OKLAHOMA ROCKS!

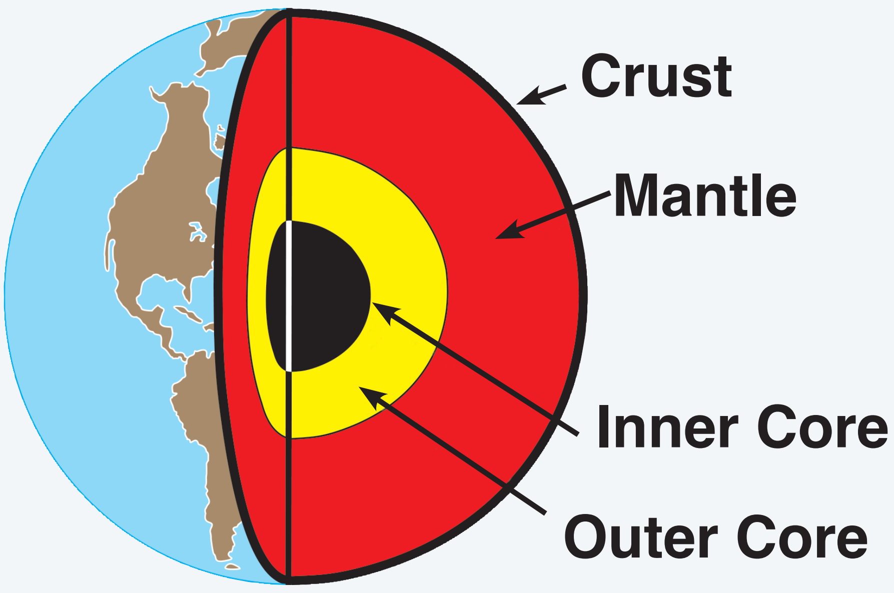
Shake, Rattle & Roll

Planet earth is made up of much more than just the rocks you know and walk on. Deep below your feet, there are liquid layers that can be as hot as ~10,000 degrees Fahrenheit. Scientists use different seismological techniques to help determine what is happening deep inside the earth. The interior of the earth contains four main layers: the solid inner core, the liquid outer core, the mantle, and the crust. The crust is on the outside, and it is what we walk around on. It is broken up into pieces like a puzzle that move around at very slow rates. The pieces of crust, called tectonic plates, are made of denser oceanic and lighter continental plates that affect where the oceans and dry land are. These pieces bump each other, slide next to each other, and sometimes collide into each other to create mountains, volcanoes and other features. Over two hundred million years ago, all of the dry land was connected and there was a supercontinent called Pangaea. Eventually the supercontinent broke apart, but you can still look at a map and see where some of the land would fit together like a puzzle.

The tectonic plates are driven by convection currents and gravity in the hot, solid rock of the mantle. These currents continually move the plates past one another causing frequent earthquakes (seismicity) at the plate boundaries.

In addition to the earthquakes at plate boundaries, there are many earthquakes that occur in the middle of these plates where cracks, called faults, can scrape past each other and lead to more seismicity.

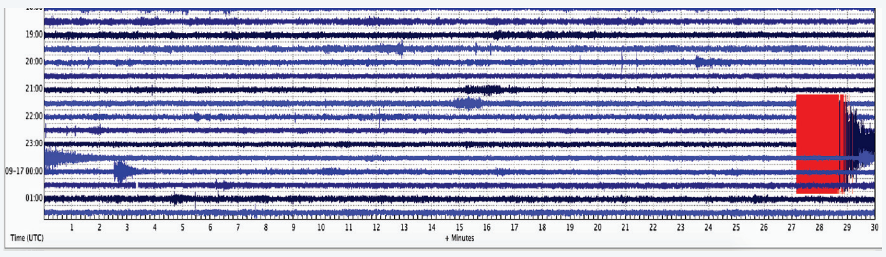
Visit www.iris.edu and click on their education--> animations tab to see how earthquakes are generated!



The earth's crust is made of tectonic plates that are both brittle and elastic, which means that those rocks can bend and stretch but can also break. The tectonic plates below our feet are constantly shifting, sliding past each other, and getting stuck together. All of this movement can cause a buildup of stress at certain parts of the rock and cause the rock to bend and store energy. Eventually the built up stress is too much for the rock to handle so it breaks, and all of the energy that was stored up is released as an earthquake. This is similar to the way you can bend a ruler, but if you bend it too far you can cause it to snap. When the ruler snaps, all of the energy is released in one harsh motion. The earth works the same way, but instead of a snapping ruler, you have rocks sliding past each other on a fault. When the rocks release the stored energy, it causes the ground to vibrate as the seismic waves, created by the earthquake, spread out all around. This is the same type of motion that happens when you throw a rock in a pond. Once the rock hits the water you can see ripples spread out in circles around the rock. These miniature waves are acting the same way the giant waves in the earth would after an earthquake. The seismic waves spread out like giant rings around the earthquake, and when you feel the shaking of the earthquake you are feeling those waves as they spread out across the planet. The bigger the earthquake, the farther and stronger those waves spread out, the same way that bigger rocks cause bigger ripples in the water compared to a small pebble.

Earthquake Analysis

The when, where, type and strength of an earthquake has to be figured out by specialists known as seismic analysts. When an earthquake occurs in Oklahoma, seismometers—the mechanical 'ears' buried just a few feet underground, all over the state—measure the vibrations. These measurements are sent by cell phone modem to the Oklahoma Geological Survey Seismic Lab. There, seismic analysts scan through the vibration measurements, or waveforms, and pick the times at which different parts of the earthquake vibration occurred. The P wave (the 'bump' or 'bang' sometimes felt or heard when experiencing an earthquake) is the initial wave, and the S wave (the rolling, sustained vibration sometimes felt during an earthquake) is the secondary wave. By precisely determining when each of these vibration types occurred at multiple seismometers, the precise location and depth of the earthquake origin can be triangulated. By determining which direction the P wave first moves (up or down) at enough stations, the precise fault movement can be determined.



Swarm software showing an M3.9 earthquake in Oklahoma on September 16, 2017 at 23:26 UTC, or 6:26pm local time. Red indicates measurement that is off the scale. Each row is half an hour of recorded seismic data at this one station. The vertical axis shows hour intervals every other row. The horizontal axis shows minutes. The most recent time is the lowermost, right part of the display. Notice how the large event wraps down to the next row.

Make Human P Waves and S Waves!

To make a human P wave, have about ten students stand in a line. Each person should face the same direction, so that everyone is staring at the back of the person in front of them. Space each other out enough that you can each raise your arms so that you're about an inch from touching the back of the person in front of you. Now, someone push on the back of the person at the back of the row. See and feel the P wave transfer along the row as each person is gently pushed forward only to push against the next person! This is like the compression motion of a slinky.

To make a human S wave, have everyone stand in a row side by side, facing the same direction, with arms linked to each neighbor. Now have someone push on the back of one of the people at the end of the line. See and feel the S wave transfer along the line as each person is in turn pulled forward by their next neighbor, only to pull forward their other neighbor! This is a bit like the waving motion a rope makes when being whipped.

NEWSPAPERS IN EDUCATION
THE OKLAHOMAN
Oklahoma's future begins in the classroom.

Newspapers for this educational program provided by:

Oklahoma Geological Survey OGS 1908
Oklahoma Geological Foundation

OKLAHOMA ROCKS! Shake, Rattle & Roll

What to do if there is a strong earthquake.

In MOST situations, you will reduce your chance of injury if you:

DROP where you are, onto your hands and knees. This position protects you from being knocked down and also allows you to stay low and crawl to shelter if nearby.

COVER your head and neck with one arm and hand.

- If a sturdy table or desk is nearby, crawl underneath it for shelter.
- If no shelter is nearby, crawl next to an interior wall (away from windows).
- Stay on your knees; bend over to protect vital organs.

HOLD ON until shaking stops

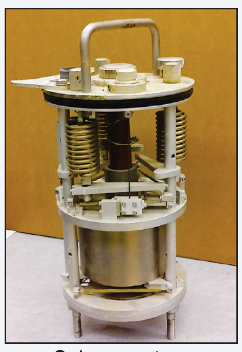
- Under shelter: hold on to it with one hand; be ready to move with your shelter if it shifts
- No shelter: hold on to your head and neck with both arms and hands.

Go to this website to find out what to do in almost every situation. http://www.earthquakecountry.org/step5/

A field technician is responsible for maintaining the seismic stations. A surveyed 6x6 foot plot of land hosts the seismometer, seismic vault, digitizer and solar panel with a back-up battery. When building a seismic station, the field technician digs a 4-5 foot hole for the seismic vault, pours concrete on the bottom to create a contained area along with a level base so the seismometer can pick up on ground motion. Where? The best seismic sites are in areas that have low seismic noise (ground motion that is recorded but is not related to what research scientists are investigating). Things that can contribute to unwanted noise can be: road traffic, oil/natural gas extraction, windmills and livestock. The stations broadcast the data received via a cell modem to the OGS seismic monitoring system. The data that is received from these instruments is used to improve understanding of active faults, subsurface rocks and their properties, ground motion observed on the surface within and near Oklahoma, and potential changes that may be causing some of the earthquakes within Oklahoma.

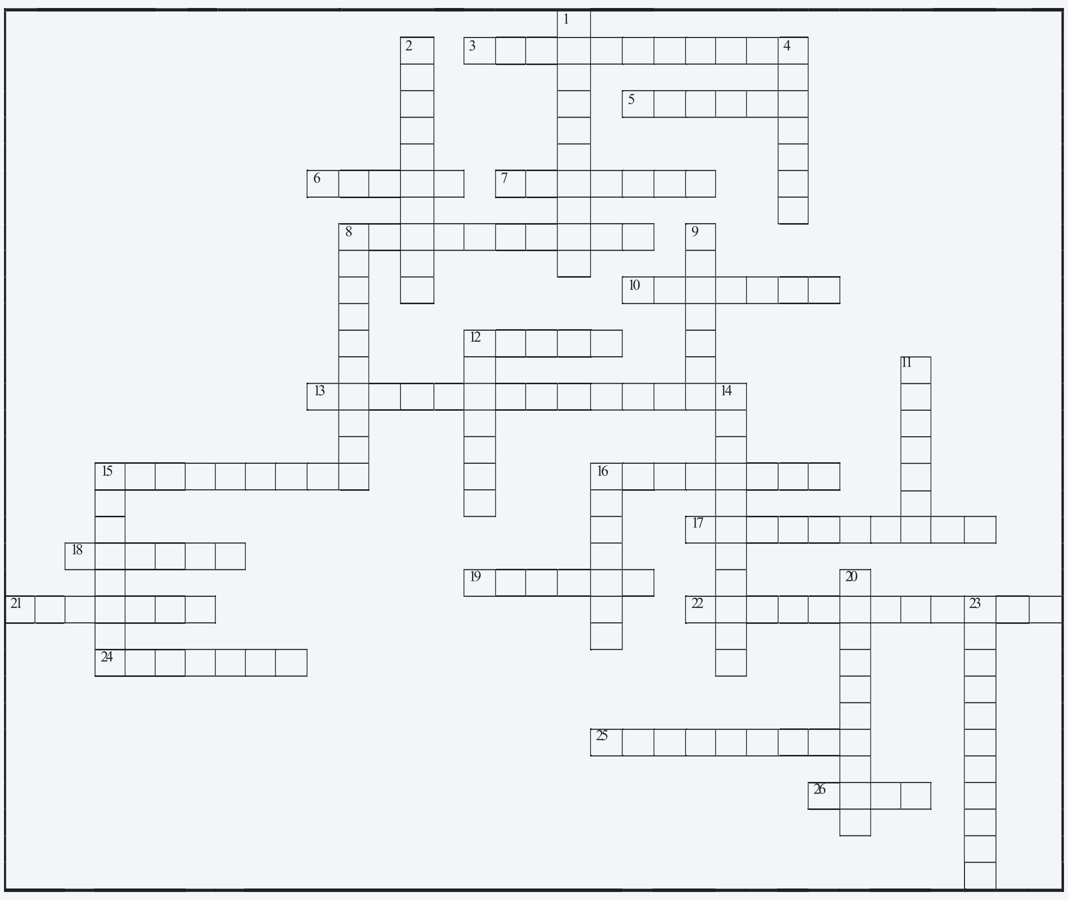
Field technician working on seismic station

Solar Panel



Seismometer

"Shake, Rattle & Roll" — Earthquakes CROSSWORD PUZZLE



Across

3 Sometimes the most damage caused by earthquakes comes from __________.

5 S waves arrive later at a seismograph station because they travel __________ than do P waves.

6 To precisely locate the epicenter of an earthquake, distance determinations from __________ or more seismograph stations are needed.

7 Continental crust is __________ than the oceanic crust.

8 The 1,000 km long __________ fault is responsible for most of the earthquakes in California.

10 Earthquakes usually last only a few __________.

12 Earthquakes that occur under or near the __________ can help to produce tidal waves called tsunamis with heights up to 50 feet near shore.

13 The theory of __________ suggests the Earth's outer shell is made up of moving rigid plates.

15 The Mercalli __________ scale measures the effect of the earthquake on structures and people.

16 Where rigid plates of the Earth's outer shell slip past one another, __________ can be expected.

17 If you are outside during an earthquake, move away from buildings and __________.

18 Most __________ from earthquakes occur when structures (homes, buildings, etc.) topple from the shaking earth.

19 Primary or __________ are the fastest of the three kinds of earthquake waves.

21 Most of the total earthquake energy for the earth is released in the zones that border the __________ Ocean.

22 The most infamous of American earthquakes struck __________ on the morning of April 18, 1906.

24 The __________ scale measures the total amount of energy released during an earthquake.

25 The location of an earthquake is usually described by the geographic position of its __________.

26 Indirect damage from earthquakes is caused by landslides, avalanches, and __________.

Down

1 Evidence for the theory that the core of the earth is composed of iron and nickel has come from the study of __________.

2 The __________ ridges are sites of numerous earthquakes.

4 __________ waves are the last to arrive at a seismograph station and are usually the most destructive waves.

8 The study of earthquakes is called __________.

9 The San Andreas Fault marks the boundary between the North American and __________ Plates.

11 The 8.5 magnitude of the 1964 __________ earthquake was the greatest ever recorded for an earthquake in North America.

12 During an earthquake do not rush __________ as falling debris has caused many deaths.

14 Approximately __________ earthquakes are detected each year throughout the world.

15 Most of the information scientists infer about the __________ of the earth has come from our study of earthquake waves.

16 Only about __________ earthquakes each year throughout the world cause disaster, death, and destruction.

20 __________ usually experiences more earthquakes in a year than all the other states combined.

23 The principal tool used to record earth movements is called a __________.

WORD LIST

Some words may be used more than once.

AFTERSHOCKS
ALASKAN
CALIFORNIA
DEATHS
EPICENTER
FAULTING
FIFTEEN
FIRE
INTENSITY
INTERIOR
METEORITES
MIDOCEANIC
OCEAN
OUTSIDE
PACIFIC
PLATE TECTONICS
POWER LINES
P WAVES
RICHTER
SAN ANDREAS
SAN FRANCISCO
SECONDS
SEISMOGRAPH
SEISMOLOGY
SIX THOUSAND
SLOWER
SURFACE
THICKER
THREE