NAME _____ DATE_____

PARTNER(S)_____

READING THE ROCK RECORD

It is a beautiful summer day and you are driving in Western Maryland approximately 6 miles west of Hancock in Washington County on Interstate 68. Suddenly you come upon an amazing passage through different colored rock layers exposed by the road cut. The slightly curved, lighter-colored horizontal lines are the result of the blasting to form the roadway but the reds, whites, and grey-blues are natural. This exposure is a site named Sideling Hill. You find yourself wondering how the formation was produced and how old the rocks are.

How would you go about determining the relative ages of the rock layers?

How do you think geologists know the history of this formation?

Activity 1: Laying the Foundations

Let's begin by investigating Earth material layers and how they can be modified by tectonic forces. We are going to model rock layers using play dough.

1. Obtain samples of 3 different colors of play dough.

2. Each material will represent a different rock layer. In the table below, list the colors. You will use the colors to identify the layers in diagrams later in this activity. Use the last column to indicate the order in which you assemble the layers.

Table of Play Dough Rock Layers

Color	Initial Layer Position (1=bottom)

3. Roll or pat out the first sample into a 1/4 inch layer on a paper plate to make a flat rectangle about 2 inches by 6 inches. Repeat with the other 2 colors. Carefully place each layer on top of the next in the order in the chart. As you make play dough sandwich you are illustrating the **principle of original horizontality**. This principle states that generally most sediments or lava flows solidify as horizontal layers

   If you had to "date" the layers based on the time they were placed on the plate, which of your layers would be youngest and which would be oldest?

   The concept that younger rocks are generally deposited on top of older rocks is called the **principle of superposition**. In any unaltered rock layer sequence, a geologist will assume that the oldest rock will be on the bottom and the youngest on top.

4. Look back at the photo of Sideling Hill on the first page of this activity. How are your play dough layers and the layers in the photograph different? (We already know that they are different composition so make observations beyond that point.)

   How do you suppose the layers in Sideling Hill achieved their shape?

   What can you do anything to make your layers look like Sideling Hill? Do it.

Draw what your modified play dough sandwich looks like viewing on-edge using the correct layer colors.

When rock layers form a downward-pointing arch, or a trough, it is called a **syncline**.

Bend the play dough sandwich to form an arch with the highest point in the center. Diagram and color the sandwich again. The upward-pointing arch you generated is called an **anticline** when describing a rock formation.

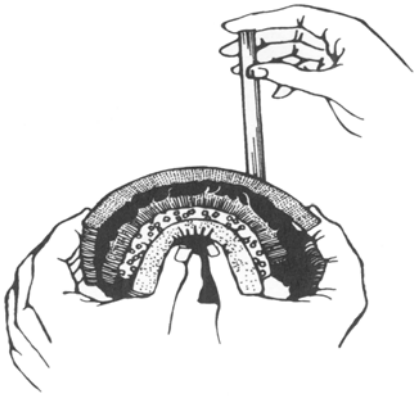
Do the relative ages of the rock layers change when they form a syncline or anticline? Explain your answer.

Synclines and anticlines are types of rock layer **folds**.

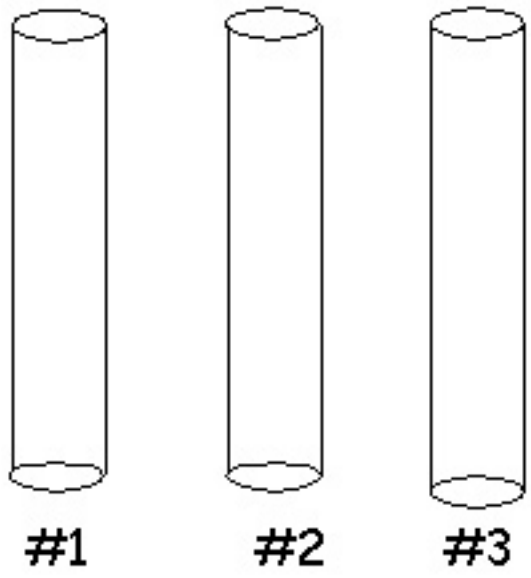
5. Sideling Hill is a beautiful example of exposed rock layers. However, most of the time geologists do not have the rock layers exposed so clearly for study. Image that your rock sandwich was buried under some soft materials and you could not see it. Without major digging, how could you could get information about the composition and/or number of layers in the play dough sandwich?

Geologists use a technique called core sampling. An open cylindrical bore is drilled into the ground. When it is extracted, it brings up a cylindrical sampling of the rocks it drilled through. You will get a core sample from your rock sandwich using a straw to simulate the bore.

You will be taking 3 core samples from different parts of your play dough sandwich.



Have one member of your group hold the sandwich in anticline form. Another member should get straw "bores". Drill down into your rocks as shown here. Take one sample from the left side (#1), one from the middle (#2), and one from the right side (#3). Be sure you go through all the layers. It may be easier to bend the layers over a Styrofoam cup or a bent paper plate when you make the cores. Be sure that you "drill" straight down as shown above and not at an angle. Be careful to remove the straw and lay it down **without rotating it**.



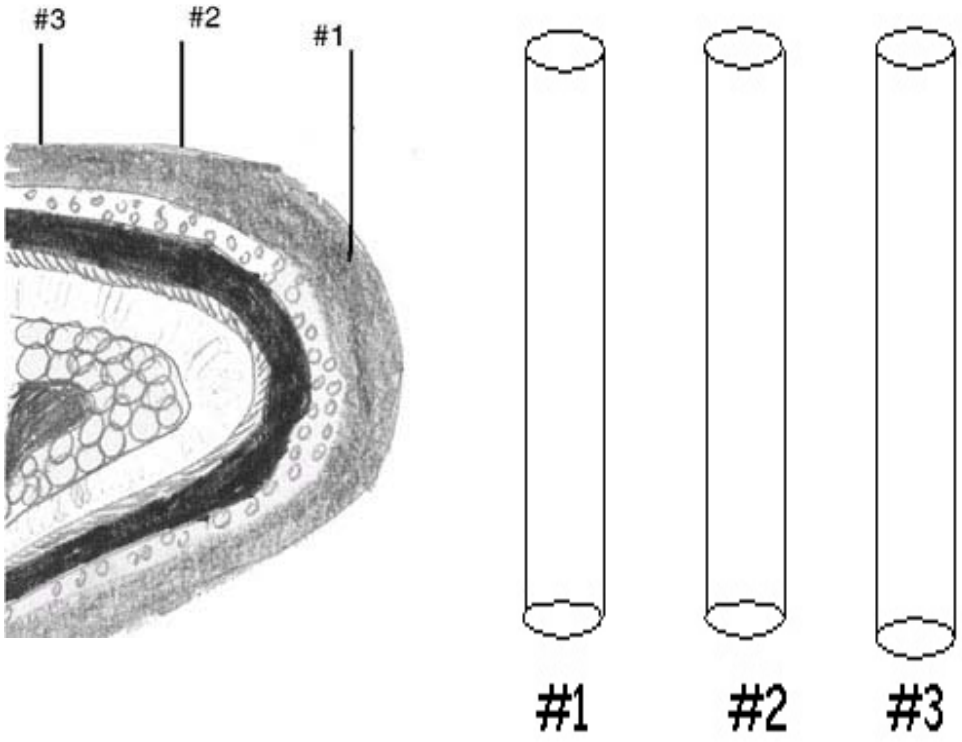
Draw the resulting core samples exactly as they appear in the core cylinders. Color each layer appropriately.

What do you notice about the right and left samples compared to the middle sample?

How can you tell that you have sampled around the center of an anticline or syncline from these core samples?

If you just took one core sample and it looked like #1 or #3 could you tell if you were sampling from a syncline or anticline? Explain.

6. Let's apply what you have discovered. Look at the segment of rock formation below. Draw the core samples you would get if you drilled at the indicated locations.



How would your conclusions about the rock formation compare if you saw only core #1 and not cores #2 and #3?

How would you know from the core sample that this formation had been folded on itself?

If you used disposable drinking straws to do the sampling, dispose of them in the trash. If you used a plastic cylinder provided by the instructor, clean it out by poking the contents through with a drinking straw and washing the cylinder with soap and water.

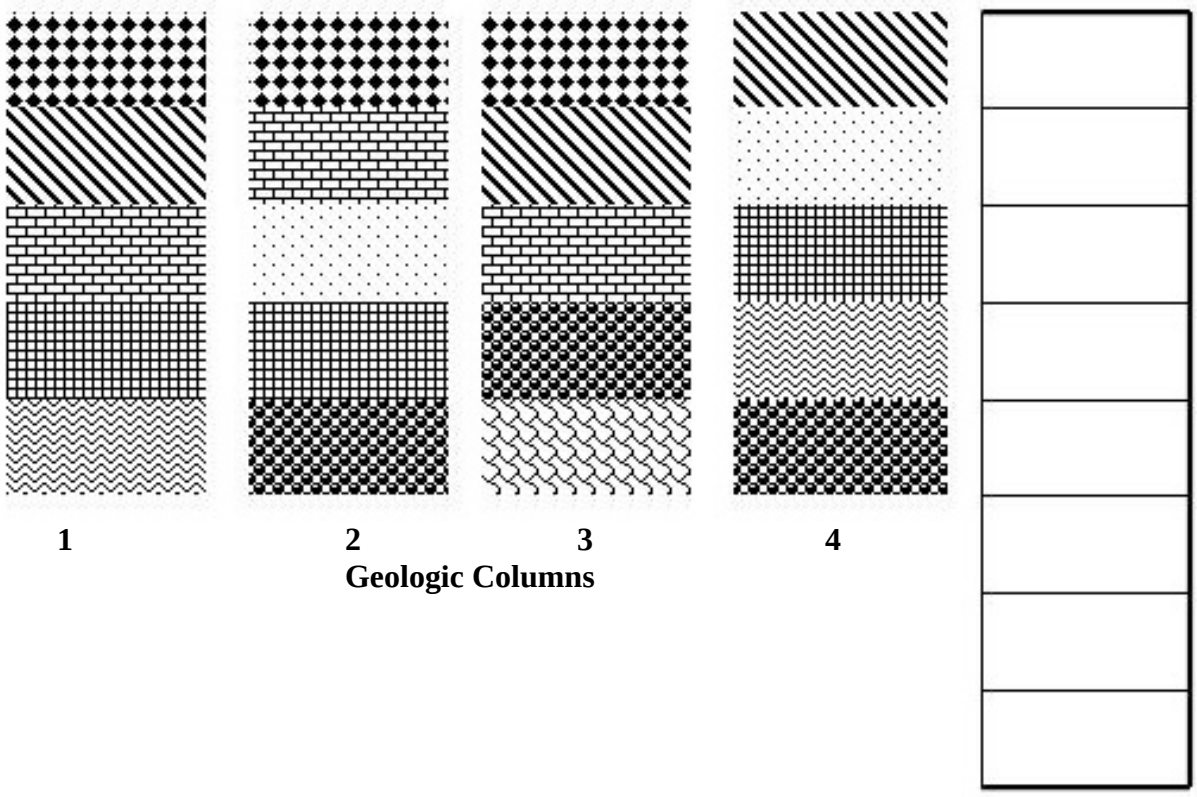
7. Suppose that some geologic process had caused a break in the rock layer, a fault, rather than a fold. Let's simulate this by straightening your layers and cutting the play dough sandwich in half so that you now have two equal pieces. Raise one half up slightly compared to the other. What happens to the alignment of the layers? Sketch what the resulting rock formation looks like. Be sure to add colors for each layer.

You can get more information on our Maryland geologic wonder, Sideling Hill, from the following Maryland Geologic Survey (MGS) site:
http://www.mgs.md.gov/esic/brochures/sideling.html

Activity 2: Not All Rock Strata are Created Equal

Once rocks begin to weather and erode, the original igneous base will be overlaid with layers of sediments and, in some cases, lava flows. A layer of sedimentary rock distinct from the layers above and below is called a **rock stratum (pl. strata)**. In Activity 1 we saw how these strata could be deformed over time. If we look at the rock strata from one region and compare it to a different region some distance away, we find that the strata may not be the same. The two formations may have some layers in common but there also may be layers interposed at one site that do not occur at the second site because of conditions at the second site over time. Can we still sequence the relative ages of the rocks? Why?

1. Here are four cross-sections that represent cores of rock strata from four locations. Each pattern indicates a rock of a particular composition. Strata with the same pattern are the same age. Using the principle of superposition, generate one geologic column from these samples with the oldest rock layer on the bottom and the youngest on top



1 **2** **3** **4**

Geologic Columns

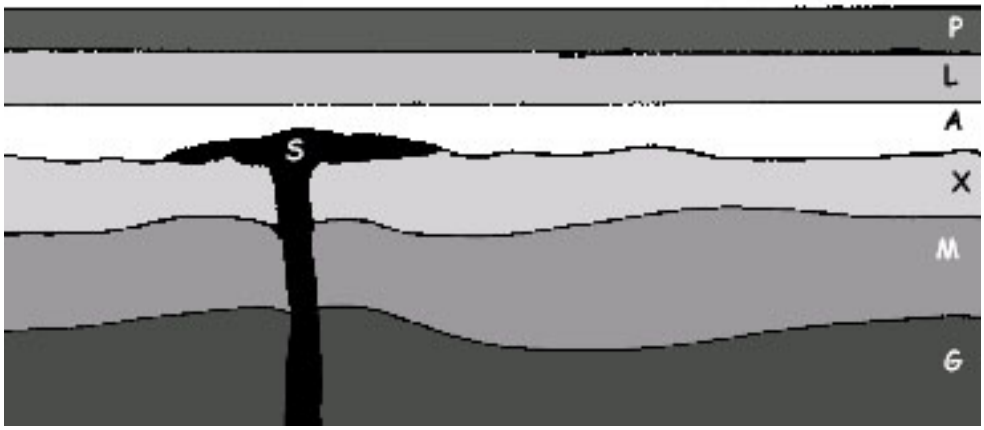
Composite Column

Sometimes the interposed layers contain fossils whose age can be determined by radioactive dating methods (http://pubs.usgs.gov/gip/geotime/radiometric.html). This allows a geologist to put an approximate date of formation to a particular layer (and those above and below). Geologists can also tell the age if the fossils are identified. The **principle of faunal succession** states that over time, organisms of the Earth have changed in a definite order reflected in the fossil record. If a geologist finds a particular fossil in a location he or she knows the approximate age of the formation because that fossil existed for a certain definable period of Earth's history.

Sometime a rock formation will be penetrated by molten rock that forces its way through weakness in the formation. The new rock that forms in this way is called an **intrusion**. Would this intrusion rock be older or younger that the rock it forms in? Explain.

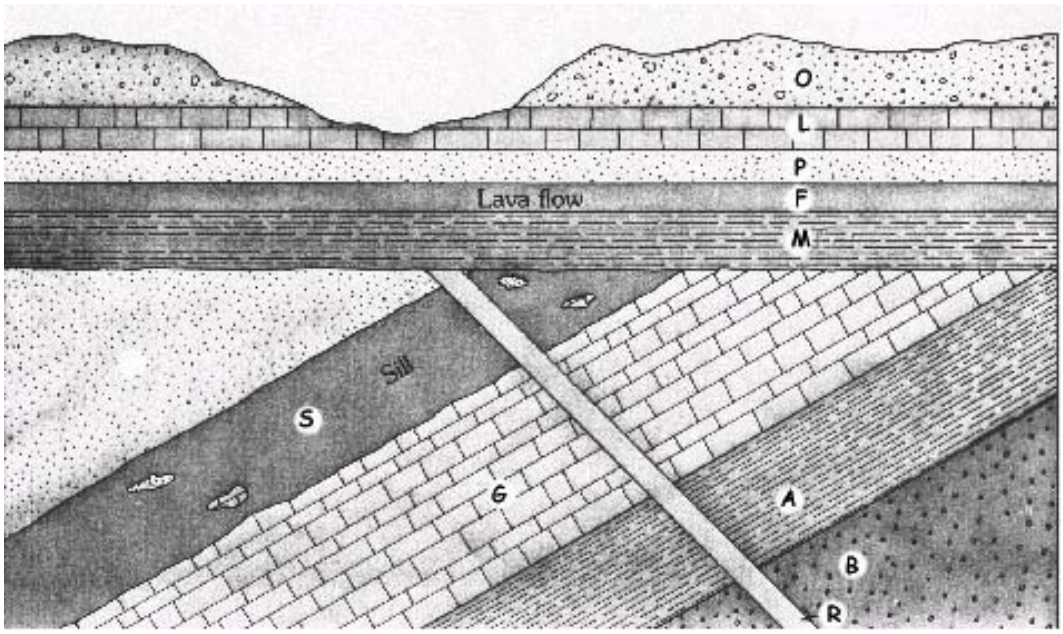
The **principle of cross-cutting relationships** states that any intrusive formation must be younger than the rock which it cuts and any fault must be younger than the rocks it cuts through.

2. Using the principles of superposition and cross-cutting relationships, determine the relative ages of the rock layers in the rock formation diagramed below.



Oldest_____Youngest

3. Look at the diagram that follows. Using the principles of superposition and cross-cutting relationships, determine the relative ages of the rock layers in this rock formation.



Adapted from and illustration by Dennis Tasa, Merrill Publishing Co

Oldest _____Youngest

4. What process(es) might account for the missing portions of layers K and J?