The Green Frog News

Science Newsletter for Kids!

Volume 2, Issue 2
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rock n' roll geology

What is Geology?

DEFINITION: science of the earth, including the composition, structure, and origin of its rocks.

Hey, what does that really mean? Well, geology is a science that looks at what the earth is made of, how it was formed and where the materials came from.

Since the beginning of time, the earth has been rocking, rolling, and shaking -- changing the land to what we see today. The earth has been covered by glaciers and oceans, mountains have been built and tilted, and rivers have carved beautiful canyons!

In this issue you will learn a lot about the geologic forces that continue to change the face of our earth.

Rock on!

earthquakes

Content for this issue was created for the Frog by Lisa Wald of the U.S. Geological Survey -Earthquake Hazards Program -- Thank you, Lisa!

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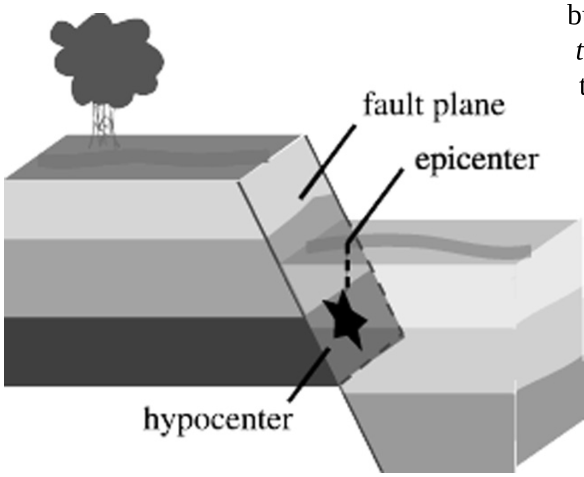
Our site, http://www.thegreenfrognews.com, offers **free science** resources for educators for grades K - 8 including coloring, experiments, newsletters, fact sheets, and much more. Our newsletters are designed to augment curriculum, and are downloadable, and reproducible.

We would love to hear your comments and suggestions. You can contact us at: froggy@thegreenfrognews.com

Rock n' on Shakey Ground



What is an earthquake?

An ***earthquake*** is what happens when two blocks of the earth suddenly slip past one another. The surface where they slip is called the ***fault*** or ***fault plane***. The location below the earth's surface where the earthquake starts is called the ***hypocenter***, and the location directly above it on the surface of the earth is called the ***epicenter.***

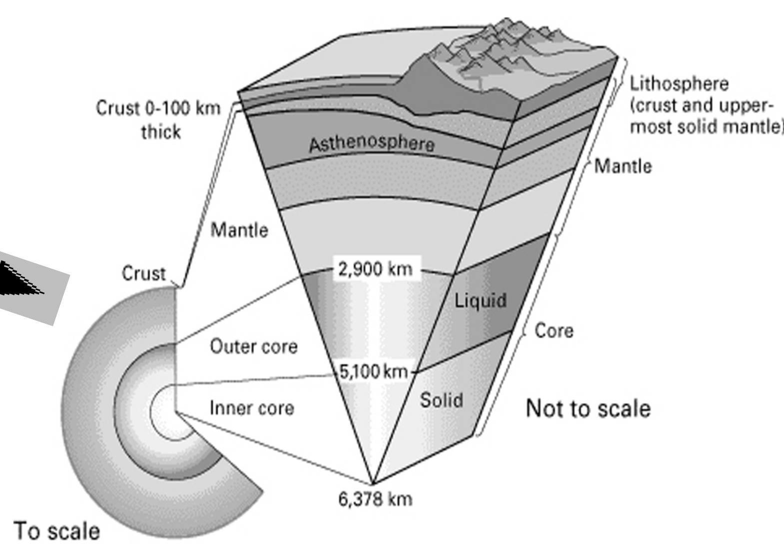
Sometimes an earthquake has *foreshocks*. These are smaller earthquakes that happen in the same place as the larger earthquake that follows. Scientists can't tell that an earthquake is a foreshock until the larger earthquake happens. The largest, main earthquake is called the *mainshock*. Mainshocks always have *after-shocks* that follow. These are smaller earthquakes that occur afterwards in the same place as the mainshock. Depending on the size of the mainshock, aftershocks can continue for weeks, months, and even years after the mainshock!

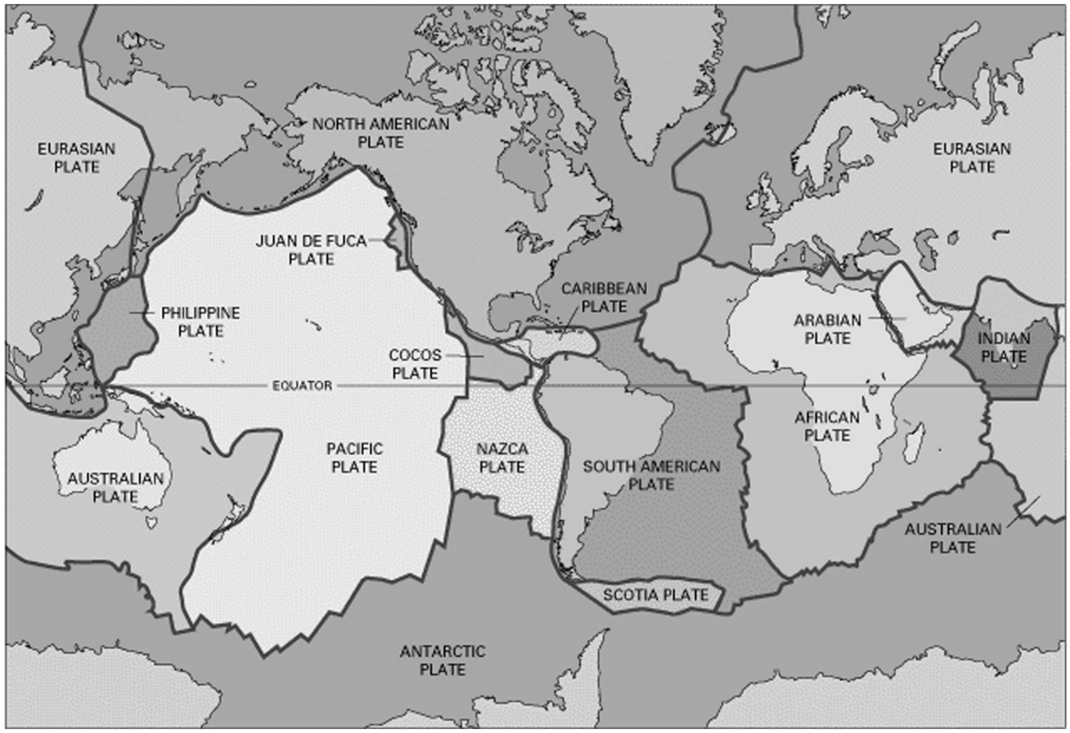
What causes earthquakes and where do they happen?

The earth has four major layers: the *inner core, outer core, mantle* and *crust* (right). The crust and the top of the mantle make up a thin skin on the surface of our planet. But this skin is not all in one piece - it is made up of many pieces like a puzzle covering the surface of the earth (next page - top). Not only that, but these puzzle pieces keep slowly moving around, sliding past one another and bumping into each other. We call these puzzle pieces *tectonic plates*, and the edges of the plates are called the *plate boundaries*. The plate boundaries are made up of many faults, and most of the earthquakes around the world occur on these faults. Since the edges of the plates are rough, they get stuck while the rest of the plate keeps moving. Finally, when the plate has moved far enough, the edges unstick on one of the faults and there is an earthquake.

Why does the earth shake when there is an earthquake?

While the edges of faults are stuck together, and the rest of the block is moving, the energy that would normally cause the blocks to slide past one another is being stored up! When the force of the moving blocks finally overcomes the *friction* of the jagged edges of the fault and it unsticks, all that stored up energy is released! The energy radiates(moves) outward from the fault in all directions in the form of *seismic waves* like ripples on a pond. The seismic waves shake the earth as they move through it, and when the waves reach the earth's surface, they shake the ground and anything on it, like our houses and us!



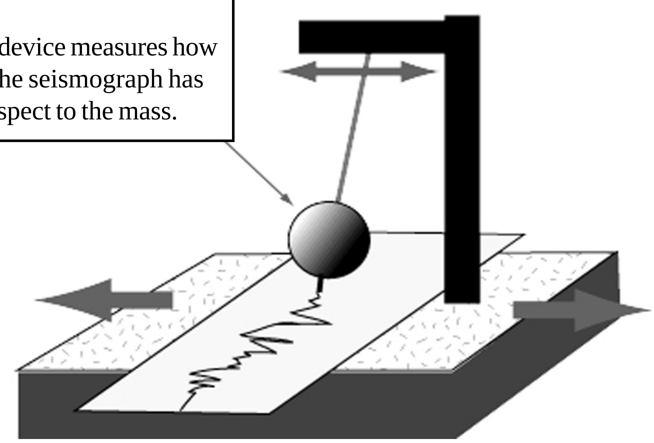


How are earthquakes recorded?

Earthquakes are recorded by instruments called *seismographs*. The recording they make is called a *seismogram*. The seismograph has a base that sets firmly in the ground, and a heavy weight that hangs free. When an earthquake causes the ground to shake, the base of the seismograph shakes too, but the hanging weight does not. Instead the spring or string that it is hanging from absorbs all the movement. The difference in position between the shaking part of the seismograph and the motionless part is what is recorded.

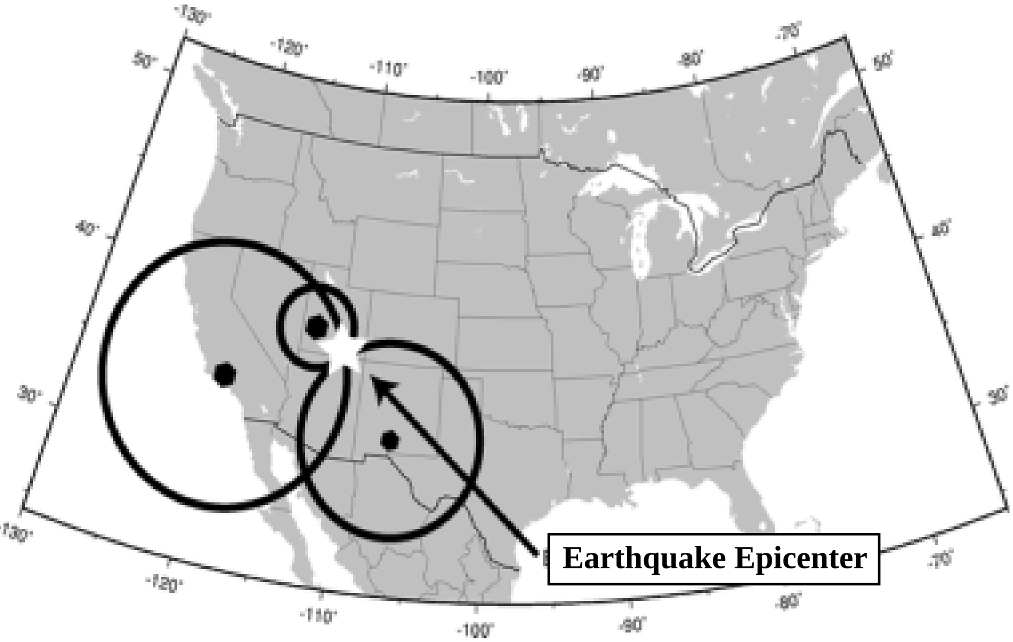
The whole seismograph moves as the earth it is attached to shakes, but the heavy mass does not move because of its inertia.

The recording device measures how far the rest of the seismograph has moved with respect to the mass.



How can scientists tell where the earthquake happened?

Seismograms come in handy for locating earthquakes too, and being able to see the *P wave* and the *S wave* is important. You learned how P & S waves each shake the ground in different ways as they travel through it. P waves are also faster than S waves, and this fact is what allows us to tell where an earthquake was. To understand how this works, lets compare P and S waves to lightning and thunder. Light travels faster than sound, so during a thunderstorm you will first see the lightning and then you will hear the thunder. If you are close to the lightning, the thunder will boom right after the lightening, but if you are far away from the lightning, you can count several seconds before you hear the thunder. The further you are from the storm, the longer it will take between the lightning and the thunder. P waves are like the lightning, and S waves are like the thunder. The P waves travel faster and shake the ground where you are first. Then the S waves follow and shake the ground also. If you are close to the earthquake, the P and S wave will come one right after the other, but if you are far away, there will be more time between the two. By looking at the amount of time between the P and S wave on a seismogram recorded on a seismograph, scientists can tell how far away the earthquake was from that location. However, they can't tell in what direction from the seismograph the earthquake was, only how far away it was. If they draw a circle on a map around the station where the *radius* of the circle is the determined distance to the earthquake, they know the earthquake lies somewhere on the circle. But where?



Scientists then use a method called *triangulation* to determine exactly where the earthquake was (below). It is called triangulation because a triangle has three sides, and it takes three seismographs to locate an earthquake. If you draw a circle on a map around three different seismographs where the *radius* of each is the distance from that station to the earthquake, the intersection of those three circles is the *epicenter* (location of the earthquake)!

How do scientists measure the size of earthquakes?

The size of an earthquake depends on the size of the fault and the amount of slip on the fault, but that's not something scientists can simply measure with a measuring tape since faults are many kilometers deep beneath the earth's surface. So how do they measure an earthquake? They use the *seismogram* recordings made on the *seismographs* at the surface of the earth to determine how large the earthquake was (bottom left). A short wiggly line that doesn't wiggle very much means a small earthquake, and a long wiggly line that wiggles a lot means a large earthquake. The length of the wiggle depends on the size of the fault, and the size of the wiggle depends on the amount of slip. The size of the earthquake is called its *magnitude*. There is one magnitude for each earthquake. Scientists also talk about the *intensity* of shaking from an earthquake, and this varies depending on where you are during the earthquake.

Is there such a thing as earthquake weather? Can some animals or people tell when an earthquake is about to hit?

These are two questions that we can't answer just yet! If weather does affect earthquake occurrence, or if some animals or people can tell when an earthquake is coming, we do not yet understand how it works.

Can scientists predict earthquakes?

No, and it is unlikely they will ever be able to predict them. Scientists have tried many different ways of predicting earthquakes, but none have been successful. On any particular fault, scientists know there will be another earthquake sometime in the future, but they have no way of telling when it will happen.

<u>Wordplay: Rockhound</u>

No, silly! A rock hound isn't a dog who likes rocks, but a person who loves to go outside and hunt for rocks! People also love to search for fossils, lost treasures and gold!

EXPERIMENT:

Peanut Butter and Jelly Sandwich Faults

You can make your own small faults with a double-decker peanut butter & jelly sandwich! Have a parent or teacher help you!

Here's how. You'll need:

Three slices of bread....Peanut butter....Jelly ....Butter knife....Bread knife

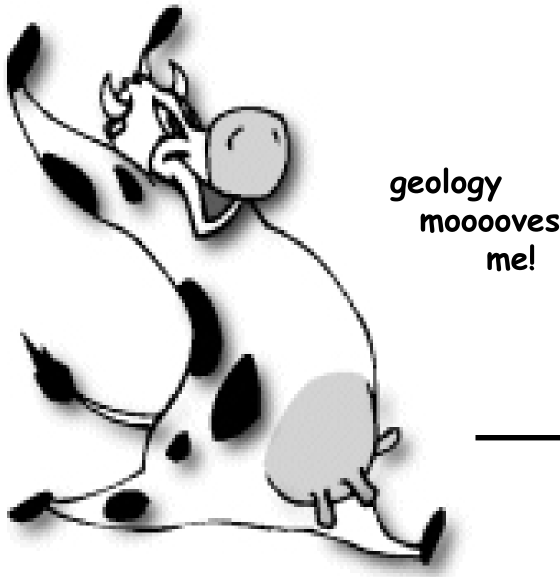
First make a double-decker sandwich. Make a regular sandwich and then put another layer of peanut butter and jelly topped with the third slice of bread. Now instead of cutting your sandwich in half vertically, cut it in half on an angle. Now try to make the different kinds of faults in the picture. Notice how the layers of peanut butter and jelly get moved, and which directions the *hanging wall* and the *foot wall* move.

Illustration Credits:

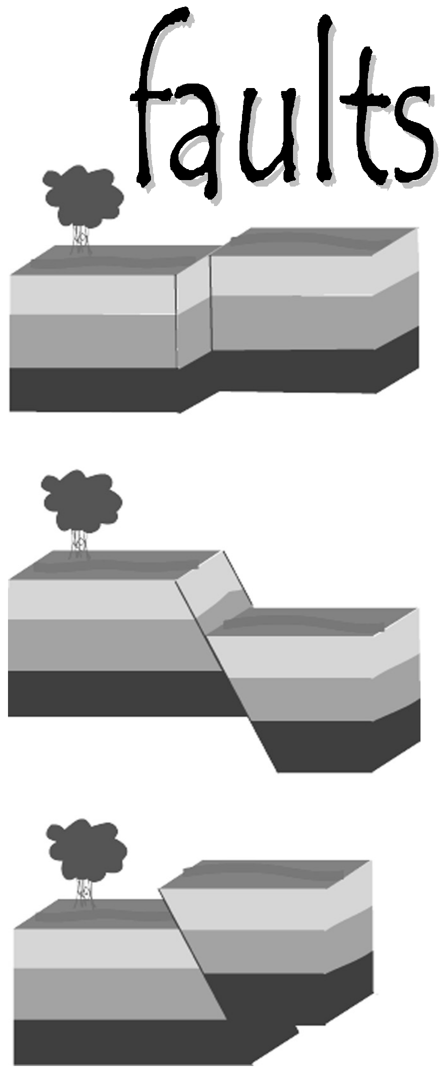
Earth's plates (from "This Dynamic Earth: The Story of Plate Tectonics", USGS)

A Cross-Section of the Earth (from "This Dynamic Earth: The Story of Plate Tectonics", USGS)

Seismograph, Triangulation and fault illustrations from the U.S.G.S.



There are three different types of earthquake faults:



1. STRIKE-SLIP FAULT
The fault is vertical, and the blocks slide past one another horizontally. This occurs in areas where the crustal blocks are sliding past one another.

2. NORMAL FAULT
The fault is at an angle, and the block above the fault (the *hanging wall*) moves down relative to the block below the fault (the *foot wall*). This occurs in areas where there is extension or pulling of the crustal blocks.

3. THRUST (REVERSE) FAULT
The fault is at an angle, and the *hanging wall* moves up relative to the *foot wall*. This occurs in areas where the crustal blocks are being pushed together.

Learn Your P's and S's

Seismic Waves

P Wave:
The fastest wave, and therefore the first to arrive at a given location - also known as compressional waves, the P wave alternately compresses and expands material in the same direction it is traveling - it can travel through all layers of the Earth - it is generally felt by humans as a **bang or thump.**

S Wave:
The S wave is slower than the P wave and arrives next, shaking the ground up and down and back and forth - also known as shear waves - these waves move more slowly than P waves, but in an earthquake they are usually bigger - S waves cannot travel through the outer core because these waves cannot travel through fluids, such as air, water or molten rock.

What is... Environmental Geology?

Environmental geology is the use of geologic information that help us improve our environment. To do this, geologists study things like landslides, landfills, drinkable water, flooding, mineral resources, and earthquakes. Some of these we want to find and use wisely (mineral resources, water supplies), others we want to avoid (landslides, earthquakes, subsidence, and floods), while others we desperately need, but want them to be safe (landfills, earthen dams). All of these subjects can make good use of our knowledge of geology, and it is the purpose of environmental geology to provide the basic geological information so that people can understand it and use it properly.

EXPERIMENT:

You Can Make Slinky Waves

You can make P waves and S waves with a slinky. All you need is a slinky and two people. With one person holding each end of the slinky, stretch it out so that it is laying flat on the floor or on a table.

To make a P wave, one person quickly pushes toward, and then pulls the slinky away, from the other person just a couple of inches. Watch the P wave travel along the slinky to the other person. It may even reflect (bounce) off the end and come back to the original person!

To make an S wave, one person quickly moves the slinky from side to side once a couple of inches. The S wave will travel along the slinky once again to the other person and may turn around and travel back.

Notice that the P wave moved the slinky back and forth in the same direction as the wave was traveling, and the S wave moved the slinky back and forth perpendicular to the direction the wave was traveling.