Name: _____ Period:_____

RELATIVE AGE DATING LAB

INTRODUCTION

Scientists have good evidence that the Earth is very old, approximately four and one-half billion years old. Scientific measurements, such as radiometric dating use the natural radioactivity of certain elements found in rocks to help determine their **"absolute age"**. Scientists also use direct evidence from observations of the rock layers themselves to help determine the **"relative age"** of rock layers. Specific rock formations are indicative of a particular type of environment existing when the rock was formed. For example, most limestone was deposited in a marine environment, whereas, a sandstone with ripple marks might indicate a shoreline environment or a riverbed.

The study and comparison of exposed rock layers, or strata, in various parts of the Earth led scientists in the early 19th century to propose that the rock layers could be correlated from place to place. Locally, physical characteristics of rocks can be compared and correlated. On a larger scale, even between continents, fossil evidence can help in correlating rock layers. The **Law of Superposition**, which states that in undisturbed horizontal sequence of rocks, the oldest rock layers will be on the bottom with successive younger rocks on top, helps geologists correlate rock layers around the world. By matching partial sequences, the truly oldest layers with fossils can be determined.

By correlating fossils from various parts of the world, scientists are able to give relative ages to particular strata; this is called **relative age dating**. Relative dating tells scientists if a rock layer is "older" or "younger" than another. This would also mean that fossils found in the deepest layer of rocks in an area would represent the oldest forms of life in that particular area. In reading Earth history, these layers would be "read" from bottom to top, or oldest to most recent. If certain fossils are typically found in many places worldwide, they may be useful as "**INDEX FOSSILS"** in determining the age of undated strata in other locations.

By using this information from rock formations in various parts of the world and correlating the studies, scientists have been able to establish the relative geologic time scale. This relative time scale divides the vast amount of Earth history into various sections based on **geological events** (sea-level rises and falls, mountain-building, and depositional events), and notable **biological events** (appearance, relative abundance, or extinction of certain life forms).

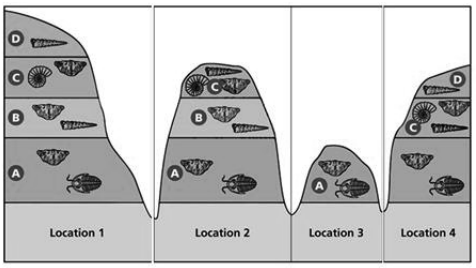
OBJECTIVES:

When you complete this activity, you will be able to:

- To understand the history of geologic thought and relate the concepts to establishing the relative age of the Earth,
- Sequence information using items witch overlap specific sets,
- Relate sequencing to the Law of Superposition, and
- Show how index fossils can be used to establish relative dates of rock layers.

While every fossil tells us something about the age of the rock it's found in, **index fossils** are the ones that tell us the most. Index fossils (also called key fossils or type fossils) are those that are used to define periods of geologic time. A good index fossil is one with four characteristics:

- it is distinctive,
- widespread,
- abundant, and
- limited in geologic time.



Because most fossil-bearing rocks formed in the ocean, the major index fossils are marine organisms. That being said, certain land organisms can also useful in young rocks and in specific regions.

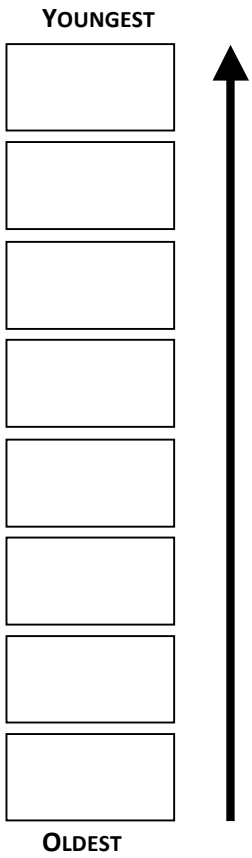
Any type of organism can be distinctive, but not so many are widespread. Many important index fossils are of organisms that start out life as floating eggs and infant stages, which allowed them to populate the world using ocean currents. The most successful of these became abundant, yet at the same time, they became the most vulnerable to environmental change and extinction. Thus, their time on Earth may have been confined to short period of time.

PROCEDURE FOR CARD SET A

a. Cut the cards labeled **Card Set A** apart.
b. Spread the cards with the letters and pictures on the table and determine the correct sequence of the eight (8) cards by comparing the letters and fossils that are common to individual cards, and therefore, overlap. The first card in the sequence, the oldest card, has **Card # 1 Set A** written in the lower left-hand corner and represents the bottom of the sequence. If the letters "T" and "C" represent fossils in the oldest rock layer, they are the oldest or first fossils formed for this sequence of rocks.
c. Now, look for another card that has either a "T" or "C" written on it. Since this card has a common letter with the first card, it must go on top of the "TC" card. The fossils represented by the letters on this card are "younger" than the "T" or "C" fossils on the "TC" card. Remember, the "TC" card represents the oldest fossils in this rock formation.
d. Sequence the rest of the cards by using the same process. When you finish, you should have a vertical stack of cards with the top card representing the youngest fossils of this rock sequence and the "TC" card at the bottom of the stack representing the oldest fossils.

ANALYSIS QUESTIONS:

1. After you have arranged the cards in order, write your sequence of letters in the space below. Starting with the bottom card, the letters should be in order from oldest to youngest. Label the rock layers 1-8 with the oldest layer (TC) being rock layer 1.



1. How do you know that fossil "X" is older than fossil "M"?
_____
_____
_____
_____
_____

2. Explain why fossil "D" in the rock layer represented by card DM is the same age as fossil "M"? _____
_____
_____
_____
_____

3. Explain why fossil "D" in the rock layer represented by card OXD is older than fossil "D" in the layer represented by card "DM"? _____
_____
_____
_____
_____

4. In your own words, describe the **Law of Superposition** and how it helps geologists determine the **relative age** of rock layers. _____
_____
_____
_____

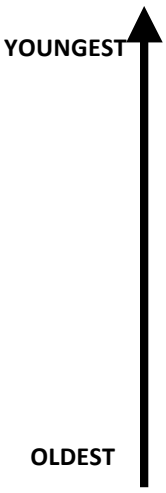
PROCEDURE FOR CARD SET B:

a. Carefully examine the second set of cards which have sketches of fossils on them. Each card represents a particular rock layer with a collection of fossils that are found in that particular rock stratum. All of the fossils represented would be found in sedimentary rocks of marine origin. Figure 2-A gives some background information on the individual fossils.

b. The oldest rock layer is marked with the letter "**M**" in the lower left-hand corner. The letters on the other cards have no significance to the sequencing procedure and should be ignored at this time. Find a rock layer that has at least one of the fossils you found in the oldest rock layer. This rock layer would be younger as indicated by the appearance of new fossils in the rock stratum. Keep in mind that **extinction is forever**, once an organism disappears from the sequence it cannot reappear later. Use this information to sequence the cards in a vertical stack of fossils in rock strata. Arrange them from oldest to youngest with the oldest layer on the bottom and the youngest on top.

ANALYSIS QUESTIONS:

5. Using the letters printed in the lower left-hand corner of each card, write the sequence of letters from the youngest layer to the oldest layer (i.e., from the top of the vertical stack to the bottom). This will enable your teacher to quickly check whether you have the correct sequence.



6. What are “index fossils”? Which fossil organisms could possibly be used as index fossils? Explain your answer.

_____
_____
_____
_____

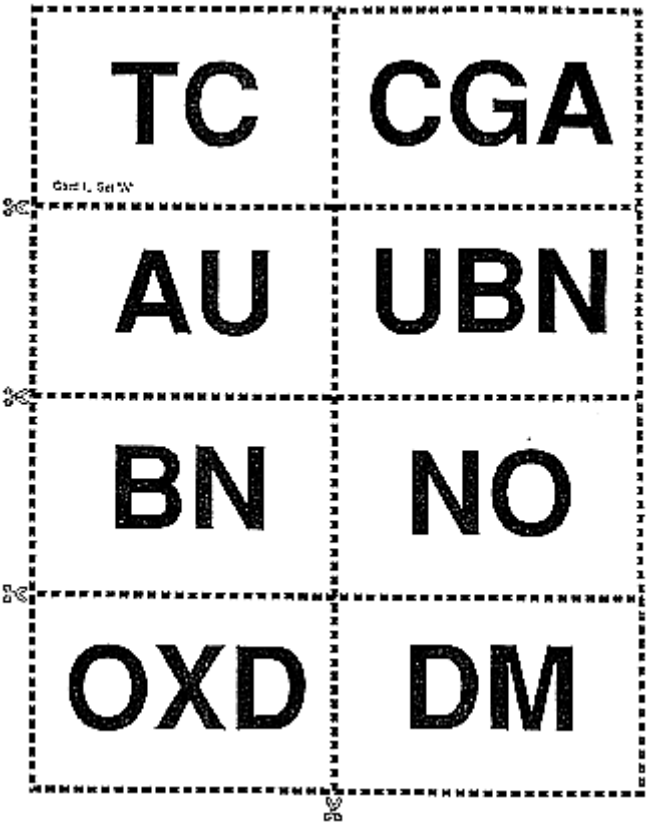
7. Name three organisms represented that probably could **NOT** be used as index fossils and explain why. _____

_____
_____
_____
_____

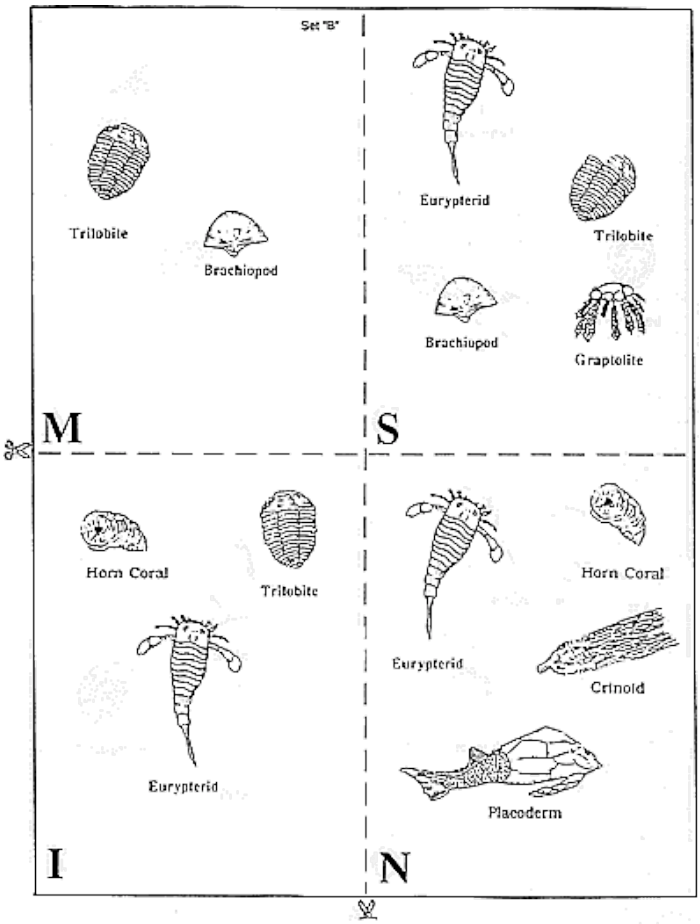
8. In what kinds of rocks (igneous, metamorphic, or sedimentary) might you find the fossils from this activity? Explain your reasoning. _____

_____
_____
_____

CARD SET A



CARD SET B



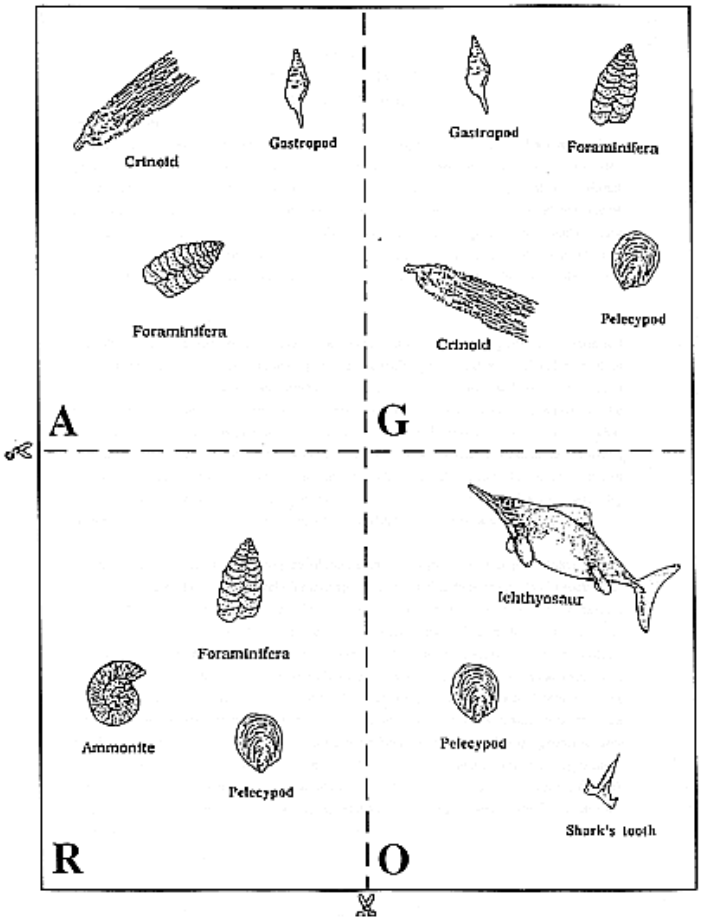
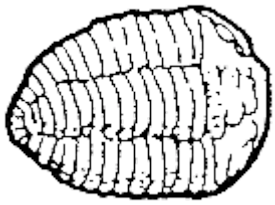
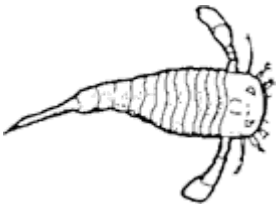


FIGURE 2-A. SKETCHES OF MARINE FOSSIL ORGANISMS (NOT TO SCALE)

NAME: Brachiopod
PHYLUM: Brachiopoda
DESCRIPTION: "Lampshells"; exclusively marine organisms with soft bodies and bivalve shells; many living species



NAME: Trilobite
PHYLUM: Arthropoda
DESCRIPTION: Three-lobed body; burrowing, crawling, and swimming forms; extinct

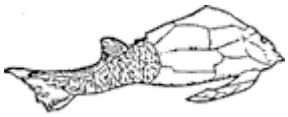


NAME: Eurypterid
PHYLUM: Arthropoda
DESCRIPTION: Many were large (a few rare species were 5 feet in length); crawling and swimming forms; extinct

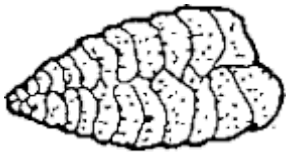
NAME: Graptolite
PHYLUM: Chordata
DESCRIPTION: Primitive form of chordate; floating form with branched stalks; extinct

NAME: Horn coral
PHYLUM: Coelenterata (Cnidaria)
DESCRIPTION: Jellyfish relative with stony (Cnidaria)(calcareous) exoskeleton found in reef environments; extinct

NAME: Crinoid
PHYLUM: Echinodermata
DESCRIPTION: Multibranched relative of starfish; lives attached to the ocean bottom; some living species ("sea lilies")



NAME: Placoderm
PHYLUM: Vertebrata
DESCRIPTION: Primitive armored fish; extinct



NAME: Foraminifera (microscopic type)
PHYLUM: Protozoa (Sarcodina)
DESCRIPTION: Shelled, amoeba-like organism

NAME: Gastropod
PHYLUM: Mollusca
DESCRIPTION: Snails and relatives; many living species

NAME: Pelecypod
PHYLUM: Mollusca
DESCRIPTION: Clams and oysters; many living species

NAME: Ammonite
PHYLUM: Mollusca
DESCRIPTION: Squid-like animal with coiled, chambered shell; related to modern-day Nautilus

NAME: Icthyosaur
PHYLUM: Vertebrata
DESCRIPTION: Carnivore; air-breathing aquatic animal; extinct

NAME: Shark's tooth
PHYLUM: Vertebrata
DESCRIPTION: Cartilage fish; many living species

Stratigraphic Section for Set B