 Name ___________________________________

This lab will introduce you to Remote Sensing, or an analysis of a geographic area via aerial (or satellite) data.

If you have ever been in an airplane, you would notice immediately that those not in the aeronautical industry have a difficult time recognizing objects from the air. We are not used to the different perspective of seeing things from above. Remote sensing is all about analyzing and identifying objects from above – which can come in handy in a number of disciplines – aerospace, geology, hydrology, demographics – just to name a few.

OK, so let's start easy. Here is an aerial shot of a typical suburb area (see Plate 1 for color version). All of the buildings you see are single-family dwellings. How many single-family dwellings can you identify in this picture? Record your answer in the data table below.

If north is up, which direction is the sun shining FROM? (Hint: look at the shadows).
Again using shadows, about what time of the day was the picture taken: morning, noon, late afternoon, evening or night?

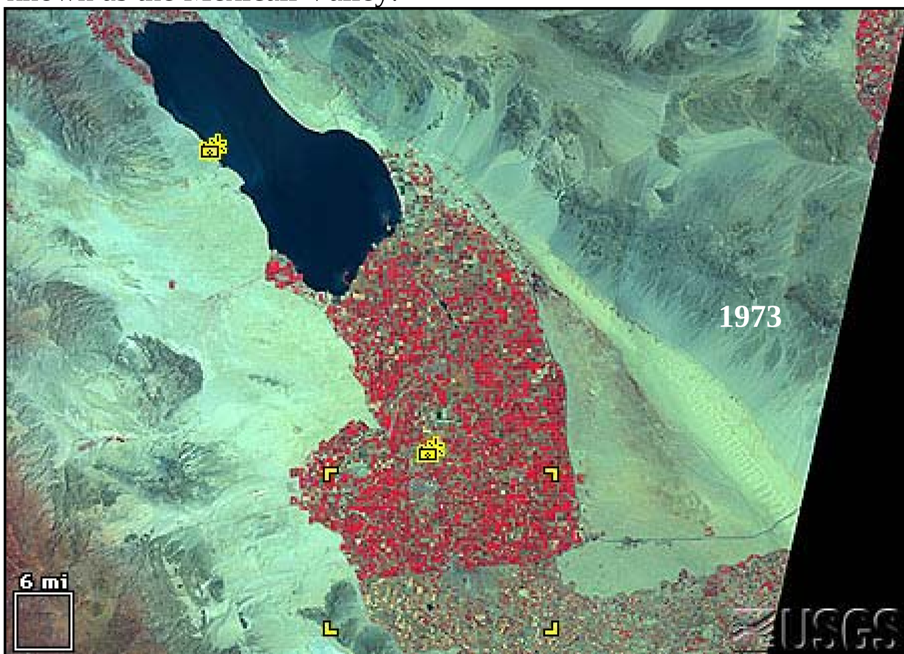
Finally, how many cars can you find?

Number of single-family dwellings?	
Direction sun is shining from?	
Approximate time of day picture was taken? (morning, noon, late afternoon, evening or night)	
Number of cars?	

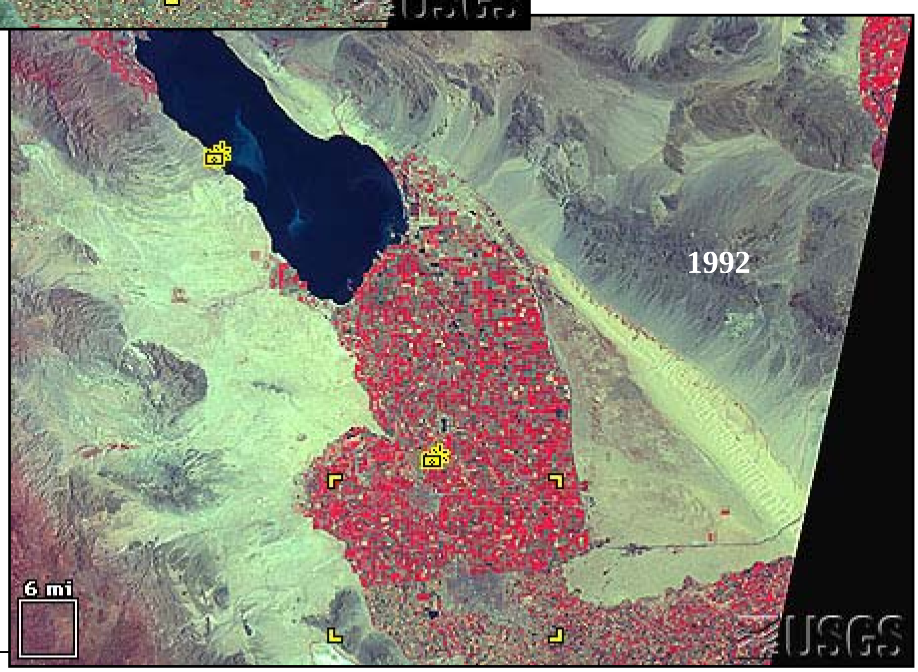
Name ______________________________

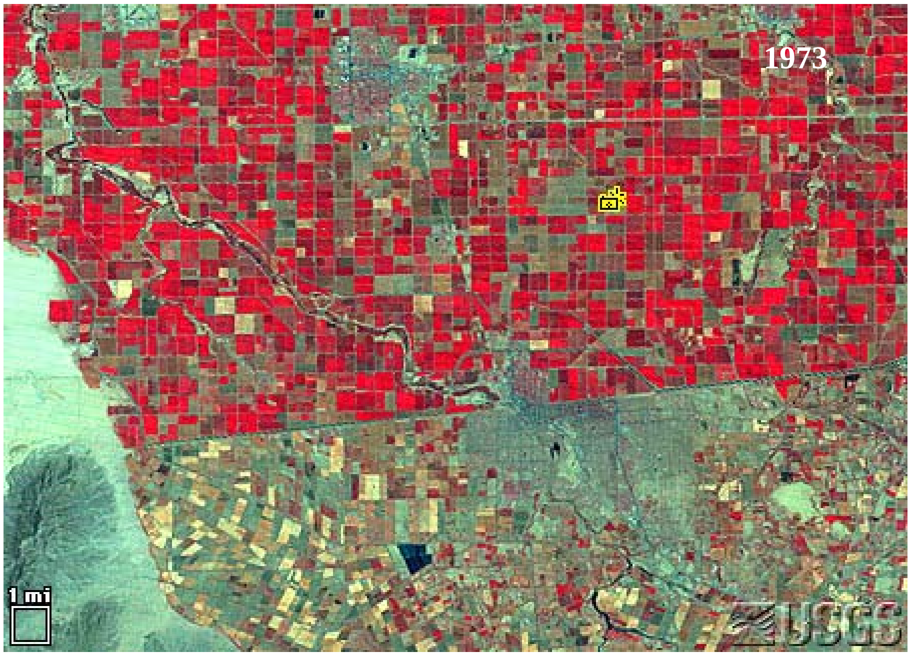
Different cameras can be used to examine trends in demographics, geology, or land use. These two images were taken of the Imperial Valley. The top image was taken in 1973, the bottom image in 1992. In an infrared image, brighter colors are associated with areas that are giving off a lot of heat (they're warm). Dark areas are cooler areas. Large bodies of water (which are generally cool) show up as black or dark blue. Lush vegetation shows up as red, scrub vegetation as a very pale red.

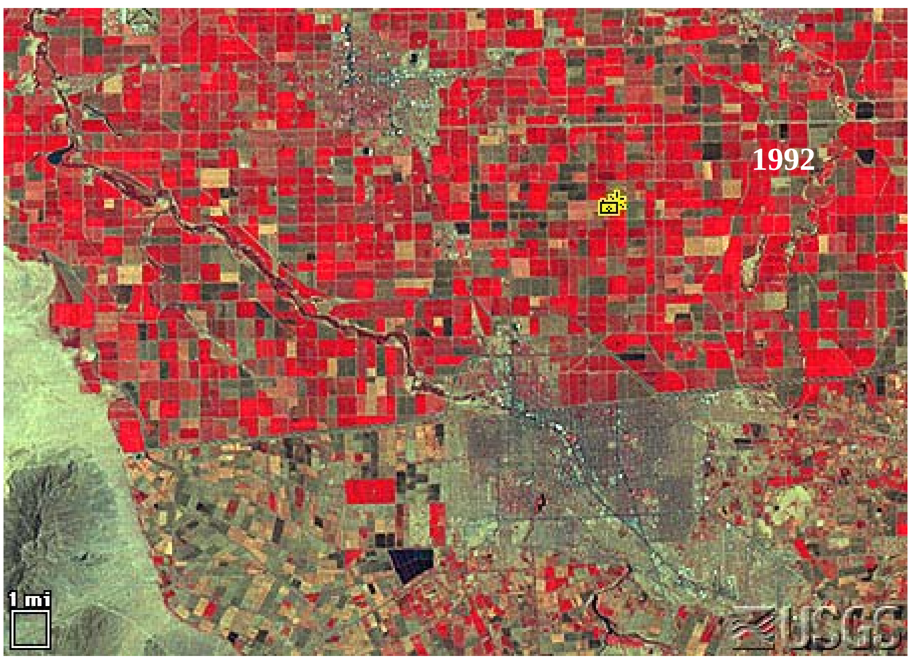
This valley, also known as the Salton Sink, the Salton Basin, and the Salton Trough, is actually an extension of the Gulf of California, cut off from the Gulf by the Colorado River's delta fan. The valley was renamed Imperial by turn-of-the-century land investors. The area south of the border is known as the Mexicali Valley.



(See Plate 2 for color version)
Looking at these two images, it is difficult to see much difference, but when you zoom in (next page), you will see quite a difference (photos courtesy USGS).







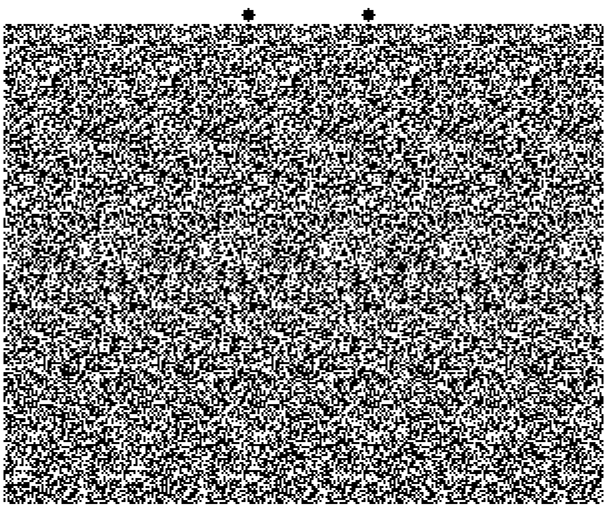
(See Plate 3 for color version) It is much easier to see the border between California and Mexico in these two images. The well-irrigated farm land on the north shows up bright red, while in Mexico, where irrigation is not used as much, there is very little bright red coloring. You can also see the Colorado River in these images (enters the photo in the top left corner, exits at bottom just to the right of center). Using these two images, answer the questions below.

Has agriculture increased or decreased in the Imperial Valley in the past 20 years?	
Has agriculture increased or decreased in this portion of Mexico in the past 20 years?	
Has the city of El Centro (top, center of photo) gotten larger or smaller?	

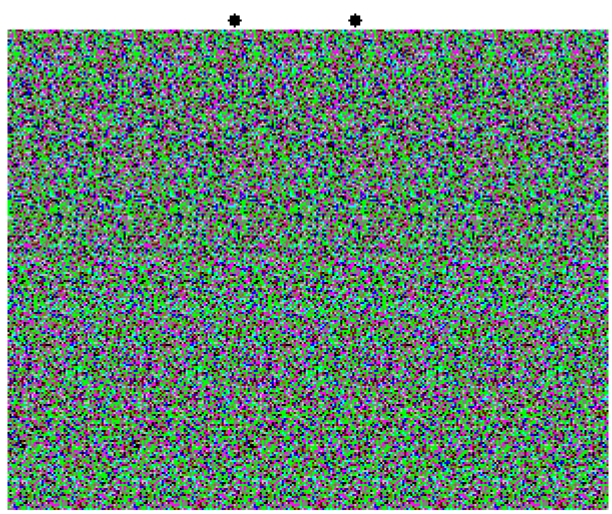
Name ______________________________

Stereograms

DIRECTIONS: Many people have difficulty seeing these types of pictures. There is a trick to it and it does require a bit of skill and patience. One way to see the objects is described here. Stand or sit directly in front of the image (it can be done from an angle but only by people that are skilled in viewing this type of image). Stare at the two dots at the top of the poster. The trick is to bring these two dots together so that they appear to be one dot. The easiest way to do this is to start fairly close to the image (for some people this will be so close that your nose almost touches the screen). Let your eyes relax and the image go blurry. Pretend that you are looking at a very distant object. With a bit of luck the dots will come together. Now the hard part is to slowly back away from the screen until you can focus on it - Don't loose sight of the dot. Once this happens you should be able to look at all parts of the image normally. Don't get discouraged if you loose the image the first few times. It takes practice and a lot of patience for some people.



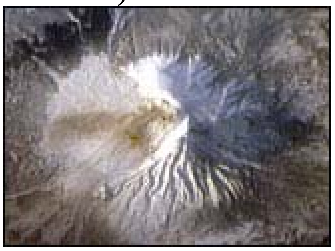
What object can be seen in the picture?	

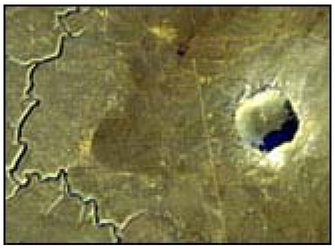


What object can be seen in this picture?	

 Name ____________________

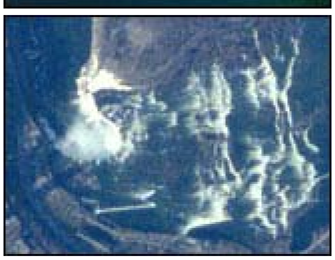
You can also use remote sensing to identify and analyze land forms. Use these pictures taken from the space shuttle to match the table below with the images. (See Plate 4 for Color Versions)


1


2


3


4


5


6

Match the following locations with the corresponding image.

A. Grand Canyon ________

B. Niagara Falls ________

C. A Volcano ________

D. Los Angeles ________

E. Meteor Crater ________

F. Sand Dunes ________

Relative Dating

Relative dating is used to determine the relative age of events in an area. Generally, a cross-section of the rock and structure is used to determine the sequence of geologic events. Why is this important (you may ask)?; knowing the relative ages helps you to determine the history of the region (geologically as well as environmentally). This knowledge helps in planning and developing urban expansion and other land use, and helps avoid geologic and environmental disasters (such as flooding, earthquakes, landslides, rockslides and any other hazard that can occur in a region). This knowledge can also be used to determine the history of the Earth; it's past climate, history of life and geologic processes.

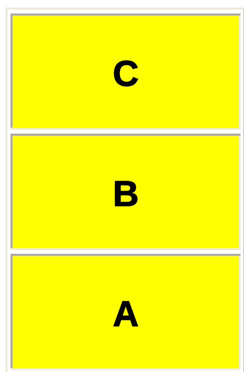
Relative dating DOES NOT assign ages to rock units or events; it is only concerned with the ORDER OF EVENTS.

In order to do this, we need to discuss a few simple 'principles". Theseprinciples are about as complicated as the law of not breathing, which states that if you hold your breath long enough, you will turn blue and become unconscious (duh). Here are some of the simple laws you will use to determine relative events:

Nicholaus Steno came up with Steno's Law (back in the 1600's). Here they are:

Principle of Superposition

If you have layers of rock, the rocks on the bottom are older than those on the top. Here is an example:



Imagine the above diagram is a representation of three layers of rock. The principle of Superposition states the layer on the bottom (A) is the oldest, and had to be there in order for layer B to form on top of it. The youngest rock layer would be Layer C. Pretty easy, eh?

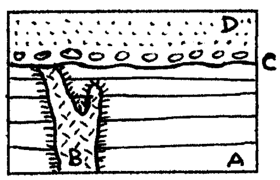
Next, let's introduce the **principle of original horizontality**, a fancy way of stating that rocks form in flat, horizontal layers (like the diagram above). Rock layers do not form at an angle – after they are deposited they can be tilted from tectonic forces, but while the layer is begin deposited, it will be flat and horizontal.

The next principle is the **principle of original lateral continuity** (why do they make up such complicated names for stuff that is really simple?). This principle states that rock that is deposited spreads out to form an even layer for a considerable distance in all directions.

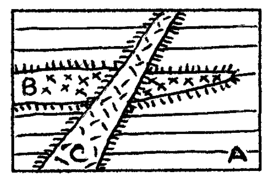
So far so good? Let's move on!

If the three principles stated on the last page were it, this would be a piece of cake; alas, we do not live in a perfect world. Things happen to the flat layers to make things a little more interesting.

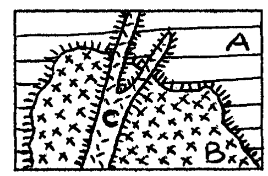
Let's start with the **principle of intrusive relationships**. Sometimes, molten magma in the Earth rises up and invades innocent rock that is just lying there minding it's own business. This principle states that the intrusive rock (once it hardens) is younger than the rock that it invaded.



(1) Dike



(2) Dike and sill



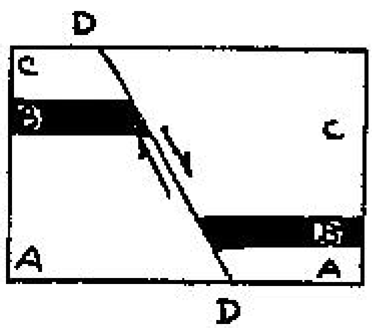
(3) Stock and dike

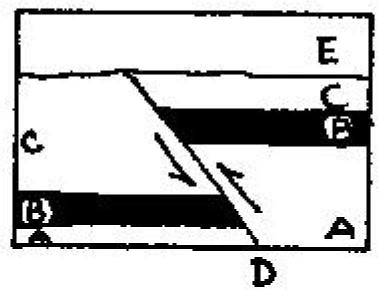
Look at the following examples. In picture #2 (center), rocks unit 'A' had to be there for intrusive rock B and C to invade it, so A is the oldest. But, which one is older between B and C? Notice that C invades and crosses B. In order for C to invade B, B must have been there first, so B is older than C.

In picture #3 (on the right), the formation of rock unit A is the oldest event. Notice that C invades both A and B, so C must be the youngest event, and B is in the middle.

In picture #1, A is again the oldest (it's on the bottom and invaded by B. Letter C represents an erosional event (rock was taken away). Notice that B invades A but is cut off by the erosion event C, so B must be older than C. Since D is on top of A, B and, C, it is the youngest event. So the correct order of events from oldest to youngest is A, B,C, D. If you are still reading this, draw a circle in the top left hand corner of page 1.

Hopefully, you're still with me. Let's make things even MORE fun by introducing the **principle of cross cutting relationships**. Sometimes a fault (a boundary where to sections of the Earth's crust move relative to each other) splits through pre-existing rock. In order for the fault to split the rock, it must have been there in the first place, making it older than the fault (makes sense, right)? Here are two examples:

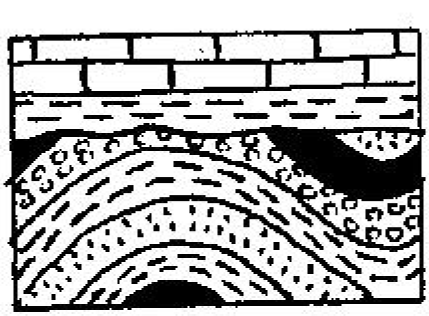


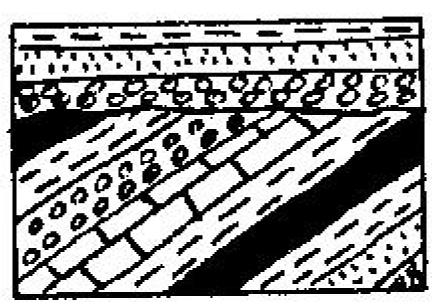


In the diagram at left, notice that the fault (D) splits through all the rock, so D is the youngest event. From there, you apply the principle of superposition to conclude that A is the oldest rock, followed by B and C.

In the diagram on the right, notice that the fault (D) does not split rock layer E, so E was deposited after the faulting occurred and thus must be younger. The correct order of events from oldest to youngest would be A, B, C, D, E.

So far, all the principles are just common sense ideas. The next principle is also very sensible. The **principle of angular unconformities** states that rock that is tilted or warped was there before the tilting or warping began. How do we know this? The principle of original horizontality states that rocks layers are laid down in flat, horizontal layers. If they are warped or tilted, this occurred after they were formed. Here are some examples...



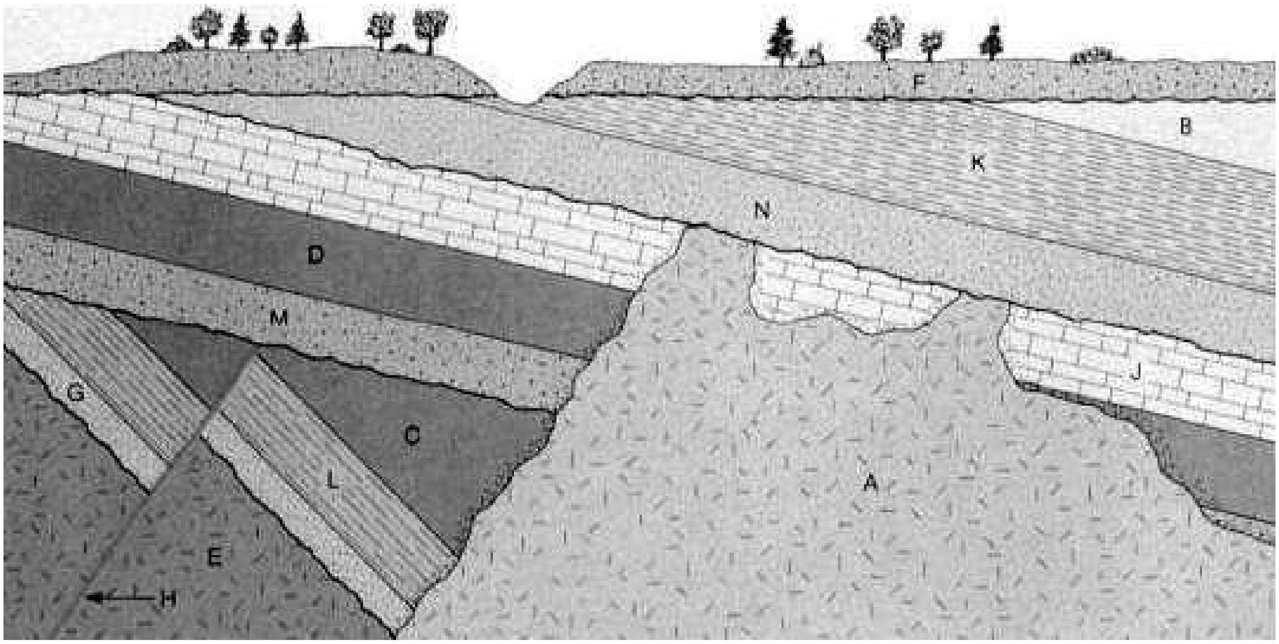


In the diagram on the left, the warped layers were first laid down horizontally, then tilted. After that, erosion made the top surface flat, followed by the addition of more rock layers. The diagram on the right shows the same thing.

If you have any questions about this, now is the time to see Mr. Horton for help; if not, let's move to the exercise...

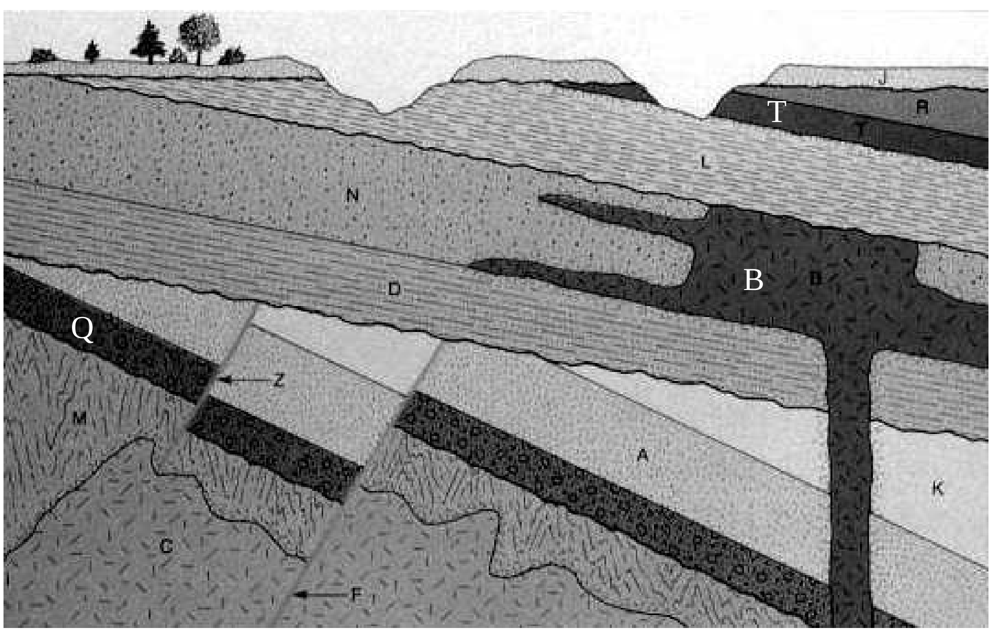
Name ____

1. List the order of events in the following geologic cross section from oldest to youngest. Take your time and use your problem solving skills to figure this out.



Oldest to youngest (Hint: E is the oldest) ____

2. Oldest to Youngest:

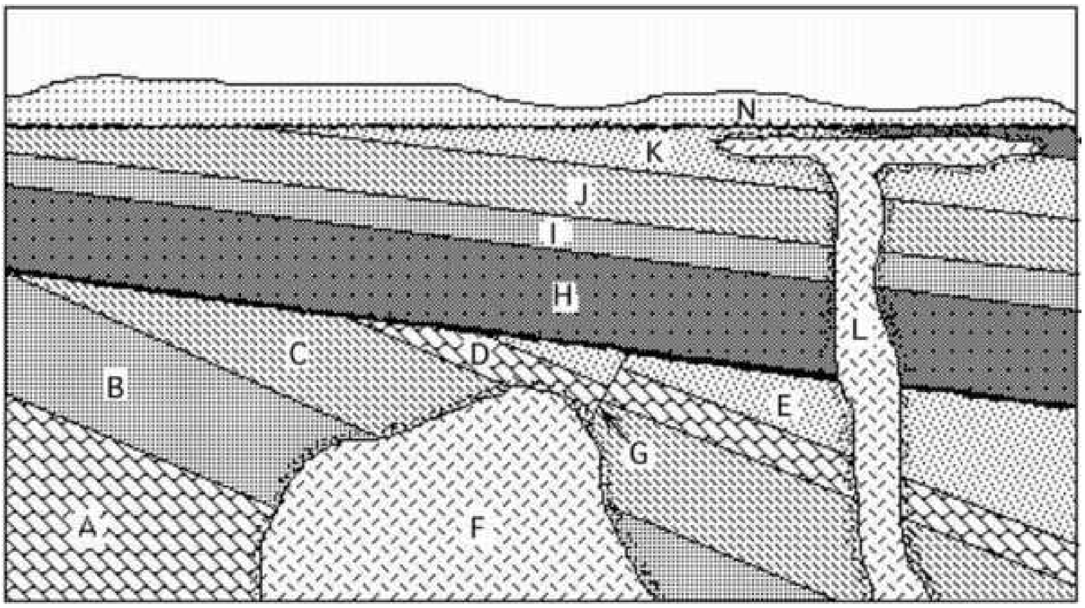


Oldest to youngest (M is oldest) ____

____

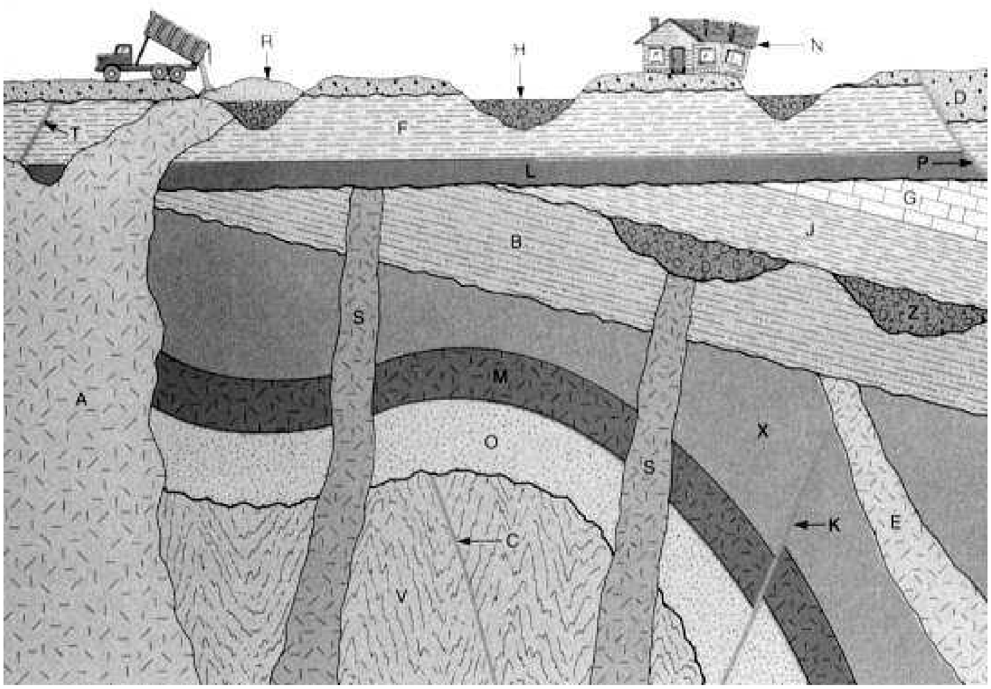
Name ______________________________

3. Oldest to youngest:



(A is oldest) ____

4. Same thing...



(V is oldest, if you get this correct, you are a full-fledged geologist!)

____

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