LaB-LOG

ACTIVITY 5: Modeling Volcanic Eruptions | Date 9/25 | Page 13

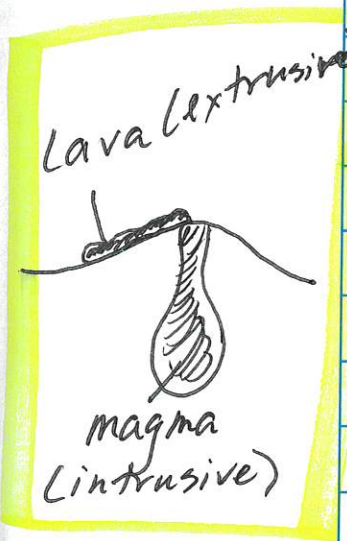
Warm-up?

TRUE or ~~FALSE~~? All volcanic eruptions look the same. Provide evidence to support your answer.

Draw a volcano.

Vocabulary

Lava: Magma that flows over Earth's surface.



Intrusive igneous rock: formed when magma cools and solidifies.

Extrusive igneous rock: formed when lava cools & solidifies.

Procedure:

type of magma	Observations	
	Trial 1	Trial 2
less gassy magma		

*Name: _____ FRIDAY NOTEBOOK REVIEW # 1

*Period: _____ *Date: _____

my pages

Learning Summary of Last Week: Notebook Pages 1 to 13 (Activities 1 to 5)

- Risks to consider when storing nuclear waste
  - landslides, EQs, groundwater, volcanic activity, rainfall
- sedimentary rock formation (lithification) & igneous rocks observations.
- How are aquifers made (aquifer vs. aquitard)
- what is nuclear waste? dangerous leftover materials from reactors.
- diff types of volcanic hazards (ashfall, lahars, pyroclastic flow, lava flows) & volcanoes
- magma (inside) vs. lava (outside)

* Something that was interesting from this week, and **why** did you find it interesting:	* Draw a diagram that will help you remember something from this week:

Question(s) that I have related to the topics learned: (you must come up with something!)

*

Name: **Activity 5: Volcanoes Notes**

Directions: *Please follow along as your teacher shares information about volcanoes with you and take notes on this form as you go. The notes will go in order with the presentation.*

What is a volcano?
A volcano is a vent or opening on the Earth's surface where magma can escape and thereby turn into lava.

These vents can be ~~often~~ small or large or long cracks called fissures.

What are some examples of types of true volcanoes?
Shield, cinder cones, composite/stratovolcano

What are some types of landforms that are remnants of volcanoes?
lava plateau & caldera

What is viscosity?
The measure of the resistance to flow.

When a liquid is runny and flows easier, its viscosity is low.

When it's thicker, stickier, and doesn't flow easily, its viscosity is high.

What are volatiles, and how do they affect volcanoes?
Dissolved gases in magma, such as water vapor, carbon dioxide, nitrogen, and sulfur are called volatiles.

Magma low in volatiles is more runny

Magma high in volatiles is more explosive

What are shield volcanoes?
Repeated fluid (low viscosity, low gas) lava flows build up to create the layered shield shape.

The example in the picture has a width of 120 km and depth of 5.8 km.

Examples near Portland include Larch Mtn, Mt. Bachelor, Belknap Volcano, and Newberry Crater.

An example not near Portland is Kilauea, HI

What are cinder cones?
Usually cone-shaped formed from tephra.

Tephra is solid particles formed from material erupted into the air, such as ash, cinders and volcanic bombs

The Boring Lava flows happened 1 mya, and some examples include MT Tabor, Mt Scott and Powell Butte. Rocky Butte

What are stratovolcanoes?

a.k.a. Composite

strato- Layers and composite means made up of different things

Stratovolcanoes – build up of lava from quiet, low viscosity eruptions mixed with explosive eruptions and lava domes

Examples include Mt. St. Helens, Mt. Raineer, Mt. Hood and Mt. Lassen.

What are lava plateaus?

The eruption volume is huge and the viscosity is low so it covers large areas of land and probably reeks havoc on the ecosystem.

An example near Portland is in the Columbia River Gorge and it was formed by the Columbia River Flood Basalts which happened 16-12 mya.

What are calderas?

Calderas occur when magma high in viscosity and gas content pools under the surface. As the magma chamber empties, the rocks above collapse.

An example near Portland is Crater Lake and Newberry Crater.

What are hot spots?

Hot spot volcanoes are not subduction zone volcanoes, or material from the core.

Hot spots are _____ that rise up from deep in the _____ plate and cause magma to rise up to the surface causing _____.

As the plate moves away from the hot spot, _____ are formed, forming an _____.

An example near Portland is _____.

What kind of volcanism is occurring at Yellowstone?

There is a giant _____ under Yellowstone due to a stationary _____.

There is a long line of _____ caused by the _____ plate moving west over the _____ mantle plume.

The 1st Yellowstone eruption covered _____.

Mt. St Helens eruption in 1980 covered _____.

The Mt. Mazama eruption, which caused the formation of Crater Lake was _____.

Rock Observations

Rock Name	Type of Rock (E/I)	How formed
Granite	Intrusive	cooled slowly underground
Basalt	Extrusive	cooled quickly above ground
Pumice		
obsidian		
Cowlitz R.		

Andesite

Analysis Questions (# 1-4)

on handout!

Rock Observations

Rock Name	Type of Rock (E/I)	How formed
Granite	Intrusive	cooled slowly underground
Basalt	Extrusive	cooled quickly above ground
Pumice		

ANALYSIS – discuss

1. Use your observations of the volcano model to answer the following:
   a. Describe the similarities and differences between the eruptions of volcanoes with less-gassy and more-gassy magma.
   b. Which type of magma produced a more explosive eruption?

ANALYSIS – discuss

2. Imagine a volcano erupting many times over a period of many years.
   a. Which of the following landforms is most likely a result of volcanic eruptions: flat plains, a hole or depression, or a mountain? Explain.
   b. Do you think that the landform might be different depending on the type of magma?

ANALYSIS – record

3. What were the strengths and weaknesses of the volcano model?

ANALYSIS – record

4. In this activity, you modeled a system. A system is a group of interacting objects or processes. Every system includes: COMPONENTS, INTERACTIONS, and BOUNDARIES.
   a. In a volcano system, how does the geological processes of a volcanic eruption result in the formation of igneous rock?
   b. In a volcano system, how can different volcanic eruptions result in the formation of different kinds of igneous rock?

6: Mapping Locations of EQs & Volcanoes — 10/10

(*) started my Guest Teacher

Procedure

- from Website database for EQ & V data.
- looked @ Relief Map to look for patterns
- watch seismic eruption program

Analysis Questions (#1, 4, & 3)

Remember the rules of doing HQ!

ANALYSIS

1. Describe any patterns you saw with the locations of earthquakes and volcanoes.
2. After drawing lines to designate the patterns of earthquakes and volcanoes, did you notice any locations that did not seem to be part of any pattern? If so, hypothesize why some earthquakes and/or volcanoes don't appear to fit any pattern.
3. Which parts of the world have had most of the
   a. strongest earthquakes?
   b. tallest volcanoes?
4. If you were to look at the data sets, the earthquake data came with dates included, but the volcano data only provided locations. Why might this be so?

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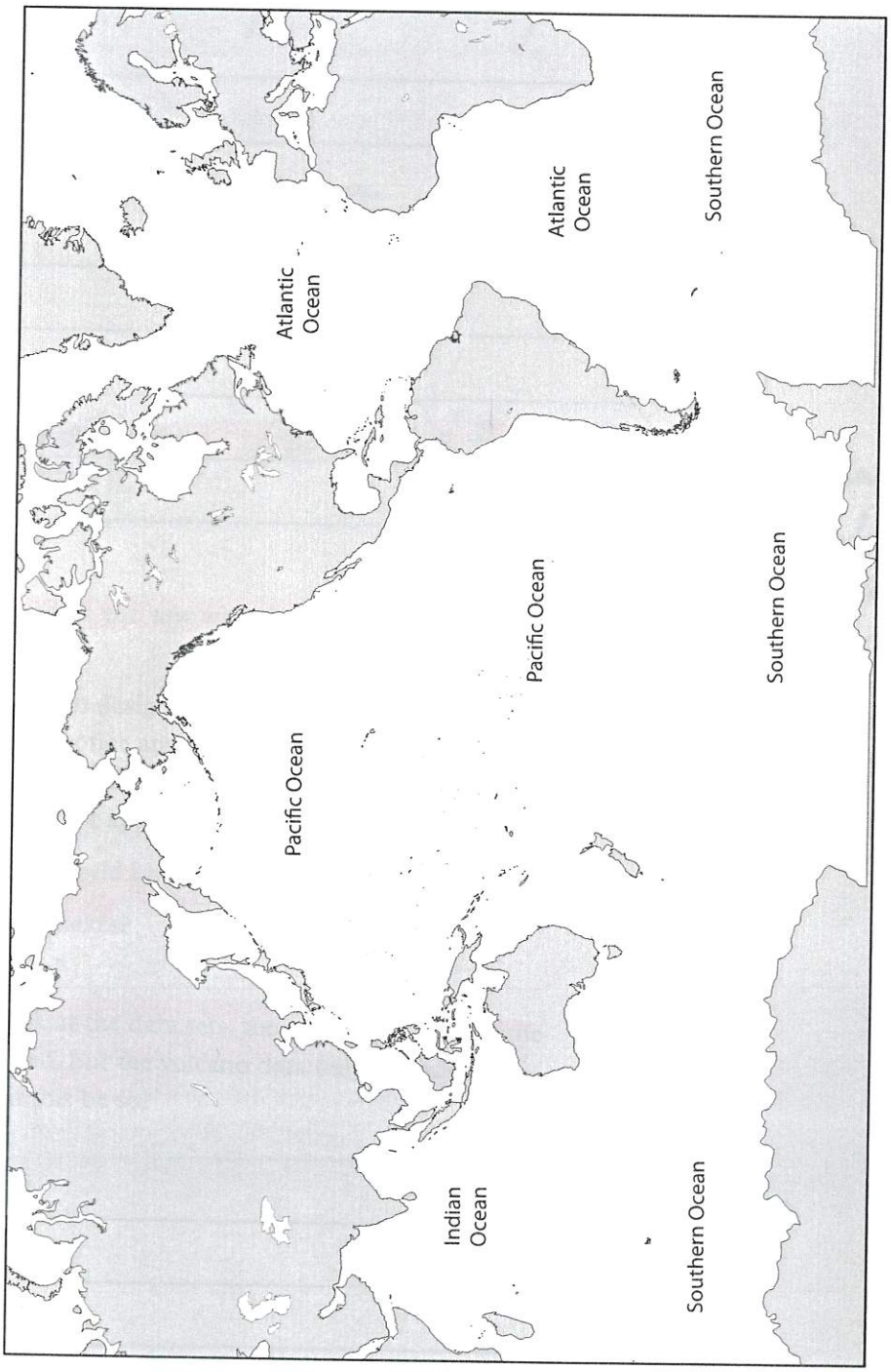
Name: _____

Period: _____

ACTIVITY 6: MAPPING LOCATIONS OF EARTHQUAKES AND VOLCANOES

STUDENT SHEET 6.1

MAP OF THE WORLD



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Name: _____ **Activity 6: Mapping Earthquakes and Volcanoes**

Period: **Relief Map Observations**

Look at the relief map of the world. This relief map shows surface features above and below the ocean. Answer the questions that follow.

1. Write down observations about the mountains on the continents. What do you notice? Do you see any patterns?

   A. _____

   B. _____

   C. _____

   D. _____

2. Write down observations about the mountains on the ocean floor. Do you see any patterns?

   A. _____

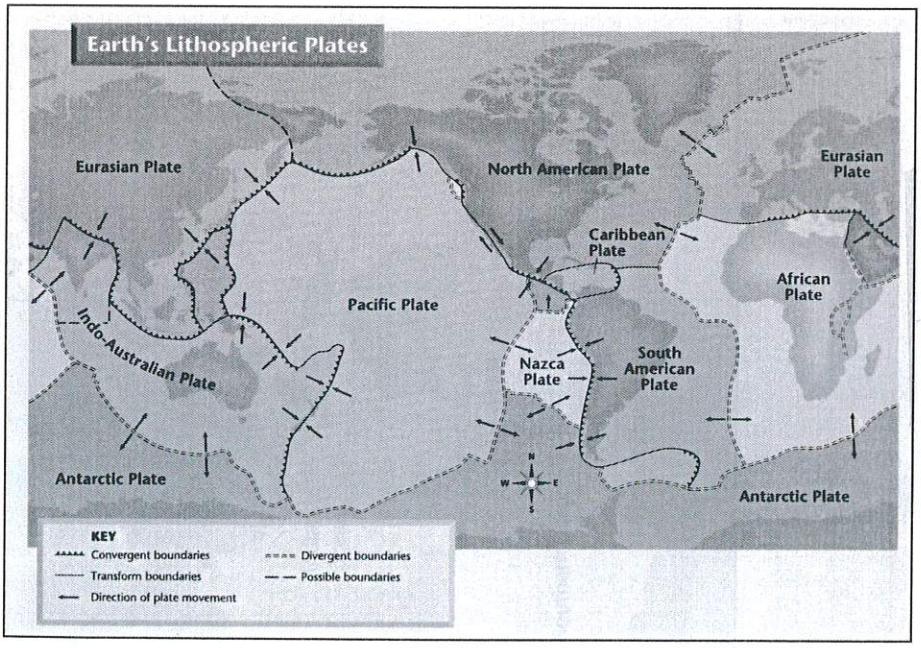
   B. _____

   C. _____

   D. _____

3. Compare the relief map to the diagram of Earth's lithospheric plates to the right. How do the features on continents and the ocean floor compare to the types of boundaries? Do you see any patterns or similarities?

   Use the back side to discuss your answer.



Name: GEOLOGICAL PROCESSES QUIZ #1 STUDY GUIDE, ACT 1-8

IMPORTANT NOTE: Review all the Learning Targets covered by this quiz in your Notebook! It's the goldenrod sheet of paper right after the Geological Processes Title Page.

ACTIVITY	QUESTIONS YOU SHOULD BE ABLE TO ANSWER AND HANDOUTS	KEY VOCABULARY
Activity 1: Storing Nuclear Waste	• What factors must be considered when deciding where to store nuclear waste? • What is nuclear waste? • Why is it considered dangerous for humans? • How do we currently store nuclear waste? What do scientists recommend instead? • **HANDOUT:** Background Info and Storage Considerations – back is NW consideration chart • AQ #1, 2, 4	nuclear waste evidence trade-off
Activity 2: Investigating Groundwater	• How does water interact with earth materials? • How are sedimentary rocks formed? • What are some characteristics of sedimentary rocks? • What is an aquifer? What is an aquitard? • What is necessary for groundwater to be stored? • **HANDOUT:** • AQ #1-3 and Groom AQ about lithification ★	groundwater aquifer sediments sedimentary rock aquitard permeable impermeable
Activity 3: Hazards Caused by Water	• How can natural hazards create challenges for storing nuclear waste? • What causes landslides? • Why do scientists use models to study landslides? • **HANDOUT:** Anticipation Guide (#3 important!), Killer Landslides Video sheet • AQ #1, 2	natural hazard landslide model variables (manipulated, responding, controlled) nuclear waste
Activity 4: Natural Hazards Caused by Earthquakes and Volcanoes	• What are earthquakes and volcanoes? • What are some of the major hazards caused by EQs and volcanoes? What are their effects, and how can damage be minimized? / mitigation • **HANDOUT:** Directed Reading Table of Hazards, Understanding Volcanic Hazards Video Questions • AQ #1, 2	earthquake volcano magma vs. lava Ash falls, ash flows (pyroclastic), mudflows (lahars), lava flows, volcanic gasses
Activity 5: Modeling Volcanic Eruptions	• How can models help us understand what happens during a volcanic eruption? • How are igneous rocks formed? • How do volcanic eruptions, and the rocks they form, differ? • What are the 3 main types of volcanoes? • What factors influence the types of eruptions? • Hot spot volcanoes • **HANDOUT:** Volcanoes Notes	lava magma igneous rock (basalt, andesite, granite, pumice, cinders, ash) intrusive vs. extrusive ★ viscosity silica volatility

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Activity 6: Mapping Locations of Earthquakes and Volcanoes	• What patterns can we see in the locations of earthquakes and volcanoes? • What patterns do we see in landforms on the ocean floor and on land? • How do we monitor the motion of the ground? • HANDOUT: Map for the World, Relief Map Observations • AQ #1, 3, 4	GPS mid-ocean ridge (mountain chains on ocean floor) continental mountains plate boundaries Ring of Fire
Activity 7: Observing Earth's Moving Surface	• What is GPS and how does it work? • What is a "Time Series Plot" and what kind of information will it give? • How can you show the direction of a GPS receiver over time using time series plots? • How do you determine how far a spot on the Earth has moved using GPS? • How can GPS data help learn about the Earth? • What types of ground movements will show up on GPS? • HANDOUTS: Interpreting GPS TSP Data, Analyzing and Interpreting GPS Data (with different locations) • AQ #1-6	GPS satellite and receiver time series plots Pythagorean Theorem
Activity 8: Earth's Surface and Below	• Reading pp. 46-48 • What is beneath Earth's surface? • How do we know about the layers of the Earth? • Which layers are solid? Hottest? Made of iron and nickel? • Which layers are the "plates" made of? • Which layer do plates move on? • HANDOUTS: Glass Elevator, Earth's Layers, Scaled Drawing • AQ #1-4	seismic waves lithosphere lithospheric (tectonic) plates asthenosphere crust mantle outer core inner core
Mt. St. Helens Field Trip	• Packet information about field trip	

Name: _____ FRIDAY NOTEBOOK REVIEW # 2

Period: _____ Date: _____

Learning Summary of Last Week: Notebook Pages 15 to 17 (Activities 5 to 6)

Something that was interesting from this week, and **why** did you find it interesting:	Draw a diagram that will help you remember something from this week:

Question(s) that I have related to the topics learned: (you must come up with something!)

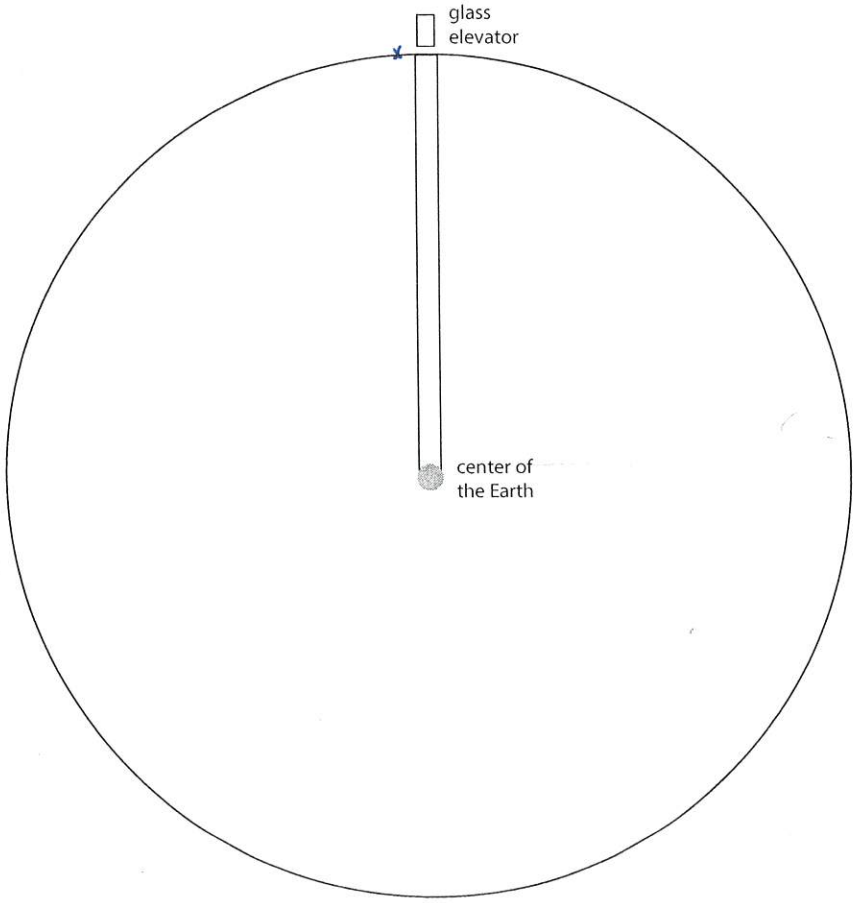
Name: _____ ACT 8: BENEATH EARTH'S SURFACE

Period: GLASS ELEVATOR

STUDENT SHEET 8.1

BENEATH EARTH'S SURFACE

1. Imagine taking a glass elevator to the center of the earth. Draw what you see. Be sure to label your drawing.
2. I think the distance to the center of the earth is: _____ kilometers (km).
3. Place an "X" at the depth you think nuclear waste should be stored. Label the depth in kilometers (km).



Name: _____ Activity 8: Beneath Earth's Surface

Period: READING OUTLINE – ANSWER KEY

1. What is the primary source of information used in the last 100 years to learn about Earth's interior?
   New technology and new methods, especially from EQs.

2. What are seismic waves, and what are a couple important things about them?
   Seismic waves are waves of energy going out in all directions from an earthquake. There are different types, they travel faster through solids and slower through liquids, and not all types of seismic waves travel through liquids.
3. What are the different types of seismic waves?
   P waves – Primary/Pressure waves – travel the fastest, in a straight line, and go through solids and liquids.
   S waves – Secondary/Shear waves – travel at a medium speed, and cannot go through liquids.
   Surface (Love/Raleigh) waves – move along the surface, travel the slowest, and cause the most surface damage.

4. Because of how seismic waves travel, what have geologists been able to determine?
   The layers of the Earth and their thicknesses.

5. Complete the table below with the missing information. Some information is not directly in the reading and will be filled in later.

Layers of the Earth	Approximate Depth Below Surface (km)	State	Material	Temperature (degrees Celsius)
Crust	5 – 40 on average	Solid	Many kinds of rocks	0 - 700
Lithosphere	100 km on average	Solid	Rock	
Asthenosphere	100 km – 250 km	Viscoelastic solid	Rock	
Mantle	40 – 2800 (actually 2900 but simplified for math for this activity)	Mostly solid Varies with . . .	Iron, Magnesium, and silicate compounds	700 - 2800
Outer Core	2,800 – 5,200	Liquid	Metal – iron and nickel	2800 - 6000
Inner Core	5200 - 6400	Solid	Metal – iron and nickel	Over 6000

6. The relative thickness of the mantle is about the same distance between ___.
   Between New York City and Denver, Colorado

7. The uppermost part of the mantle is called the ___. Why does it get that name?
   Lithosphere – Got it's name from being solid (lithos = rock/stone) because it's colder.

8. Tectonic plates are also called ___.
   Lithospheric plates because they are pieces of the lithospher.

9. The edges of these plates are called ___.
   Plate boundarioes

10. How does the asthenosphere get its name?
    A = without, and thenos = strength, so it's the layer of soft, viscoelastic solid that can deform and change shape over time.

11. What property of the asthenosphere gives it its unique function?
    It can change shape with pressure and time.

12. Look at the diagram of the lithospheric plates. The 'Ring of Fire' is located around what plate? What is the name of the plate that is off our coast?
    Ring of Fire is around the Pacific Plate. The plate off our coast is the Juan de Fuca plate.

13. What can be used to monitor movement of the lithospheric plates?
    GPS can be used to show movement of plates.

14. What do you notice about the arrows of the GPS movement? What are they showing? Write at least a few observations.
    Arrows more on the west coast are longer and pointing in the same direction.
    One closer inland are shorter and most are moving towards the northwest. Way further inland, like near Nevada and Idaho, the arrows are all much shorter and appear to be moving in a curving motion.

Name: _____

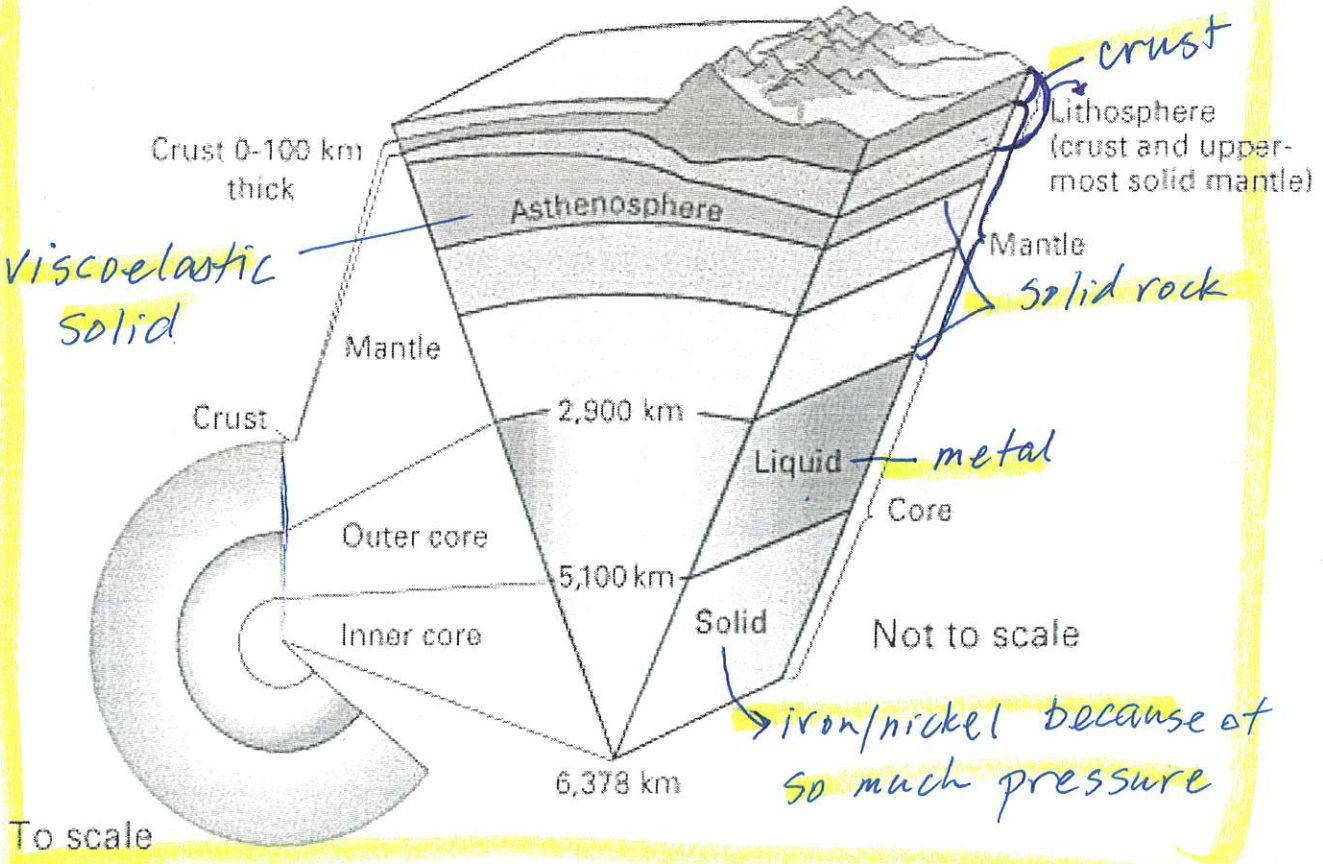
Period:

Activity 8: Beneath Earth's Surface
USGS READING

From https://pubs.usgs.gov/gip/dynamic/inside.html

The size of the Earth -- about 12,750 kilometers (km) in diameter-was known by the ancient Greeks, but it was not until the turn of the 20th century that scientists determined that our planet is made up of three main layers: *crust, mantle,* and *core.* This layered structure can be compared to that of a boiled egg. The ***crust***, the outermost layer, is rigid and very thin compared with the other two. Beneath the oceans, the crust varies little in thickness, generally extending only to about 5 km. The thickness of the crust beneath continents is much more variable but averages about 30 km; under large mountain ranges, such as the Alps or the Sierra Nevada, however, the base of the crust can be as deep as 100 km. Like the shell of an egg, the Earth's crust is brittle and can break because it is cold rock.

Cutaway views showing the internal structure of the Earth. Below: This view drawn to scale (lower left) demonstrates that the Earth's crust literally is only skin deep. Below right: The view not drawn to scale is to show the Earth's three main layers (crust, mantle, and core) in more detail (see text).



Below the crust is the ***mantle***, a dense, hot layer of semi-solid rock approximately 2,900 km thick. The mantle, which contains more iron, magnesium, and calcium than the crust, is hotter and denser because temperature and pressure inside the Earth increase with depth. As a comparison, the mantle might be thought of as the white of a boiled egg.

At the center of the Earth lies the ***core***, which is nearly twice as dense as the mantle because its composition is metallic (iron-nickel alloy) rather than rocky. Unlike the yolk of an egg, however, the Earth's core is actually made up of two distinct parts: a 2,200 km-thick ***liquid* outer core** and a 1,250 km-thick ***solid* inner core**. As the Earth rotates, the liquid outer core spins, creating the Earth's magnetic field.

Not surprisingly, the Earth's internal structure influences plate tectonics. The upper part of the mantle is cooler and more rigid than the deep mantle; in many ways, it behaves like the overlying crust. Together they form a rigid layer of rock called the ***lithosphere*** (from *lithos,* Greek for stone). The lithosphere tends to be thinnest under the oceans and in volcanically active continental areas, such as the Western United States. Averaging at least 80 km in thickness over much of the Earth, the lithosphere has been broken up into the moving plates that contain the world's continents and oceans. Scientists believe that below the lithosphere is a relatively narrow, movable zone in the mantle called the ***asthenosphere*** (from *asthenes,* Greek for weak). This zone is composed of hot, semi-solid material, which can soften and flow after being subjected to high temperature and pressure over geologic time. The rigid lithosphere is thought to "float" or move about on the slowly flowing asthenosphere.

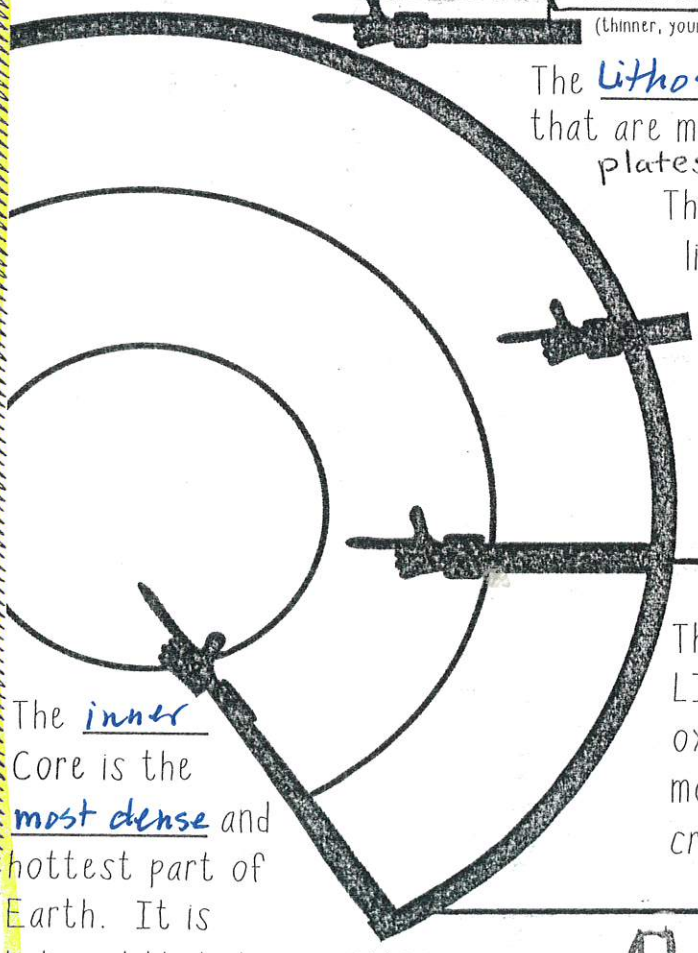
EARTH'S LAYERS

Earth is composed of

The crust is the outermost layer of the planet. It includes the entire surface of continents all the way to the ocean floor. The crust consists of the soft, plastic mantle. It is made of two main types of rock:

granite — Continental crust (thicker, older, Granite)

basalt — Oceanic crust (thinner, younger, Basalt)



The lithosphere includes the crust and upper mantle that are made of rigid, brittle lithospheric plates.

The asthenosphere is a hot, dense, asphalt-like layer of rock that flows causing lithospheric plates to move. It's a viscoelastic solid, like Silly Putty!

The outer Core is made of LIQUID iron, nickel, sulfur and oxygen. Scientists infer that movement of IRON in the outer core creates Earth's magnetic field.

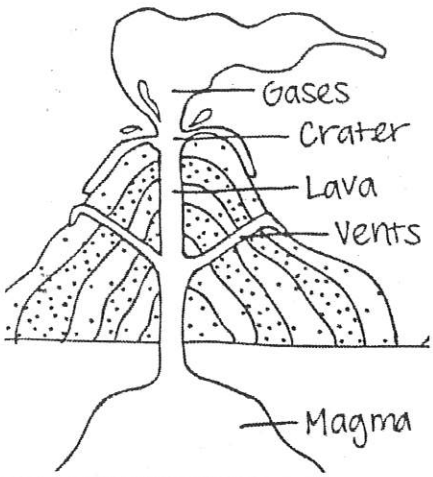
The inner Core is the most dense and hottest part of Earth. It is believed that it is a SOLID ball made mostly of iron and nickel.

of Earth in kilometers by the distance you measured in centimeters on the drawing. Record your scale in the table.

#8 Reading Notes

How do we know what lies below Earth's surface?

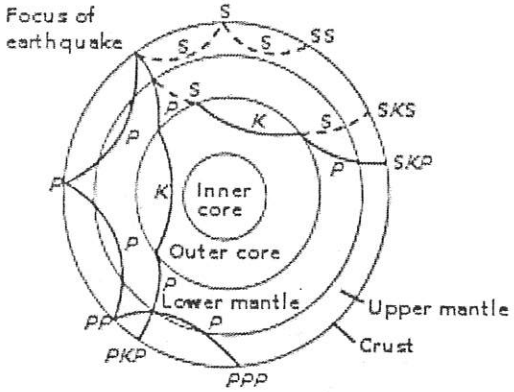
Volcanoes



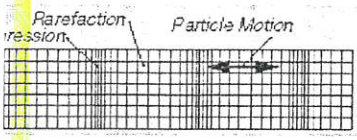
Earthquakes

During an earthquake, energy is transmitted in all directions. The waves that transmit the energy are called seismic waves.

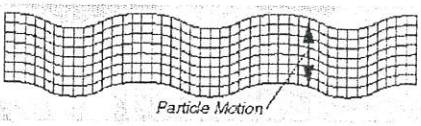
Seismic waves move faster through dense solids, and slower through liquids. Some waves don't travel through liquids.



P waves



S waves



Seismometers: tool used to measure earthquakes.

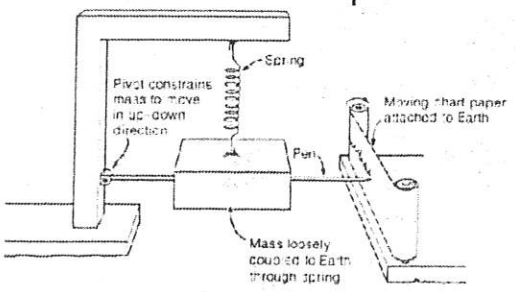


Figure 18-2
Spring mounted seismograph to record vertical ground motion

Inge Lehmann
Danish Seismologist who discovered 2 cores using seismic waves

Not really assigned - suggested

Analysis Questions (#1, 2)

ANALYSIS

1. Which layer or layers of Earth
   a. are the hottest?
   b. are at Earth's center?
   c. are completely solid?
   d. contain the asthenosphere?
2. Copy the five words and phrases shown below:

   outer core
   lithosphere
   upper mantle
   solid
   crust

   a. Look for a relationship among the words. Cross out the word or phrase that does not belong.
   b. Circle the word or phrase that includes all the other words.
   c. Explain how the word or phrase you circled is related to the other words in the list.

   Your teacher will give you Student Sheet 8.2, "Scaled Drawing of Earth's Interior." Use it and the information from the reading to answer Analysis items 3 and 4.

3. On Student Sheet 8.2, answer Parts a–g to create a scaled drawing of Earth's layers. If you have colored pencils available, you may want to color in the different layers.
   a. Record the distance in kilometers from Earth's surface to its center.
   b. To make an accurate drawing, you first need to determine the scale, which tells how many kilometers each centimeter on your drawing will represent. On Student Sheet 8.2, use a clear metric ruler to measure and record the distance from the circle, representing Earth's surface, to its center in centimeters. Measure to the nearest 0.1 cm, and record this measurement in the table.
   c. Calculate the scale by dividing the actual distance to the center of Earth in kilometers by the distance you measured in centimeters on the drawing. Record your scale in the table.