Earth & Space Science Packet

April 6th-17th, 2020

Griffin & King

This packet contains:

1. Worksheets for Earthquakes, Plate Tectonics, Volcanoes, Mountains
2. Plate Tectonics Lab
3. Volcano Lab
4. National Geographic Article on Volcanoes

What needs to be turned in for a grade?

- Worksheets with questions answered

(Earthquakes and Plate Tectonics is April 6-9; Volcanoes and Mountains is April 14-17)

Optional/Enrichment included:

- Labs
- Science Articles

If these are completed, we would LOVE for you to share:
Send us pictures on remind/email, or tag @TheBurgScience and #Team DCS on Twitter

***Earth and Space Science students*,**

The only assignments required from us are the worksheets included. At times we may also include a Scientific article for you to read. You can either submit them electronically or you can take a picture of your answers and send us the picture either through Remind or via email. Paper packets should be completed and “turned in” the same way – snap a picture and send it to us either via Remind or email. These are not meant to be difficult or overwhelming. We simply hope they keep your mind engaged while we try to accomplish distance learning. The labs are completely optional and only meant to help bring some of this material to life. Also, we hoped it would be something fun for you to do.

We miss you all very much! We hope you are doing well and that you are staying healthy. If there is ever a time that you need help with anything during this time, please do not hesitate to let one of us know. We are certainly more than happy to help if we can!

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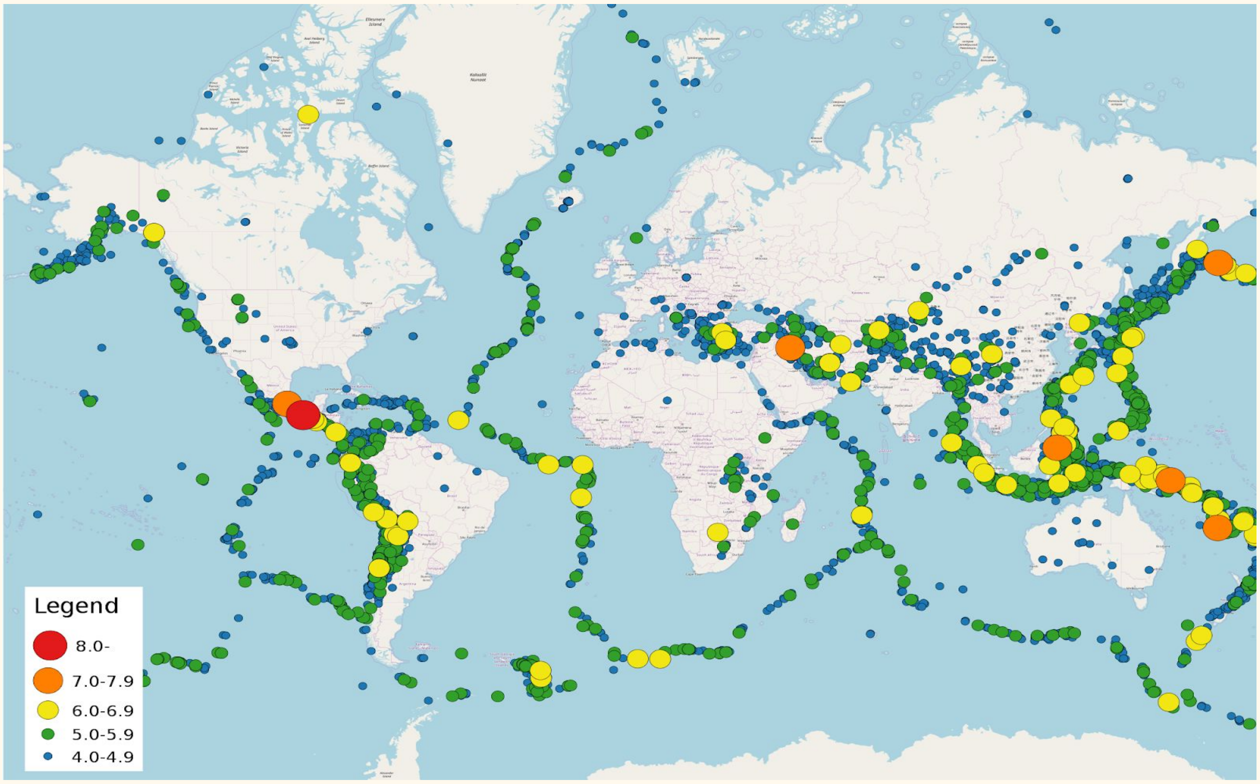
EARTH & SPACE SCIENCE
GRIFFIN & KING

EARTHQUAKES



EARTHQUAKES

Earthquakes- vibrations in the ground that result from movement along breaks in the Earth's lithosphere called faults (plate tectonics)

- Occur in oceans and along continents (plate boundaries)
- **Large Earthquakes**- Plates collide along a **convergent** plate boundary causing subduction; they release a large amount of energy
- **Small Earthquakes**- along **divergent** plate boundaries (San Andreas Fault in CA); can cause rocks to bend and break
- **Focus-** the point within Earth where the earthquake starts
- **Epicenter-** the location on the surface directly above the focus
- The energy released by an earthquake travels in all directions from the focus in the form of **seismic waves.**

According to the **elastic rebound hypothesis**, most earthquakes are produced by the rapid release of energy stored in rock that has been subjected to great forces. When the strength of the rock is exceeded, it suddenly breaks, releasing some of its stored energy as seismic waves.

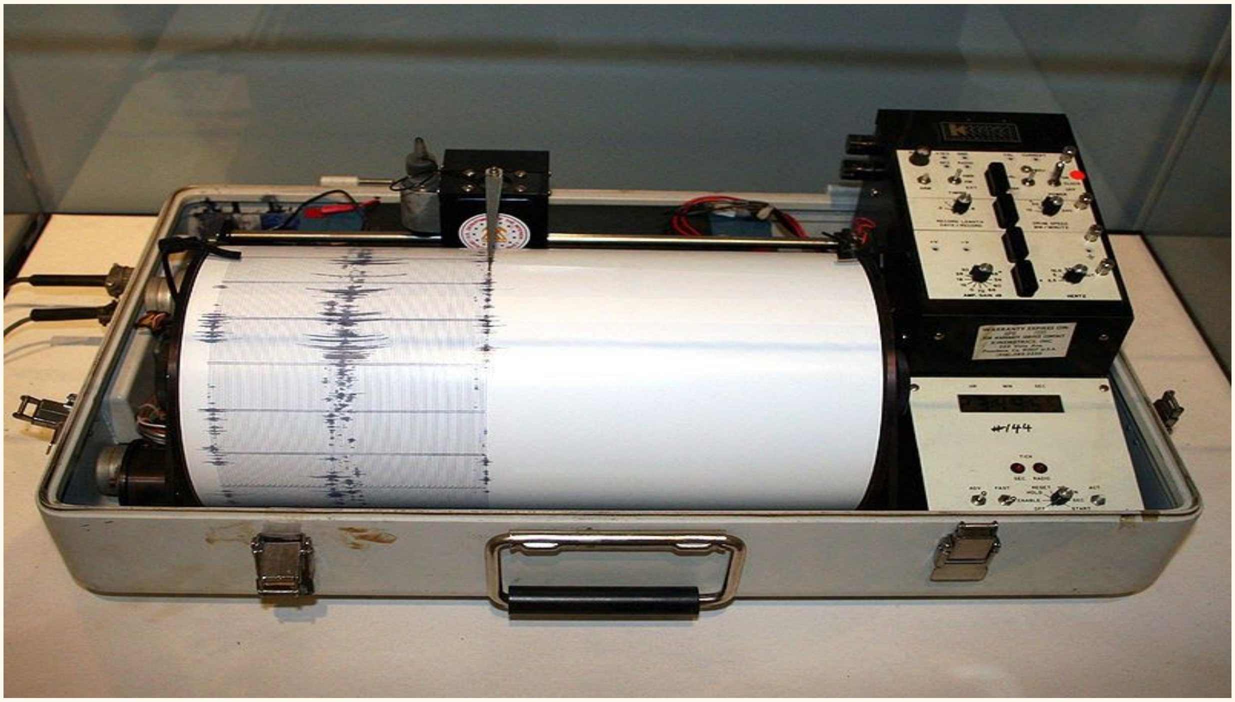
MEASURING EARTHQUAKES

Earthquakes produce two main types of seismic waves- **body** waves and **surface** waves.

- There are two types of body waves: P waves and S waves.
  - **P (primary) waves** are push-pull waves that push (or compress) and pull (or expand) particles in the direction the waves travel.
  - **S (secondary) waves** shake particles at right angles to the waves' direction of travel.
- When body waves reach the surface, they produce **surface** waves. These are the most destructive seismic waves.

Scientists have developed an instrument to record seismic waves- the **seismograph**.

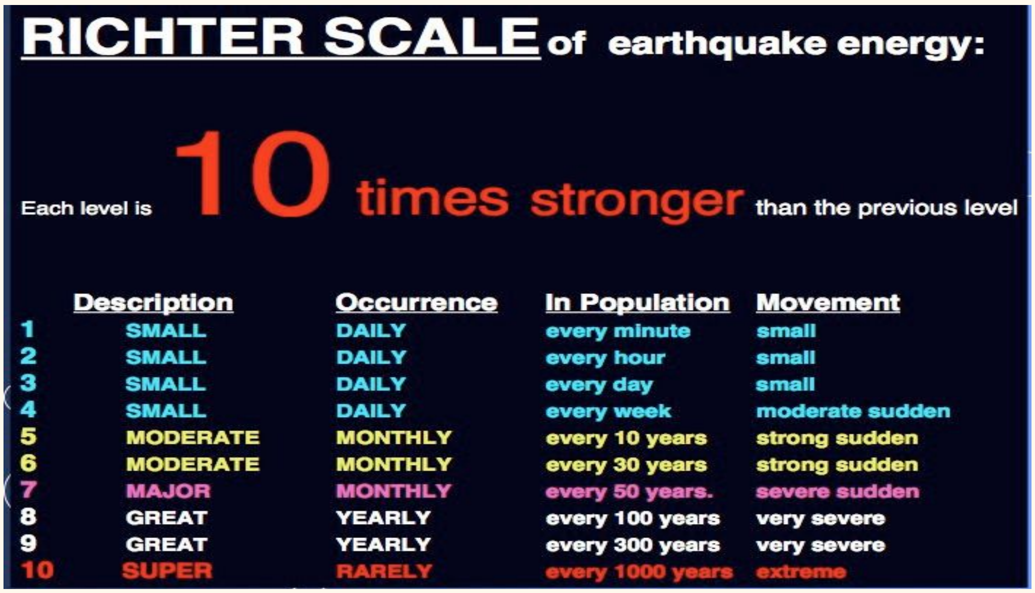
- A **seismograph** produces a time record of ground motion during an earthquake called a seismogram. A **seismogram** shows all three types of seismic waves.

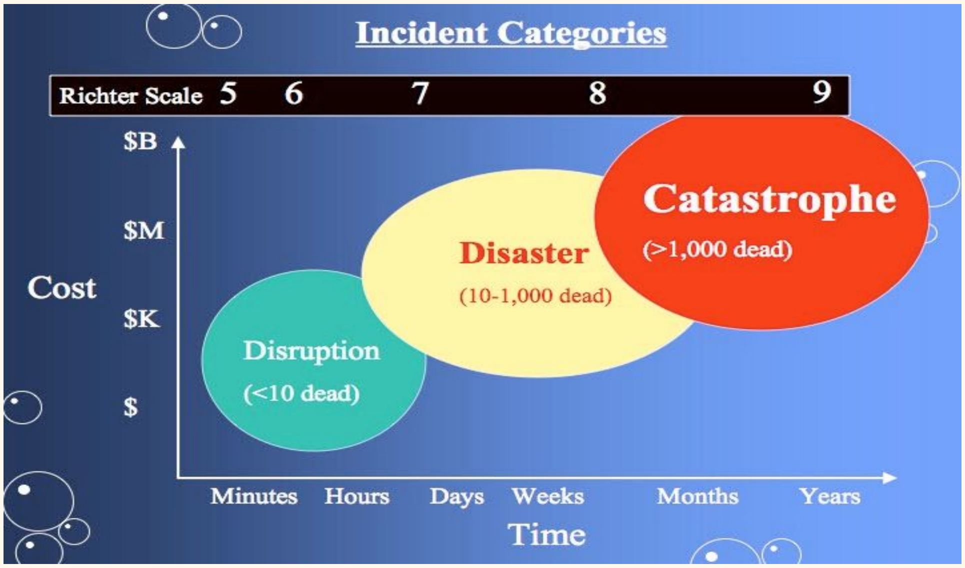


The **Richter scale** and the **moment magnitude scale** measure earthquake magnitude. The **Modified Mercalli scale** is based on earthquake intensity.

- The moment magnitude is derived from the amount of **displacement** that occurs along a fault. Scientists today use the moment magnitude scale to measure earthquakes.

A **travel-time graph**, data from seismograms made at three or more locations, and a globe can be used to determine an earthquake's epicenter.





QUESTIONS

1. What causes earthquakes?

2. Where do they occur?

3. What is the focus?

4. What is the epicenter?

5. What is the elastic rebound hypothesis?

6. What are the two types of seismic waves?

7. Describe the two types of seismic waves.
    a.

    b.

8. Which type of wave is the most destructive?

9. What is the difference between a seismograph and a seismogram?

10. How is an earthquake's epicenter located?

PLATE TECTONICS

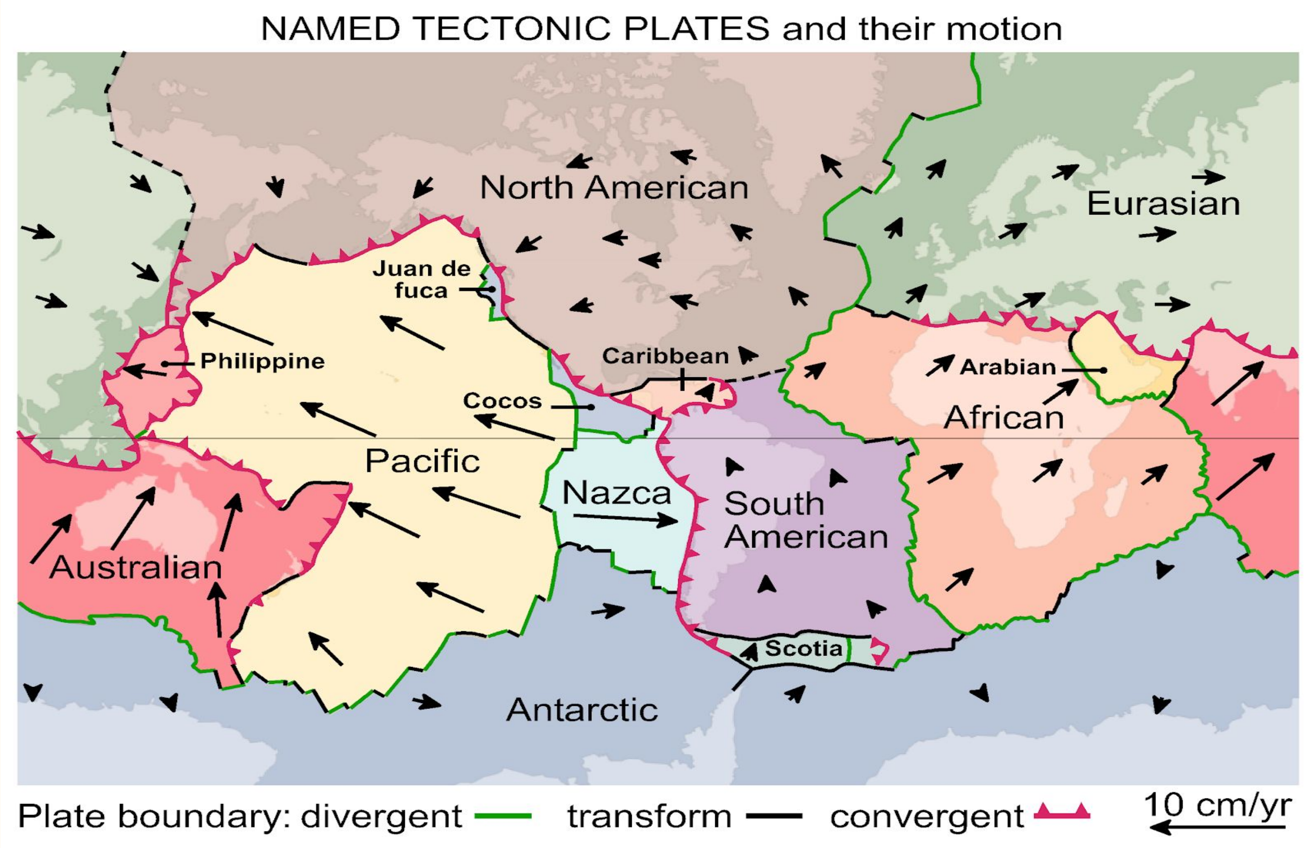
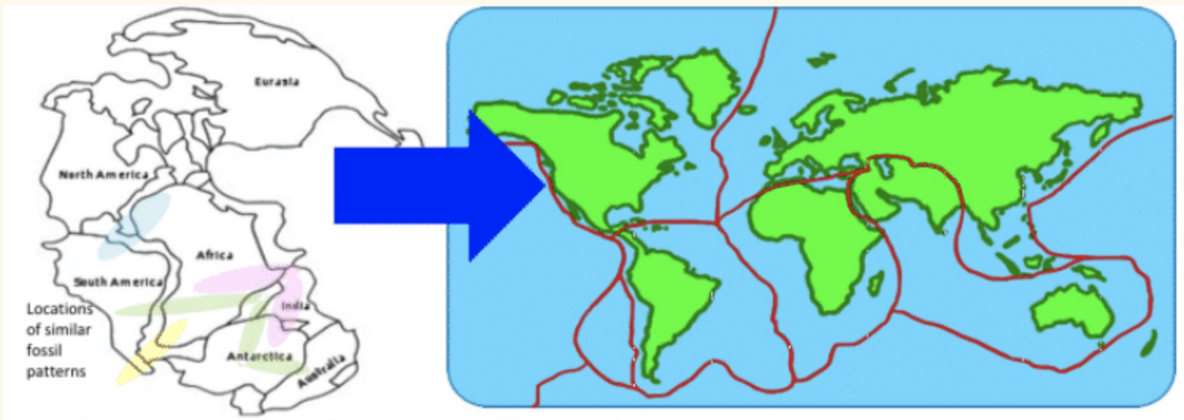


PLATE TECTONICS THEORY

- **Theory of Plate Tectonics**- Earth's surface is made of rigid slabs of rock, or plates, which move with respect to each other.
- Tectonic plates are large pieces of **lithosphere**
    - **Lithosphere-** cold and rigid outermost rock layer
    - **Asthenosphere-** layer beneath the lithosphere, it is hot and moves like plastic
    - They work together and the heat of the asthenosphere causes melting and allows the plates of the lithosphere to move- plate tectonics
- The Pacific Plate is the largest
- Juan de Fuca Plate is the smallest
- Boundaries in the oceans match the **mid-ocean ridges**.

PANGEA & CONTINENTAL DRIFT

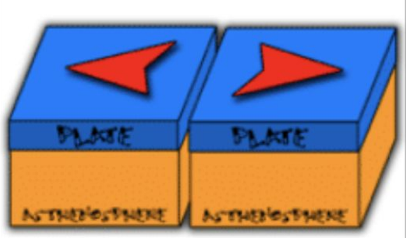
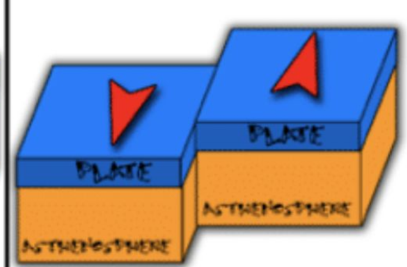
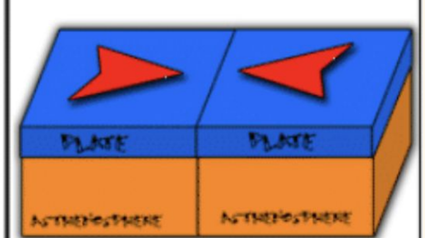
- Pangea- all the continents were once part of a supercontinent
- **Continental drift-** over time the continents which are in constant motion on the surface of the Earth separated the continents.
- Clues from climate patterns, fossils found, and rock clues led to **Continental Drift Theory.**

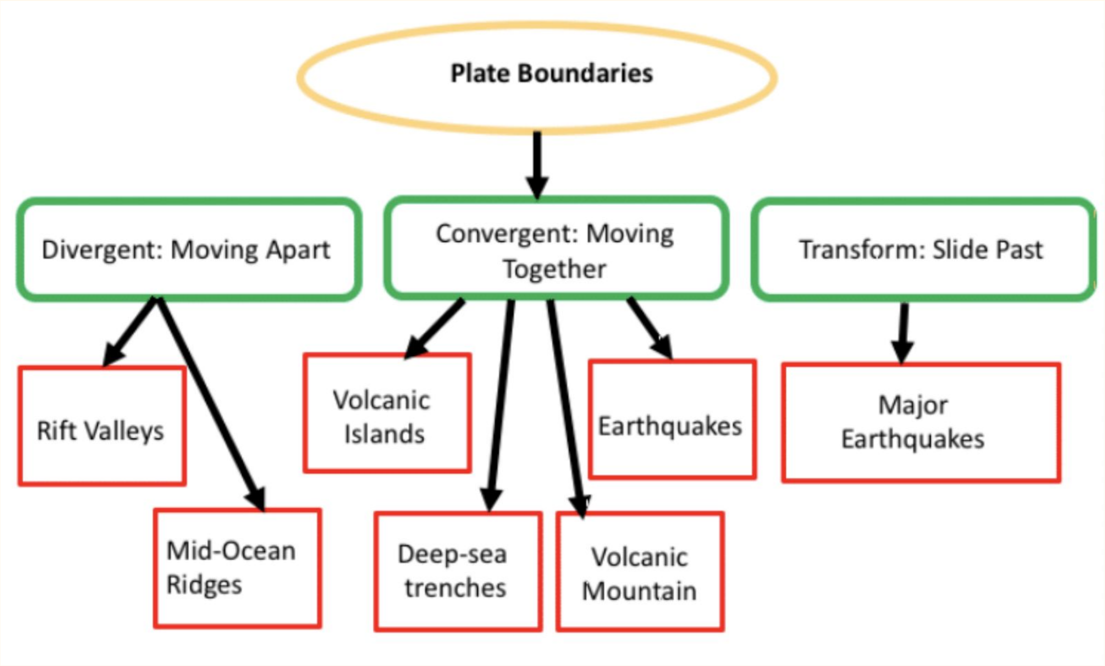


Continents appear to fit together like puzzle pieces

PLATE BOUNDARIES

- **Plate Boundaries**- where two plates meet, they either move together, they move apart, or they move past one another

Divergent Plate Boundary→ two plates separated	Transform Plate Boundary→ two plates slide past each other	Convergent Plate Boundary→ two plates collide
		



PATTERNS OF PLATE BOUNDARIES

Tectonic plate theory explains why earthquakes and volcanoes occur in certain places. It also explains how mountain ranges are formed.

Ring of Fire- Area of earthquake and volcanic activity that surround the Pacific Ocean.

QUESTIONS

1. What are tectonic plates?

2. What layer is hot and liquid?

3. How does the liquid layer allow the plates to move?

4. Which plate is the largest?

5. What is happening with the plates at each type of boundary?
    a. Divergent-
    b. Transform-
    c. Convergent-

6. What does each type of boundary form?
    a. Divergent-
    b. Transform-
    c. Convergent-

7. Why is the "Ring of Fire" significant?

Graham Cracker Plate Tectonics Lab

Just a little info…

The Theory of Plate Tectonics states that the crust of the Earth is composed of seven major plates and numerous smaller plates. These plates "ride" on the hot plastic upper mantle called the asthenosphere. This theory also says that most of these plates are in motion, creating a variety of interactions at the plate boundaries. As plate boundaries, plates may converge, diverge, or slip (lateral) past each other in a horizontal motion. In addition, some plates may appear to be inactive.

Do some research online to answer the questions below as you work through this lab. Again, this assignment is completely optional. Don't stress, just have fun with it!

Pre-lab Questions:

1. What is subduction?

2. Explain what a divergent boundary is.

3. Explain what a convergent boundary is.

4. Explain what a transform boundary is.

5. True or False. When sea-floor spreading occurs, new crust is added to the ocean floor.

6. What is a fault?

7. Which type of boundary (divergent, convergent, or transform) do the most earthquakes occur on?

8. Explain what convection currents are.

Materials:

Graham crackers

Spoonful of cool whip or frosting

Wax paper or paper plates

Foam Board

Cup of water

Procedures to represent Sea Floor Spreading:

Break a whole graham cracker into two square pieces by following the perforations on the cracker.

Using a knife or spoons spread a thick layer of cool whip in the center of the paper plate or wax paper.

Lay two pieces of the graham cracker side by side on top of the cool whip.

To imitate sea-floor spreading, press down lightly on the crackers as you slowly push down and apart in opposite directions. Do not push the crackers more than 1 centimeter apart! Remove the graham crackers from the cool whip.

Questions:

1. What happened to the cool whip between the crackers?

2. What do the graham crackers represent?

3. What does the cool whip represent?

Procedures to represent Convergent Plate Boundaries- Oceanic and Continental:

Now lay a WHOLE of graham cracker and the foam board end-to-end (against each other) on top of the cool whip. The graham cracker represents the thin but dense oceanic plate while the foam board represents the thicker but less dense continental plate.

Push the two “plate” models slowly toward each other and observe which plate rides up over the other. On the actual surface of the earth, the lower and more dense plate is subducted.

Questions:

1. Which plate is more dense: continental or oceanic?

2. Which plate will subduct or sink under the other?

3. Why do you suppose oceanic crust is so dense and heavy?

Procedures: Convergent Boundaries- Continental:

Re-use the graham cracker used above for this activity. Break the graham cracker into four pieces- use only two and save the remaining two pieces of graham cracker for the next section. Each piece of graham cracker represents a continental plate.

Dip one end of each of the two graham crackers two centimeters into a cup of water. IMMEDIATELY remove the crackers and lay them end to end on the cool whip with the wet edges nearly touching.

Slowly push the two crackers together.

Questions:

1. What happens to the wet ends of the graham crackers?

2. In what way do the wet crackers act more like the real crustal plates than the dry crackers?

3. When two continental plates collide in a convergent boundary, they squeeze together to form what?

Procedures: Transform Boundaries:

Use the two remaining graham cracker pieces for this part of the lab.

Fit the two pieces together side to side on top of the cool whip on the paper. Place one hand on each of the cracker pieces and push them together by applying steady, moderate pressure. At the same time, also push one of the pieces away from you while pulling the other toward you.

If you do this correctly, the cracker should hold while you increase the push-pull pressure, but will finally break from the opposite forces.

Questions:

1. Why is this movement often described as “horizontal” sliding?

2. What natural disaster occurs often near this type of boundary?

FINAL QUESTIONS:

1. What are plates?

2. What do scientists think causes the movement of Earth’s plates?

3. If oceanic crust collides with continental crust-what will most likely happen?

4. Why do you think it was so important to science when Alfie Wegener and Harry Hess proved their theories of continental drift and sea-floor spreading?

EARTH & SPACE SCIENCE
GRIFFIN & KING

VOLCANOES

VOLCANOES

- **Volcanoes-** a vent in Earth's crust that melted (or molten) rock flows from
- **Magma-** molten rock below Earth's surface
- Volcanic eruptions form mountains, create new crust, and destroy the earth
- Volcanoes are formed from the movement of Earth's plates
- **Hot Spots-** volcanoes not associated with plate boundaries
- **Divergent Plate Boundary**- two plates separated
    - Seafloor spreads along mid-ocean ridge
- **Convergent Plate Boundary**- two plates collide
    - Ocean plate collides with Continental plate- subduction is formed when they collide and the denser plate sinks below the more buoyant plate- creates trenches and forms volcanoes
- Volcanic eruptions affect **climate**
    - Ash in the atmosphere blocks sunlight

- High winds can move ash around the world
- Sulfur dioxide gases are released into the atmosphere causing temperature changes

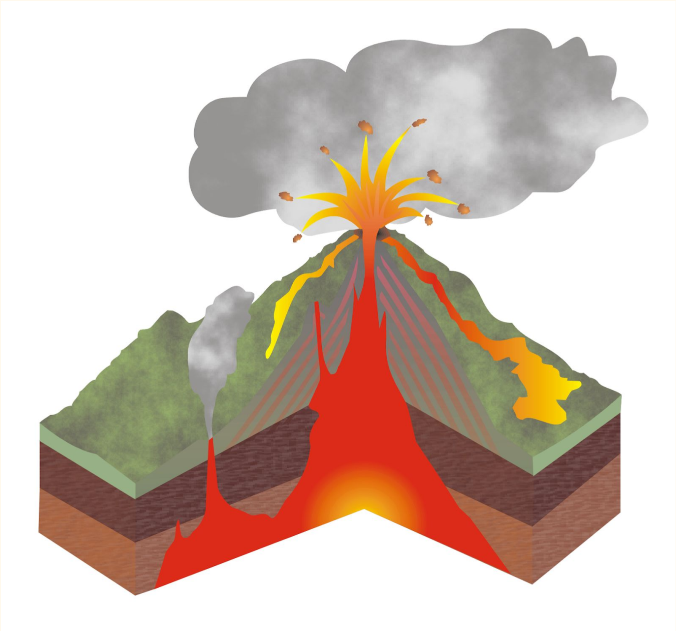
The primary factors that determine whether a volcano erupts explosively or quietly include characteristics of the magma and the amount of dissolved gases in the magma.

- **Viscosity** is a substance's resistance to flow.
- A **vent** is an opening to the Earth's surface. During explosive eruptions, the gases trapped in magma push the magma out.

Depending on the type of eruption, volcanoes may produce **lava flows** or eject **pyroclastic materials**, or both. All volcanic eruptions also emit large amounts of **gases**.

- Particles from volcanic eruptions are called **pyroclastic materials**.
- The fragments ejected during eruptions range in size from very fine dust and ash to pieces that weigh several tons.

The **three** main volcanic types are shield volcanoes, cinder cones, and composite cones.



- **Shield volcanoes** are produced by the accumulation of fluid basaltic lavas and have the shape of a broad, slightly domed structure.
- A **cinder cone** is a small volcano built primarily of pyroclastic material ejected from a single vent.
- A **composite cone** is a large, nearly symmetrical volcanic mountain composed of layers of both lava and pyroclastic deposits.

QUESTIONS

1. What is a volcano?

2. What are hot spots?

3. What causes volcanoes to form?

4. What is viscosity?

5. Describe a vent.

6. What can volcanoes produce?
    a.
    b.
    c.

7. List and describe the three main types of volcanoes.
    a.
    b.
    c.

MOUNTAIN BUILDING

FOLDS, FAULTS, AND MOUNTAINS

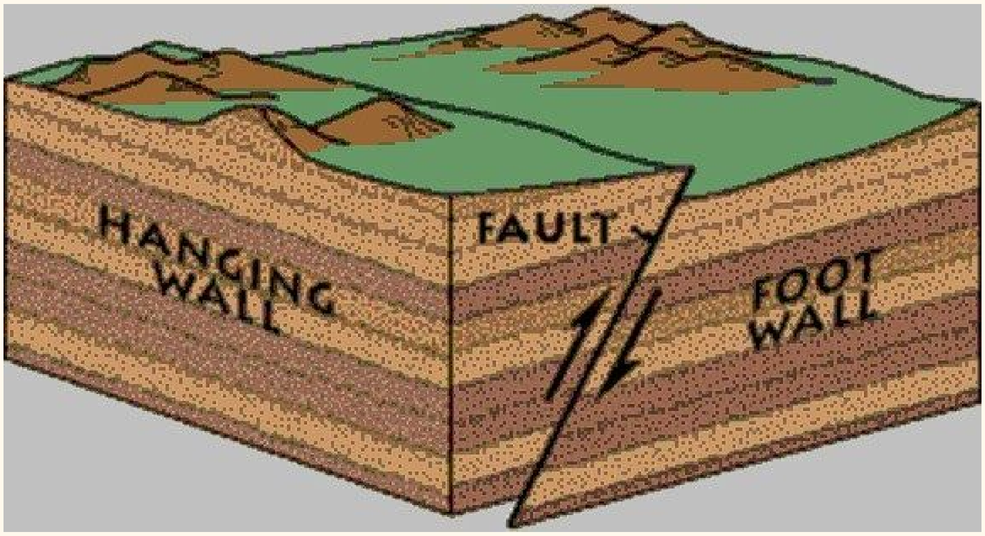
The **three** main types of folds are anticlines, synclines, and monoclines.

- An **anticline** is formed by the upfolding, or arching, of rock layers.
- Often found in association with anticlines are downfolds, or troughs, called **synclines**.
- **Monoclines** are large, step-like folds in sedimentary strata.

The major types of **faults** are normal faults, reverse faults, thrust faults, and strike-slip faults.

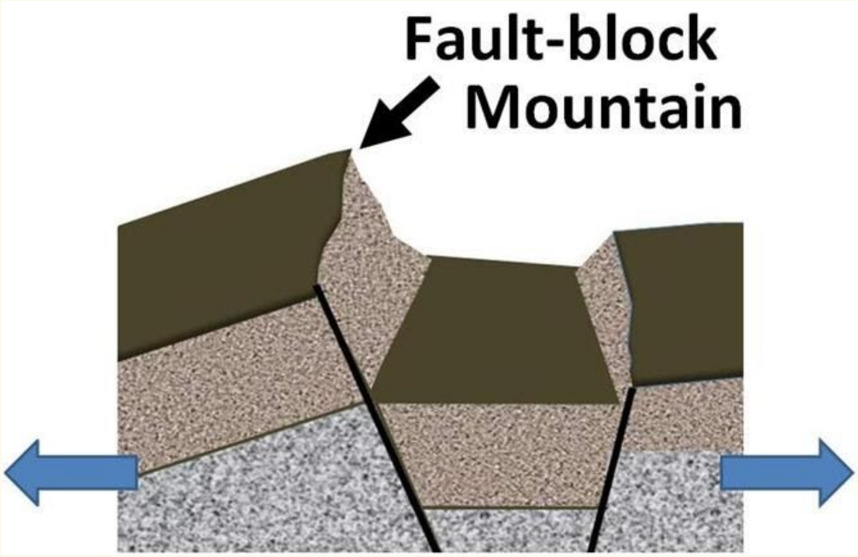
- The rock surface just above the fault is called the hanging wall, and the rock surface below the fault is called the footwall.
- In a **normal fault**, the hanging wall moves down relative to the footwall.
- In a **reverse fault**, the hanging wall moves up relative to the footwall.
- **Thrust faults** are reverse faults with dips of less than 45 degrees.

- Faults in which the movement is horizontal and parallel to the trend of the fault surface are called **strike-slip faults**.



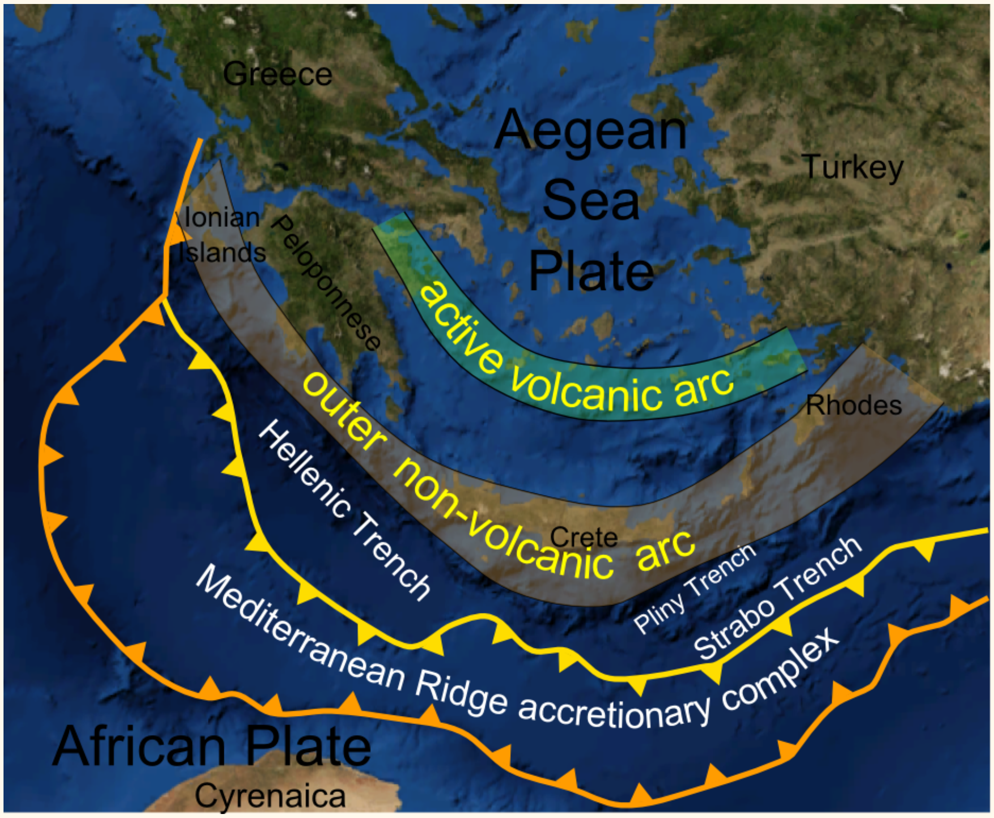
The **major types of mountains** include volcanic mountains, folded mountains, fault-block mountains, and dome mountains.

- Mountains that are formed primarily by compressional stresses, which create folds in the rock layers are called **folded mountains**.
- Compressional stress is the major factor that forms folded mountains.
- **Fault-block mountains** form as large blocks of crust are uplifted and tilted along normal faults.



MOUNTAINS AND PLATES

- The convergence of two oceanic plates mainly produces **volcanic mountains**.
    - The result of this collision is the formation of a **volcanic island arc**.
- The convergence of an oceanic plate and a continental plate produces volcanic mountains and folded mountains.
- At a convergent boundary, a collision between two plates carrying continental crust will form folded mountains. This happens because the continental crust is not dense enough to be subducted.
- The mountains that form along ocean ridges at divergent plate boundaries are fault-block mountains made of volcanic rock.
- Volcanic mountains at **hot spots**, as well as some upwarped mountains and fault-block mountains, can form far from plate boundaries.



QUESTIONS

1. List and describe the three main types of folds.
    a.
    b.
    c.
2. What are the major types of faults?
3. Describe the differences between folded mountains and fault-block mountains.
4. Where do volcanic mountains usually form?
5. What is a volcanic island arc?
6. Are hot spots along plate boundaries?

How to make a Volcano

*****NOTE: This should be done outside due to the mess.*****

Materials:

10 ml of dish soap

100 ml of cold water

400 ml of white vinegar

Food coloring

Baking soda slurry (fill a cup about ½ with baking soda, then fill the rest of the way with water)

Empty 2 liter soda bottle

Instructions:

Combine the vinegar, water, dish soap and 2 drops of food coloring into the empty soda bottle.

Use a spoon to mix the baking soda slurry until it is all a liquid.

Eruption time! … Pour the baking soda slurry into the soda bottle quickly and step back!

How it Works:

A chemical reaction between vinegar and baking soda creates a gas called carbon dioxide. Carbon dioxide is the same type of gas used to make the carbonation in sodas. What happens if you shake up a soda? The gas gets very excited and tries to spread out. There is not enough room in the bottle for the gas to spread out so it leaves through the opening very quickly, causing an eruption!

Extra Experiments:

1. Does the amount of vinegar change the eruption?
2. Does the amount of water change the eruption?
3. Does the amount of baking soda change the eruption?

NATIONAL GEOGRAPHIC

https://www.nationalgeographic.com/science/2018/10/news-most-dangerous-volcanoes-usgs-list-geology.html

SCIENCE

These are the most dangerous U.S. volcanoes, scientists say

The first update to government rankings since 2005 uses multiple factors to reveal the potential severity of impacts from future eruptions.

BY MAYA WEI-HAAS

PUBLISHED OCTOBER 26, 2018

In the wake of its recent fiery rampage, it's perhaps no surprise that Kīlauea in Hawaii tops the list as the most dangerous volcano in the U.S., according to newly released rankings from the U.S. Geological Survey. Washington's Mount St. Helens and Mount Rainier round out the top three slots.

The new volcano threat assessment is an update to a 2005 report that determined the greatest risks based on the potential for eruption and human impacts. To be clear, the report does not forecast the volcanoes most likely to erupt—it is merely a ranking of the "potential severity of impacts" of future hypothetical eruptions.

"The threat articulated in this report is the same threat that was there a week ago," says Ben Andrews, the director of the Smithsonian's Global Volcanism Program. "It's maybe just a little better described here."

Such rankings provide vital information so that the USGS and other organizations can determine which volcanoes deserve the most attention for research, monitoring, emergency planning, and funding. By doing so, these groups can more effectively help local communities react to future eruptions.

"It's so critical," volcanologist Janine Krippner of Concord University says of the report. Volcanology funding is limited, she notes, so the ranking helps scientists and government officials home in on the biggest dangers and try to avert disaster.

"Volcanoes tend to give us warning before they erupt," Krippner says. "But if we're not listening, we'll miss it."

How volcanic is the United States?

The United States is one of the most volcanic countries in the world, boasting more than 10 percent of the planet's active or potentially active volcanoes. The latest report identifies 161 volcanoes of concern, the majority of which cluster along the nation's western coast through California, Washington, Oregon, and Alaska.

This intense activity is driven by the underlying collision of tectonic plates, where the denser oceanic plate is being shoved beneath the North American continental plate. As the ocean slab plunges deep into the planet, temperatures and pressures climb, causing water to escape. The presence of water reduces the melting point of the rocks overhead, forming magma. If that molten material makes it to the surface, a formerly quiescent peak can burst to life in an eruption. (Here's what may happen when Earth's plate tectonics stop.)

But the West Coast isn't the only place in the country with potential for volcanic activity. Though they're placed at a much lower threat level, volcanoes in Arizona, Colorado, and Utah also make the list.

"The reason why they are there is much debated," Adam Kent, a volcanologist at Oregon State University, says of these interior volcanoes. They could be powered by hotspots, where an underlying plume of magma lurks. This is the mechanism behind the Hawaiian island chain, which formed as its tectonic plate crept over a largely stationary plume. Kent likens the process to a conveyor belt moving over a blowtorch.

A volcanic hotspot is also the explanation for the infamous Yellowstone caldera, which ranks just 21 on the new list. Though its supervolcano status has sparked a lot of bluster over the years, it's unlikely it will erupt anytime soon.

"I want to emphasize this in bold, underlined, blinking text: We are in no way overdue for an eruption in Yellowstone," Andrews says.

How are the rankings determined?

The updated rankings are based on 15 hazard factors, including the type of volcano, the known frequency of eruptions, the threat of triggering a tsunami, and the potential for volcanic mudslides, or lahars. The rankings also take into account nine so-called exposure factors, which relate to the threats to local communities, such as past fatalities and nearby population density.

Each volcano gets rankings for these individual factors that contribute to its final overall hazard score. The final list is then divided into five categories based on the threat level: very high, high, moderate, low, and very low. Kent notes that he sees these larger groupings are more important than each individual number.

The risks posed by volcanoes have continually increased, Krippner says. "But that's not because the volcanoes are changing," she says. "That's because we're closer to them." (See where people live in the shadow of active volcanoes.)

In addition to noting population increases and proximity, the new report pays particular attention to aviation threats. Flying through volcanic ash clouds is extremely dangerous and can cause issues such as engine erosion, clogged air filters, and even complete engine failure.

Since the 2005 report, estimates of air traffic over Alaska's volcanoes has tripled from some 20,000 people a day to an estimated 60,000 each day. That's part of why the list includes five of Alaska's peaks among the 18 "very high threat" volcanoes.

Have the rankings changed?

Overall, though, the new rankings closely resemble those in the 2005 report, which also placed Kīlauea in the top slot. The same 18 volcanoes also remained in the "very high threat" category.

"Things wiggled a bit," Andrews says, but the fact that not much has changed is positive news. "It suggests we have a pretty good handle on what are the really dangerous volcanos."

The list does include eight fewer volcanoes than the 2005 report, following changes to the Smithsonian's Global Volcanism Program. This "loss" is largely due to more accurate dating methods, which place some volcanoes' last known eruptions further in the past than previously thought. If the last known eruptions date to before 11,700 years ago, the volcanoes are considered inactive. (Here's how ancient volcanic eruptions may have helped kill the dinosaurs.)

The new rankings make only three exceptions to this rule: Wyoming's Yellowstone supervolcano, New Mexico's Valles caldera, and California's Long Valley volcano. These three are particularly sizable and are thought to erupt on intervals much longer than the 11,700-year cutoff, Andrews says.

What does this mean for me?

"If you live in volcano country, like if you live in hurricane country or earthquake country, just take the time to inform yourself and be prepared," says Oregon State University's Kent. If you are in a dangerous region, he suggests maintaining a basic disaster kit.

You can also arm yourself with the knowledge of where the hazards are and how to respond, Krippner adds. The USGS has many online resources to help locals and visitors understand volcanic dangers nearby.

"This is a really good opportunity to remind people that, yeah, this is one of the most volcanically active countries in the world; it needs to be a priority for funding and monitoring," Krippner says. "USGS is working incredibly hard to understand what these hazards are and communicate them—and everyone needs to listen."

The 18 volcanoes included in the "very high threat" category are:

1. Kīlauea, Hawaii
2. Mount St. Helens, Washington
3. Mount Rainier, Washington
4. Redoubt Volcano, Alaska
5. Mount Shasta, California
6. Mount Hood, Oregon
7. Three Sisters, Oregon
8. Akutan Island, Alaska
9. Makushin Volcano, Alaska
10. Mount Spurr, Alaska
11. Lassen volcanic center, California
12. Augustine Volcano, Alaska
13. Newberry Volcano, Oregon
14. Mount Baker, Washington
15. Glacier Peak, Washington
16. Mauna Loa, Hawaii
17. Crater Lake, Oregon
18. Long Valley Caldera, California

Maya Wei-Haas is a science staff writer for National Geographic.