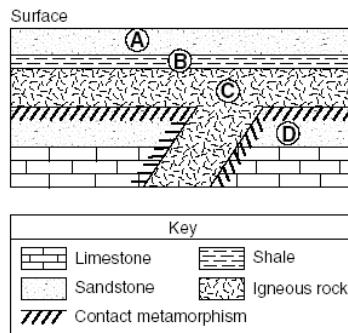
6. The gases in Earth's early atmosphere are inferred to have come primarily from

- (1) meteor showers
- (2) melting of glacial ice
- (3) evaporation of seawater
- (4) volcanic eruptions

7. The diagram shows a geologic cross section. Letters A through D represent different rock units.

Which sequence correctly shows the age of the lettered rock units, from oldest to youngest?

- (1) A → B → C → D
- (2) C → D → A → B
- (3) D → B → A → C
- (4) D → C → B → A



Topic: **Earth History**
Aim:

Absolute Age Dating -

recall

notes

1. What is radioactive decay?

The natural breakdown of an unstable element in a more stable one (decay product).

2. What is a half-life?

The time it takes for half of a radioactive material to breakdown (disintegrate) and become the stable decay product.

3. What radioactive isotopes are used in absolute age dating?

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

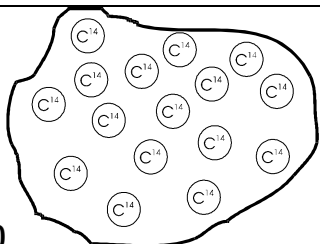
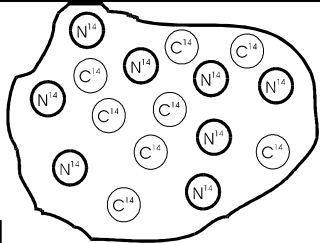
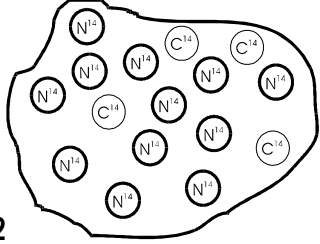
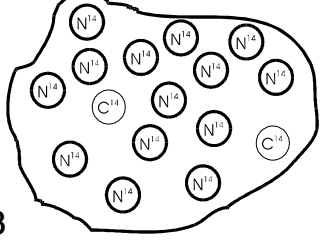
Carbon-14: used to date recent fossils (less than 50,000 years old)

Uranium-238: used to date oldest rocks on Earth (4.5×10^9 years)

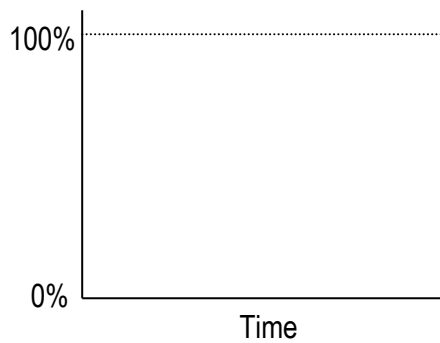
4. What factors affect the radioactive decay rate?

NOTHING !!!
decay rate does not change

RADIOACTIVE DECAY OF CARBON - 14

Number of Half-Lives	% Radioactive Material Remaining	% Stable Decay Product Formed	Fraction Radioactive Material Remaining	Fraction Stable Decay Product Formed	Age of Rock
0 					
1 					
2 					
3 					

Sketch of a Graph Illustrating Radioactive Decay:



Absolute Age Dating Practice

1. Why are radioactive materials useful for measuring geologic time?
 - (1) The disintegration of radioactive materials occurs at a predictable rate.
 - (2) The half-lives of most radioactive materials are less than five minutes.
 - (3) The ratio of decay products to undecayed material remains constant in sedimentary rocks.
 - (4) Measurable samples of radioactive materials are easily collected from most rock types.

2. After one half-life, how much of the original sample of U^{238} would remain?
 - (1) 12.5%
 - (2) 25.0%
 - (3) 50%
 - (4) 87.5%

3. If 25% of the radioactive potassium-40 in a sample is remaining, what is the approximate age of the rock?
 - (1) 1.3×10^9
 - (2) 2.6×10^9
 - (3) 3.9×10^9
 - (4) 4.5×10^9

4. The diagram to the right represents a sample of a radioactive isotope.

Sample before decay



Key	
■	Radioactive isotope
□	Decay product

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



(1)



(2)



(3)



(4)

5. A fossil shell contains 25% of the original amount of its carbon-14. Approximately how many years ago was this shell part of a living organism?
 - (1) 5,700 years ago
 - (2) 11,400 years ago
 - (3) 17,100 years ago
 - (4) 22,800 years ago

6. Fossil pollen has been recovered from sediments deposited in late-Pleistocene lakes. The pollen's geologic age can most accurately be measured by using
 - (1) rubidium-87
 - (2) potassium-40
 - (3) oxygen-18
 - (4) carbon-14

7. Which graph best shows the radioactive decay of carbon-14?

