Determining Geologic Ages

Introduction

Evidence of past life on Earth can be found in the fossil record. **Fossils** are among the most important tools scientists use to interpret Earth's history. Not only can they help in dating rock layers, they also reveal the changing nature of life over the vast scale of Earth's history. Fossils and **relative** and **absolute dating** have also told us what we know about geologic changes on Earth—from the gradual rearrangements of the continents to cataclysms that caused mass extinctions.

In this investigation, you will try your hand at using fossils, relative dating, and radiometric dating to uncover some of Earth's history.

Problem

How can you interpret the fossil record to determine Earth's history?

Pre-Lab Discussion

Read the entire investigation. Then work with a partner to answer the following questions.

1. **Inferring** This activity incorporates information from Chapters 12 and 13. How are these two chapters related?

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2. **Inferring** Why is it important to have more than one dating technique available?

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3. **Using Analogies** Look at the Geologic Time Scale (Resource 10) in the DataBank. How are eras, periods, and epochs like the divisions used in textbooks?

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Name _____ Class _____ Date _____

4. **Posing Questions** Write a question that summarizes the purpose of this activity.

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Materials *(per pair of students)*

geologic block diagram (Figure 1)
logarithmic scale showing decay of U-235
Resource 10 in the DataBank
Resource 11 in the DataBank

Procedure

Part A: Understanding Relative Dating

1. Carefully study Figure 1, the geologic block diagram below. Use the rules you have learned for determining relative age to find the sequence of geologic events. List their letters from oldest to youngest in the space provided beside the figure.

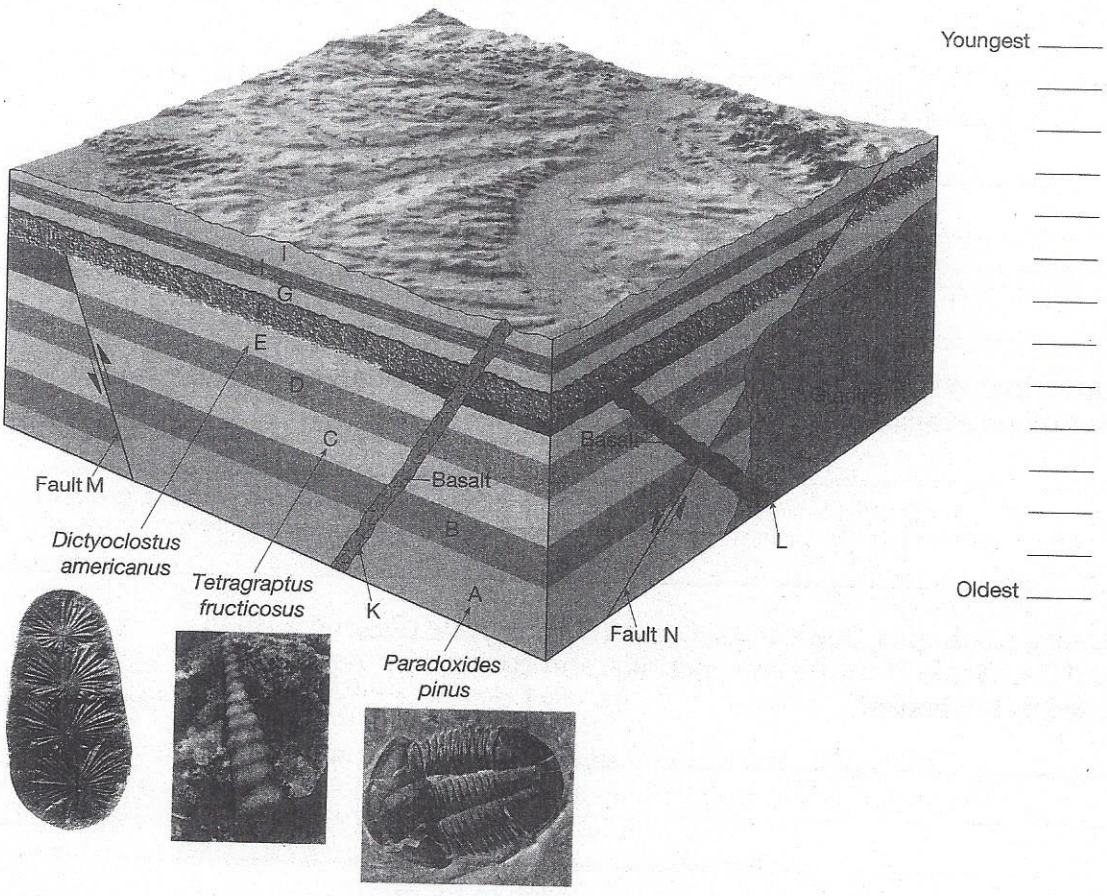


Figure 1

Name _____ Class _____ Date _____

Part B: Understanding Half-Life

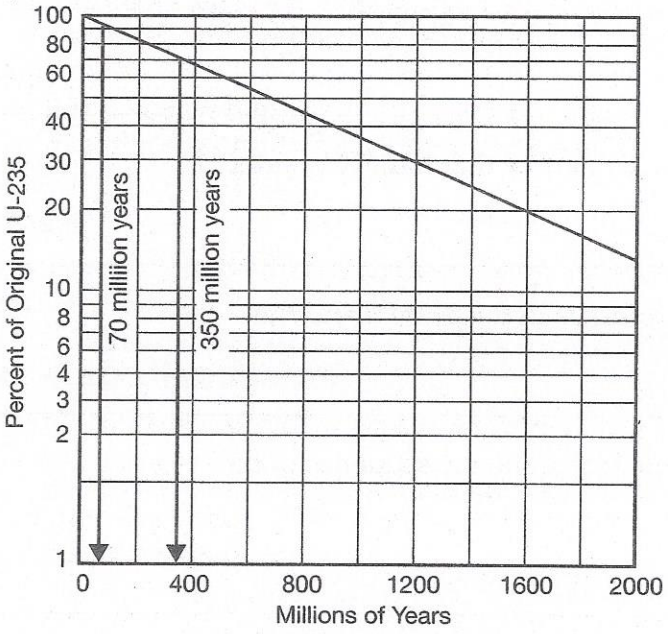
2. Study Data Table 1 below. It contains information about the parent-daughter ratios of the isotope uranium-235 (U-235) for several of the rock layers in the block diagram.

DATA TABLE 1

Parent-Daughter Percentages of Isotope U-235			
Rock Layer	**Percentage of U-235**	**Absolute Age**	**Period**
G	94		
F	90		
D	65		
B	60		

3. Study the graph Half-Life of U-235 below. The half-life graph is plotted on a logarithmic scale, which straightens the curved line for radioactive decay. This scale can make it easier to plot data, as well as easier to use when the parent-daughter ratio represents less than a single half-life. Use the graph to determine the absolute ages of the rock layers in the chart.

Half-Life of U-235



4. It takes 713 million years for half of a sample of U-235 to decay to lead-207. Use the Geologic Time Scale (Resource 10 in the DataBank) to complete Date Table 1 with the period during which each rock layer formed.

Name _____ Class _____ Date _____

Part C: Understanding Index Fossils

5. Complete Data Table 2 below using the Geologic Time Scale (Resource 10) and the Key to Index Fossils (Resource 11) in the DataBank to determine approximate absolute ages for the rock layers in the block diagram (Figure 1) that display index fossils.

DATA TABLE 2

Approximate Age of Index Fossils			
Rock Layer	**Index Fossil**	**Period**	**Approximate Age**
C			
E			
A			

Analysis and Conclusions

1. **Applying Concepts** Which law, principle, or doctrine of relative dating did you apply to determine the relative ages of rock layers H and I?

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2. **Applying Concepts** Which law, principle, or doctrine of relative dating did you apply to determine the relative ages of fault M and rock layer F?

_____

3. **Applying Concepts** Explain how you know that fault N is older than the igneous intrusion J.

_____

4. **Inferring** Why are there no index fossils in the granite and the basalt?

_____

5. **Applying Concepts** How did you determine the sequence of the three igneous intrusions?

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6. **Problem Solving** How is it possible for two distinct rock layers to derive from the same period?

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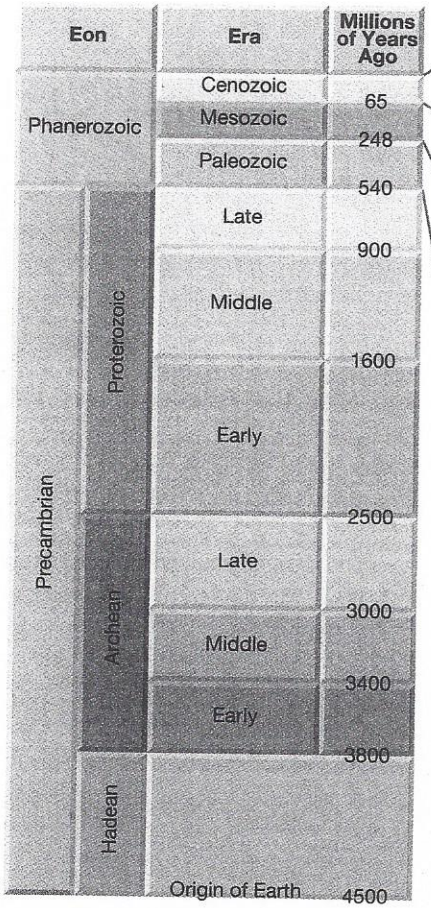
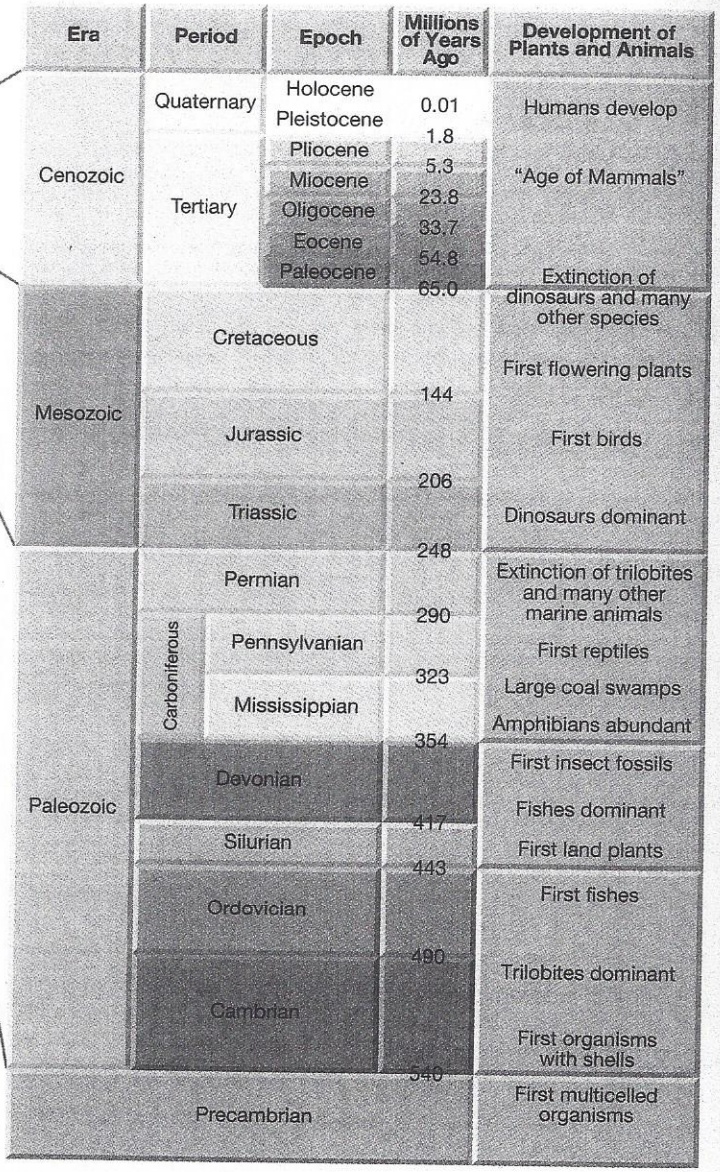
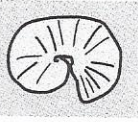
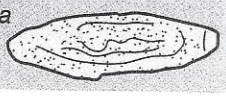
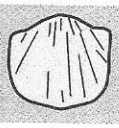
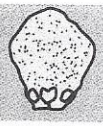
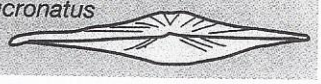
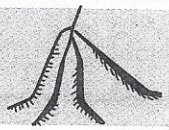
Resource 10 The Geologic Time Scale

DataBank





Resource 11 Key to Index Fossils

CENOZOIC ERA (Age of Recent Life)	Quaternary Period	*Pecten gibbus* 	*Neptunea tabulata* 
	Tertiary Period	*Calyptraphorus velatus* 	*Venericardia planicosta* 
MESOZOIC ERA (Age of Medieval Life)	Cretaceous Period	*Scaphites hippocrepis* 	*Inoceramus labiatus* 
	Jurassic Period	*Perisphinctes tiziani* 	*Nerinea trinodosa* 
	Triassic Period	*Trophites subbullatus* 	*Monotis subcircularis* 
PALEOZOIC ERA (Age of Ancient Life)	Permian Period	*Leptodus americanus* 	*Parafusulina bosei* 
	Pennsylvanian Period	*Dictyoclostus americanus* 	*Lophophyllidium proliferum* 
	Mississippian Period	*Cactocrinus multibrachiatus* 	*Prolecanites gurleyi* 
	Devonian Period	*Mucrospirifer mucronatus* 	*Palmatolepus unicornis* 
	Silurian Period	*Cystiphyllum niagarense* 	*Hexamoceras hertzeri* 
	Ordovician Period	*Bathyurus extans* 	*Tetragraptus fructicosus* 
	Cambrian Period	*Paradoxides pinus* 	*Billingsella corrugata* 
PRECAMBRIAN	— — — —		

DataBank