

# Geologic Time NOTES

## OBJECTIVES:

**Correctly define:** principle of uniformitarianism, correlation, outcrop, index fossils, anomalies, unconformity, isotopes, outgassing, principle of superposition

## GEOLOGIC TIME:

- Explain that humans and dinosaurs never lived at the same time.
- Use the Earth Science Reference Tables to correctly place events on a geologic time line.
- Use the Earth Science Reference Tables to identify where in NY State rocks containing fossils would be likely to be found and not found.

## RELATIVE AGE:

- Determine the relative age of rock layers based on the following criteria:
  - **principle of superposition---oldest rock layers on bottom**
  - **intrusions are younger than the rocks they cut through**
  - **faults and folds are younger than the rocks they cut through**
- Determine the relative age of an igneous intrusion/extrusion based on evidence of contact metamorphism.
- Explain what an unconformity is and why it is important in dating rock layers.
- Correlate rock layers based on index fossil evidence.

## ABSOLUTE AGE:

- Explain how radioactive elements can be used to calculate the absolute age of a rock layer.
- Explain why radioactive isotopes are reliable to calculate absolute age.
- Calculate the absolute age of a rock based on radioactive decay data.
- Identify  $C^{14}$  as the radioactive isotope useful in determining the absolute age of organic materials

## THEORY OF EVOLUTION:

- Explain the theory of evolution.
- Explain how the fossil record supports this theory.

# Vocabulary

**Anomalies:**

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**Correlation:**

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**Index Fossils:**

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**Isotopes:**

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**Outcrop:**

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**Outgassing:**

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**Principle of Superposition:**

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**Principle of Uniformitarianism:**

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**Unconformity:**

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# Geologic Time

- Fossils can only be found in sedimentary rocks.
- Why is this statement false: “The caveman had dinosaur for breakfast.”?  
**man and dinosaurs never lived at the same time**
- Name the primary way that geologists find the absolute and relative ages of rock layers.
  - absolute age: radioactive decay---half-lives
  - relative age: index fossils

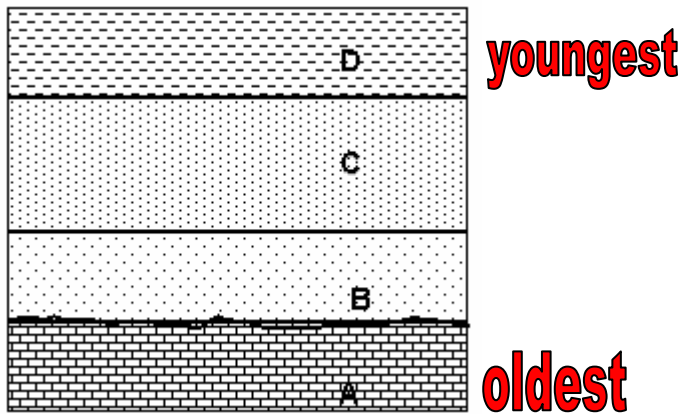
## Be able to answer these types of questions:

1. Approximately how many million years ago did the earliest amphibians appear? **362-418**
2. Approximately how many million years ago was the initial opening of the Atlantic Ocean? **142-206**
3. During which era did the earliest fish appear? Paleozoic
4. During which epoch did large carnivores appear? Pliocene
5. Of the following rocks which would be most likely to contain fossils? \_\_\_\_\_  
a. rhyolite    b. basalt    c. metaconglomerate    **d. limestone**
6. At Binghamton, NY what is age of the bedrock? Devonian (362-418 myo)
7. How does the age of the bedrock at Old Forge compare with that at Jamestown? it's older
8. Name a location in NY State where you may be able to find bedrock which was formed at the peak of the eurypterid's development. Silurian, [Niagara Falls, Syracuse]
9. Why would fossils be unlikely to be found in quartzite? **it's metamorphic**
10. For each of the following locations in NY State below, identify whether fossils would be likely or unlikely to be found:
  - Old Forge: unlikely
  - Binghamton: likely
  - Albany: likely

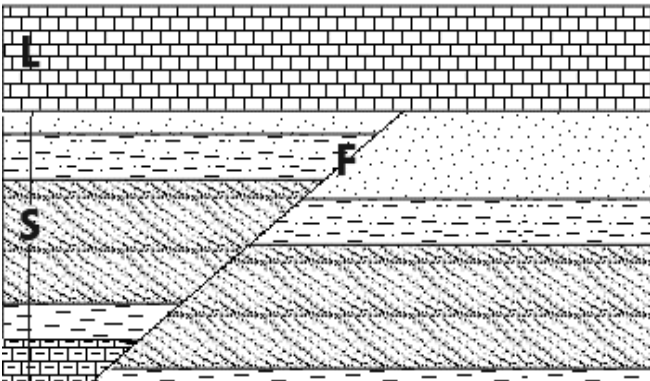
# Relative Age

- If a sedimentary rock outcrop has not been overturned, which layer would be the oldest? What is this principle known as? **the oldest layer is on bottom, the Principle of Superposition**

Using the principle above, label the strata below from oldest to youngest.



- Faults are always (older, **younger**) than the rocks they cut through.



Which is older:

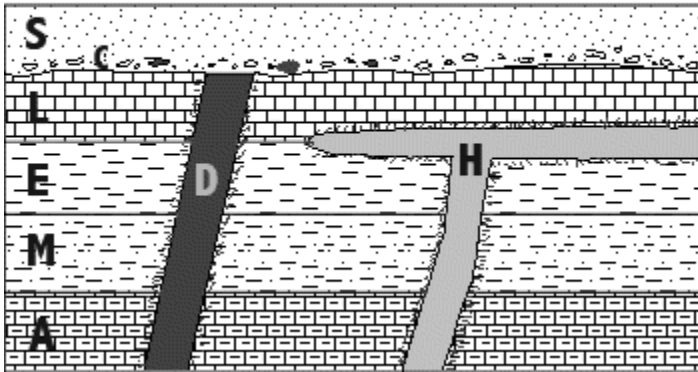
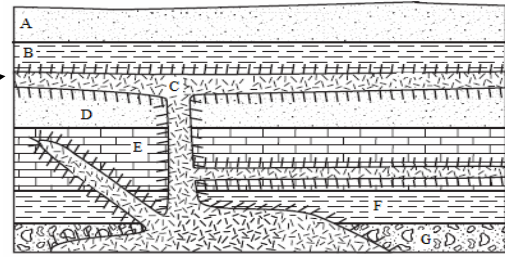
F or S: \_\_\_\_ S

How do you know? **F cuts through S, so S had to be there first which makes it older**

➤ If a geologist finds an igneous sill, how can she determine if the sill is an intrusion or an extrusion?

by looking at where there is contact metamorphism

Intrusions (formed inside)---  
 contact metamorphism all around  
 Extrusions (formed on surface)---  
 no contact metamorphism on top



Is "H" an intrusion or extrusion?

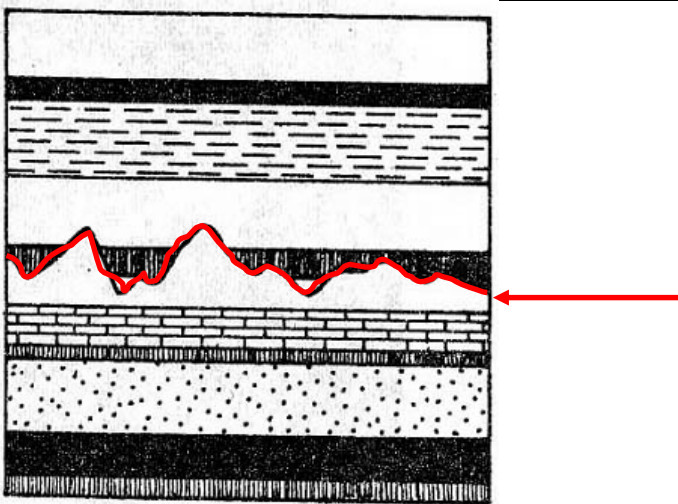
**H is an intrusion**

How can you tell?

**there is contact metamorphism all around**

## Unconformities

What is an unconformity?	How does it complicate the relative dating of rock layers?	What processes could lead to an unconformity?
a buried erosional surface	part of the rock record is missing	weathering, erosion



Using the diagram to the left, identify where the unconformity is located by drawing an arrow and writing the word "unconformity" next to it.

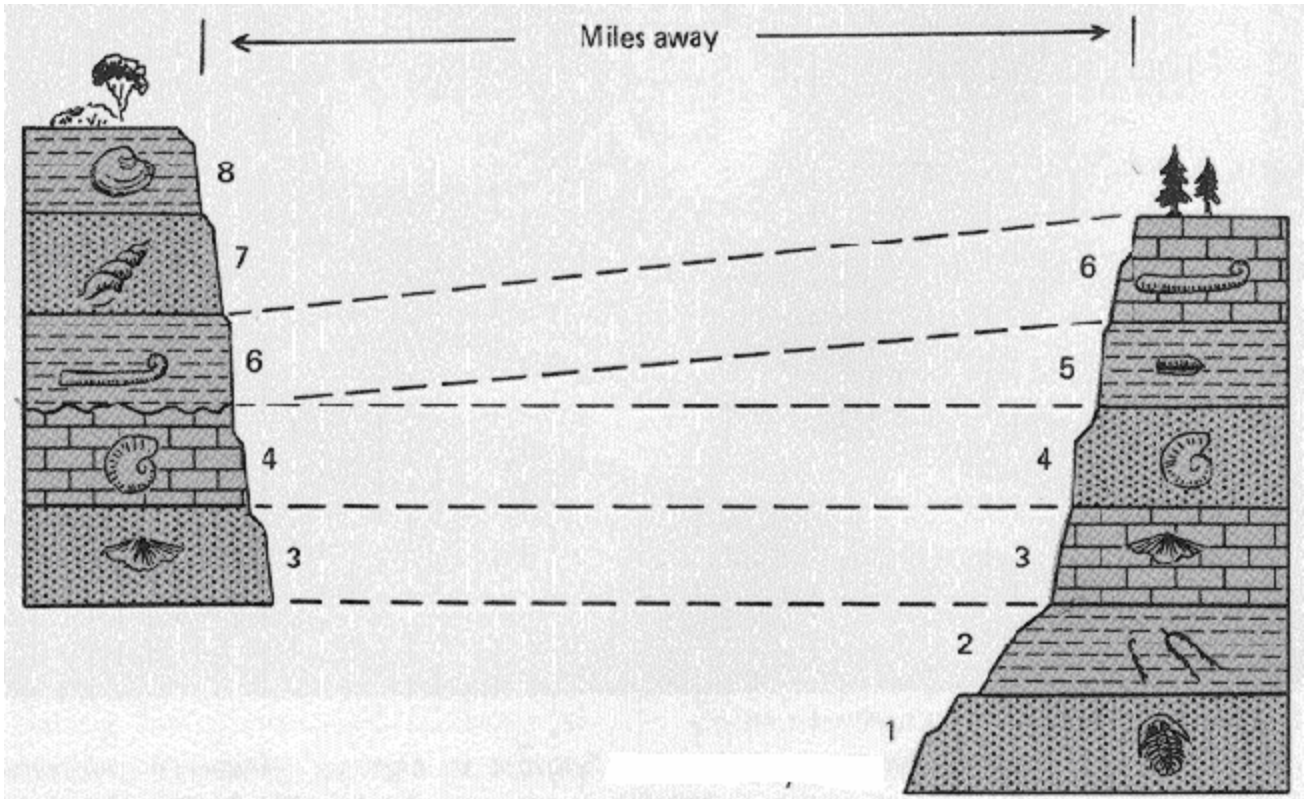
- What two characteristics must fossils have in order to be good index fossils?

must have lived over a large geographic area

must have lived for a short period of time

In the diagram below, a geologist has matched up rock layers based on index fossils.

In geology, this is referred to as CORRELATION



# Evolution

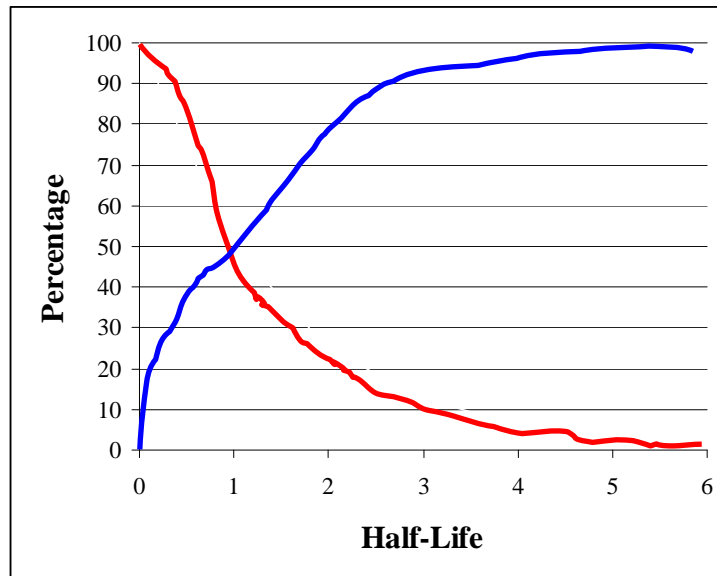
- Explain the theory of evolution.  
organisms adapt to their environment in order to survive
- Explain how the fossil record supports this theory.  
can see how different organisms have changed over time

Geologic Time

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# Absolute Age

- Why are radioactive isotopes useful in determining the absolute age of a rock?  
**their half-lives are constant**
- What can be done to change the half-life of a radioactive isotope? Why is this important?  
**NOTHING! It is reliable to calculate age.**
- Draw the generic graph for the half-life of a radioactive isotope.



- What radioactive isotope could be used to determine the absolute age of material that was recently living? **carbon-14**

**Be able to answer these types of questions:**

1. What is the half life of uranium-238? \_\_\_\_\_  
 a. 4500 years    b. 45,000 years    **c. 4,500,000,000 years**    d. 45,000,000,000 years
2. If there is a 100g sample of  $C^{14}$ , how many grams of  $C^{14}$  would remain after three half-lives? How long would this take? Show all work.



$$\begin{aligned}
 3 \text{ half-lives} \times (5.7 \times 10^3) &= 1.71 \times 10^4 \\
 &= 17,100 \text{ years}
 \end{aligned}$$