CASCADIA: THE HIDDEN FIRE Name _____ Per.____

VIDEO QUESTIONS Today's Date _____

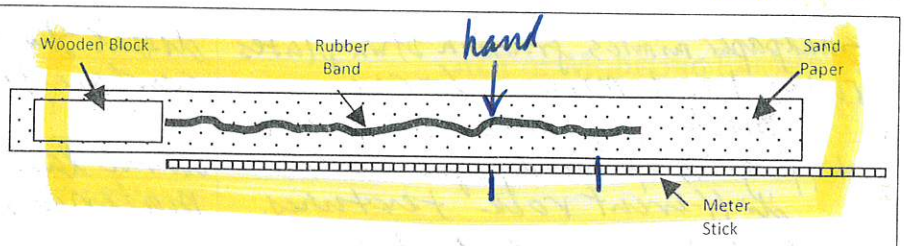
1. The 2001 Nisqually quake (south of Seattle) was a ___*6.8*_____ in magnitude.
2. There are 3 main types of quakes in Cascadia – the so-called 'triple threat'. They are:
   a. _____ ***crustal*** _____ quakes
   b. _____ ***subduction zone*** _____ quakes
   c. _____ ***deep*** _____ quakes (like the Nisqually quake)
3. Was the Nisqually quake what everyone in the Seattle area had been preparing for?
   No, they were preparing for more of a crustal quake (there's a huge fault under Seattle!)
4. What event showed that the Cascadia Subduction Zone was still active?
   The eruption of Mt. St. Helens.
5. What is the 'Ring of Fire', and where is it? ***Ring of volcanoes that surrounds the Pacific plate***
6. In 1964 there was a gigantic quake (magnitude 9.2) in what city and state?
   Anchorage, Alaska
7. Listen carefully to the story of Tay Thomas. When she says all she could hear was 'dripping water' look at the scene. What has happened to the Earth and the houses?
   Everything was in complete disarray with huge chunks of the Earth moved. That part of the damage was due also to a large landslide.
8. How long is the Cascadia Subduction Zone? ***About 700 miles***
9. Brian Atwater is introduced – what is he looking for?
   Evidence that there has been major subduction zone EQs and tsunamis here.
10. In 1986 he discovered soil and sand layers in bays and marshes. What do the layers show?
    That there are sand sheets brought in by tsunami waves and that the land dropped.
11. What brought in the layers of gray sand on top of the dark brown peat layers?
    Different tsunami waves!
12. He has found records of how many large quakes in the last 7000 years? ***18***_____
13. David Yamaguchi analyzed what? ***Tree rings***
    a. What did he want to find out? ***When the trees died so he could determine the date.***
14. Japanese historical records show that they had a large tsunami wave but no earthquake to cause it. Along with the cores taken by Japanese scientists, when and where was the earthquake that caused the Japanese wave? ***Jan 26, 1700, 9:00 pm in Cascadia!***

15. There was a debate about the "Decade of Terror" vs. the "Instant of Terror." What's the difference between the two?
    a. "Decade of Terror": *Big EQs spread out over time along the subduction zone*
    b. "Instant of Terror": *The whole subduction zone rupturing at once*
16. Chris Goldfinger set out to prove the Decade of Terror idea. He studied "turbidites." Where are turbidite samples taken from? *Underwater landslide deposits taken by boats*
17. Turbidites are layers of Earth caused by landslides under *water*.
18. What did his studies prove? *That all the turbidites show the same layering of age showing that the whole subduction zone ruptured multiple times*
19. What do some of the coastal Native American stories say?
    Canoes were put in trees, not to live near the coast
20. In 1994, Herb Dragert discovered some odd GPS data. He discovered "slow earthquakes" that take _____*weeks*_____ instead of minutes/seconds.
21. What is the link between the "slow earthquakes" and a large subduction zone earthquake?
    The times when the slow EQs are happening are times where there is more stress adding to the locked portion of the subduction zone!
22. Besides the large subduction zone earthquake danger, there is a large danger of shallow crustal fault quakes in Seattle and Portland. What is the main problem with Portland?
    The faults running right under Portland, and worry about liquefaction, building collapse
23. What is the message about the threat of danger of earthquakes?
    It's better to be prepared.
24. If you had to spend tax dollars on preparing for a large earthquake or defense against terrorist acts, what is more important to you? Why?

Name: Activity 9: Modeling Earthquakes, Pg. 1

PART A: EXPERIENCING EARTHQUAKE MACHINE: Follow the directions called "Sandpaper Block Earthquake Model." Record observations and answer questions below.

OBSERVATIONS:



THE ENERGY **TRANSFORMATIONS** AND **TRANSFERS** IN THIS SYSTEM INCLUDE:

KE of hand Tx to KE of r. band
KE of r. band → (changes) to Elastic PE in band
EPE in band [illegible] → (changes) to block
KE of band Tx to block
KE of block ~~Tx~~ to KE of air (sound)

Matching: Match the real world term with the part of the model used to represent it.

Letter of Match	Real World	Model
E	Earthquake / Elastic rebound	a. block
F	Convection currents in upper mantle	b. rubber bands
A	Plate	c. sandpaper
C	Friction between plates	d. measurement of block movement
D	Magnitude	e. block movement
B	Stress on fault	f. person pulling rubber bands

ANALYSIS of Basic EQ Machine:

1. What are the strengths and weaknesses of this model? (Write small, please)

Strengths	Weaknesses
sandpaper mimics friction btwn plates	doesn't show damage / large shaking
rubber bands mimic a force pushing / pulling the plate	surface texture doesn't vary on sandpaper
diff grits of sandpaper model different rock textures.	doesn't last as long as a real EQ
cheap supplies to model something really complicated	materials can wear down
mimics how variable earth moves	

2. What can we not learn about a real earthquake because of the shortcomings of this model?

PART B: CHANGING EARTHQUAKE MACHINE VARIABLES

Make a list of at least six possible **manipulated variables** (MV = What's you're changing on purpose):

Possible Manipulated Variable	How it can be changed or quantified
# of rubber bands	1, 2, 3, ... 6 rubber bands.
grit of s.p. on block	variety of grits
size of the block	3 diff sizes (keep same mass)
angle of pull	different angles (protractor)
grit of s.p. on board	diff grits
weight of block	3-4 diff masses
speed of pulling	3-4 diff speeds

Make a list of at least four possible **responding variables** (RV = the outcome after changing the MV.):

Possible Responding Variables	How it can be quantified
- how far block moves after 1 movement (or more)	meterstick
- how far hand moves	meterstick
- speed of block (distance / time)	" and stopwatch

EQ Machine Data Table

Name: _____

Period: _____

ACT 9: MODELING EARTHQUAKES
BACKGROUND INFORMATION

PLATE BOUNDARIES AND EARTHQUAKES

An earthquake is the sudden release of energy in Earth's lithosphere, which can cause shaking at the surface. This energy can be generated by a sudden movement along a fault, by a volcanic eruption, or even by manufactured explosions. The strongest earthquakes, and many smaller ones, are the result of movements within the rocks of the lithosphere. The lithospheric plates that form the outer surface of Earth are constantly in motion. Sometimes the movement is gradual; at other times, the plates are locked together due to friction between them, unable to release accumulating energy. Eventually, this energy overcomes the friction between the plates and they break, causing an earthquake.

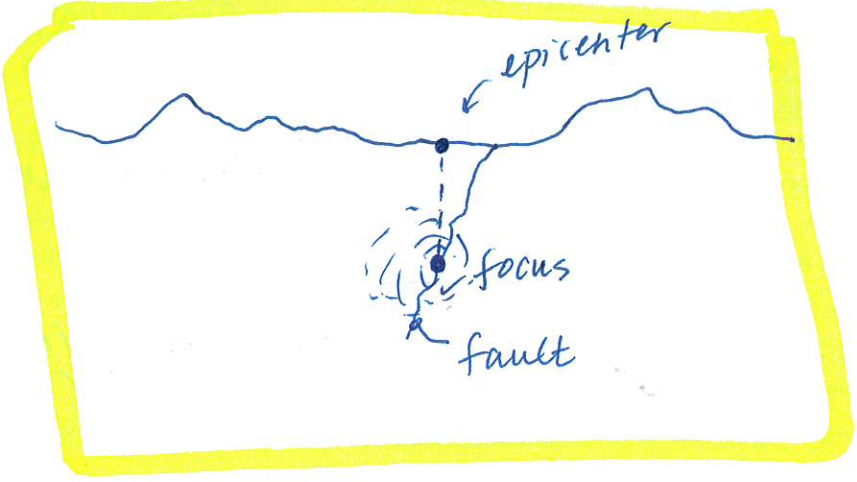
Lithosphere may first bend and then, when the stress exceeds the strength of the rocks, break and "snap" to a new position, through a process called elastic rebound. The process of breaking generates vibrations called seismic waves. These waves travel outward from the source of the earthquake through the earth at varying speeds, depending on the material through which they are moving. Earthquakes can be destructive in many ways. They can cause shaking at the surface that can damage buildings and other infrastructure. Earthquakes that occur beneath the ocean floor sometimes generate tsunamis, like the one that affected Southeast Asia in December 2004 and caused over 230,000 casualties around the Indian Ocean. Other earthquakes can cause natural hazards, such as landslides or liquefaction of the soil (where solid sand behaves like a liquid), which can harm people, structures, and the environment.

The location where an earthquake's energy originates is known as the focus. The foci (plural of focus) of most earthquakes are located in Earth's crust or upper part of the mantle. Earthquakes are also commonly located by their epicenter, which is the point on Earth's surface directly above the focus. A fracture in Earth's surface, along which two blocks of the crust have slipped, is known as a fault. Faults are usually described by how the blocks move in relation to each other. Geologists have found that earthquakes tend to reoccur along faults, which are most common on or near tectonic plate boundaries.

ANALYSIS of Basic EQ Machine:

1. What are the strengths and weaknesses of this model? (Write small, please)

In the space below, draw a diagram of a fault, a focus, and an epicenter.



Scientists use machines called seismometers to measure earthqua
A seismometer is designed to address the fact that when the ground moves, so does the seismometer. These machines usually contain a large suspended mass (which tends to remain at rest) attached to a recording structure. A **seismograph** records the difference in motion between Earth's surface and the suspended mass. Since a single seismograph can only record motion in a single direction, most sites contain several seismographs (including one that can measure vertica motion).

ENERGY

Energy is the ability to do work, which in science means applying a force to an object that causes the object to move. There are many types of energy. Some energy stored energy, which is called potential. When a rubber banc pulled apart by your fingers, it has elastic potential energy. Its stored energy can be transformed into motion (kinetic energy when it is released. Some energy is due to the movement of an object. This can be movement of object itself, as in our rubber band example, or movement of some part of an object. For example an object at a temperature above absolute zero has thermal energy because the particles that make it up are in motion.

Transfer of E - same kind of E moving from one thing to another
(Tx)

ACTIVITY 9, cont. | Date 11/5 | Page 23

9. EQ Machine Data Table

	QN data Quantitative		QL Data Qualitative
	Distance Block Moved	Distance Hand Moved	observations
Trials 1			
2			
3			
4			

Name: Activity 9: Modeling Earthquakes, Pg. 3

Decide with your group which one **manipulated variable** your group would like to test. The other possible manipulated variables will become your **constants**.

Our **manipulated variable** will be	
It will be changed by	
The units will be	

Our **responding variable** will be	
It will be measured by	
The units will be	

Controlled Variables

Constants	How they will be kept constant
speed that you pull rband with	____ cm per second

Hypothesis: What do you think will happen? Use vocabulary words such as the types of energy, energy transformations and transfers, friction, elastic rebound, earthquake, etc. Write it as an if/then statement, WITH an explanation of your thinking. Include NUMBERS if possible!

If I change the # of rubber bands from 2 to 4 to 6, and then 8, then I think that ... I think this will happen because ____

Name: _____

Period: _____

ACTIVITY 9: EARTHQUAKE MACHINE

ANALYSIS SCORING RUBRIC

Section	Self-Assessment Checklist	Self-Assessment and Explanation Use the checklist. If you think you've earned a 4, explain how you've gone above and beyond.	Teacher Assessment
SEP #5: Using Mathematics and Computational Thinking (Data)	**CLOSE TO PROFICIENT** ○ Missing something from Proficient checklist, or something is done incorrectly.		

	PROFICIENT *(Complete and Correct)*
	○ Data table includes accurate:
	  ○ Title, Labels, and Units
	○ Graph includes accurate:
	  ○ Title, Labels on x- and y- axes
	  ○ Scale to make data fill available space
	  ○ Use of line or bar graphs		

	HIGHLY PROFICIENT *(Above and beyond)* ○ Very specific labeling and units on data tables and graphs ○ Created an equation or line of best fit to describe the relationship between the variables ○ OTHER		
SEP #4: Analyzing and Interpreting Data	**CLOSE TO PROFICIENT** ○ Missing something from Proficient checklist, or something is done incorrectly.		
	PROFICIENT *(Complete and Correct)* ○ Relationship between MV and RV discussed ○ Data (numbers with units) used to provide evidence ○ The results of the experiment were related back to hypothesis, and include logical explanation of results ○ Connection made between experiment and earthquake processes ○ Sources of error are listed and how they affect data ○ An idea for a new experiment listed		
	HIGHLY PROFICIENT *(Above and beyond)* ○ Research relationship between location of earthquake and magnitude or depth of an earthquake ○ Includes very detailed explanations of all data, thoughtful discussions of errors, and/or connections to earthquakes ○ OTHER		

Name: Activity 9: Modeling Earthquakes, Pg. 5

Experiment #1: _____ vs. _____
(manipulated variable) (responding variable)

As the _____ increases,
(manipulated variable)

the _____
(responding variable)

The data I collected that supports this is: *(Use numbers from data table and/or graphs. Discuss ranges, odd data)*

QUALITATIVE Results: What qualitative data did you collect or observe that might connect with your quantitative results above?

Hypothesis Revisited: Look again at your hypothesis. Did this experiment provide data to support or refute your hypothesis? Be specific.

My hypothesis was: _____

Therefore, the data I collected _____ my hypothesis because
(supports or refutes)

(continue on next page)

Name: _____

Activity 9 EQ Machine Lab

GRADING ABBREVIATIONS AND COMMENTS

✔	Good, yep, got it	E	Energy
INC	Incomplete / not enough info	EX	Explain/Explanation
?	Not clear / confusing	T	Title
H	Hypothesis	CX	Connection
EA	Error Analysis	TX	Transfer
X	Incorrect	TM	Transformation
MIT	Missing an Important Term	U	Units
HG	Hypothesis Graph	TV	Too vague
AV	Average	RB	Rubber band(s)
F	Friction	R	Ruler

add! →

TB Information Too Brief – didn't explain in detail

EPE Elastic Potential Energy

D of T? Discussion of Trials? Missed out on analyzing aspects of your data.

NTD Need to Think Deeper – what you have is pretty basic or simple

NLG Would have been Nice to have a Line Graph with evenly spaced X-axis scale to better show pattern

RVCH Need a Responding Variable Column Heading – it just says Trials.

SP Spelling! Be professional and have someone proofread your work if you know that your spelling isn't usually very good

General Comments

- What is <u>pressure</u>? Stress? Elastic potential energy? Friction build-up?
- A yard stick is something people have in their back yards to throw for their dogs. In Science, we use **meter** sticks . . .
- Weight and mass are not the same thing. Use mass.
- Error Analysis – great way to show deeper thinking – good scientists are reflective of their process. Be specific – don't just say things like 'pulling at different speeds will cause blocks to go shorter or further.' And to fix it, don't just say 'pull at same speed.' Explain HOW you'll do that.

ACTIVITY 10: Plate Boundaries | Date 11/18 | Page 26

Warm-up Qsns

Describe or draw dance moves for each type of boundary

- convergent
- divergent
- transform

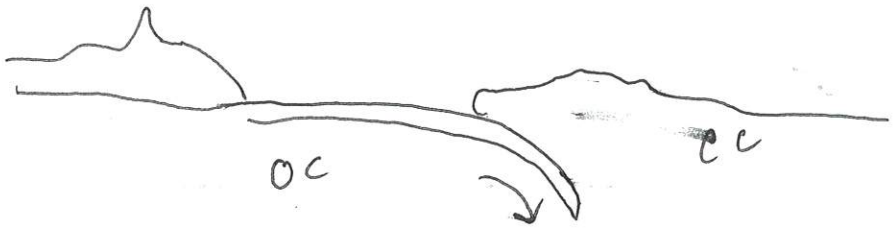
ACTIVITY 10: Plate Boundaries | Date 11/18 | Page 26

LAB-LOG

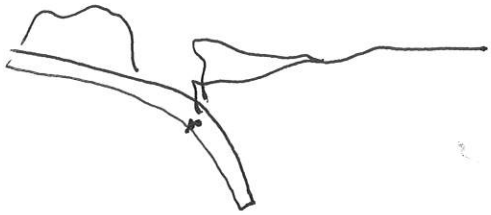
Warm-up Qsns

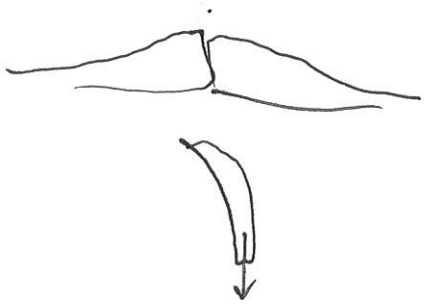
Describe or draw dance moves for each type of boundary

- convergent
- divergent
- transform



Subducting plate breaking off





How well I understand

Name:

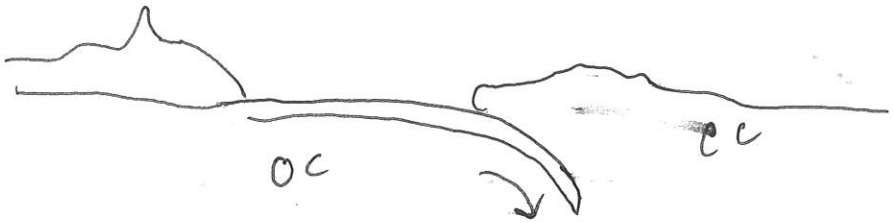
Activity #

LAB-LOG

Warm-up Qsns

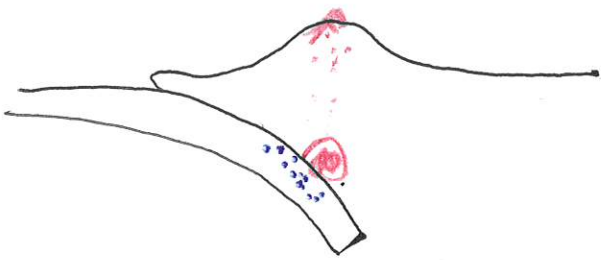
Describe or draw dance moves for each type of boundary

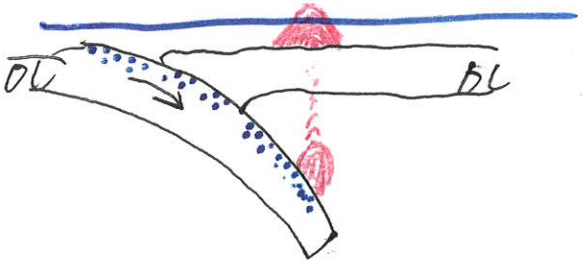
- convergent
- divergent
- transform



Subducting plate breaking off

OC – CO converging





OC – OC converging

Name: _____

Period: _____

ACT 10: PLATE BOUNDARIES
COMPUTER SIMULATION OBSERVATIONS

Direction of Plate Movement: Moving Apart

Scientific Term for the Boundary Type: Divergent

Period of time	Changes to land, such as • earthquakes • volcanoes • mountains • valleys • lithosphere	Changes to water, such as • appearance of water • formation of oceans or lakes • change in direction of rivers
10 years	nothing other than tiny movement of GPS stations away from each other, and tiny stretching!	n/a
100 years	one EQ (should be a few more)	n/a
1,000 years	moved further more EQs!	n/a
1 million years	depression/dip on surface " " under lithosphere	
5 million years	crack on bottom of L-sphere oceanic l-sphere comes in L-sphere gets thinner	water enters from oceans
20 million years	lots of EQs volcanoes!	

Direction of Plate Movement: Sliding past one another

Scientific Term for the Boundary Type: Transform

Period of time	Changes to land, such as • earthquakes • volcanoes • mountains • valleys • lithosphere	Changes to water, such as • appearance of water • formation of oceans or lakes • change in direction of rivers
20 million years	EQs! - tons of them! GPS moving away from each other river channels change & dry out	river H_2O can form a newly shaped river

Direction of Plate Movement: Towards each other

Scientific Term for the Boundary Type: Convergent

Period of time	Changes to land, such as • earthquakes • volcanoes • mountains • valleys • lithosphere	Changes to water, such as • appearance of water • formation of oceans or lakes • change in direction of rivers
20 million years	Two continental lithospheric plates: mountains Two oceanic lithospheric plates: lots of EQs	→ french ↘ older & colder goes down line of volcanoes

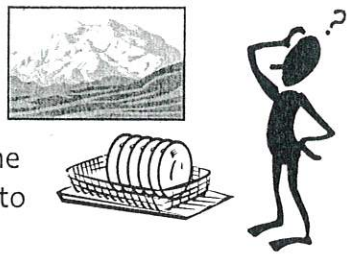
Use more space below for further notes on convergent boundary of oceanic and continental lithospheric plates.

- line of volcanoes on land
- lots of EQs
- crumpling of crust
- OC plate goes down

STUDENT SHEET 10.2

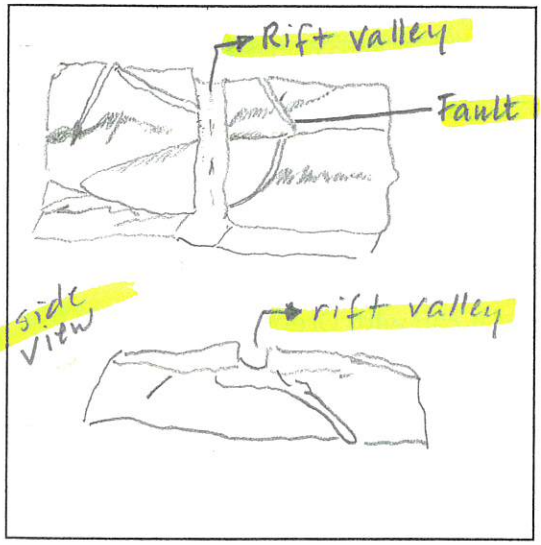
Name: _____ ACT 11: UNDERSTANDING PLATE BOUNDARIES

Per: Date:



In the boxes below, draw AND LABEL detailed pictures of what happens at divergent, convergent, and transform boundaries. In the lined spaces, describe what happens, AND compare what happens to Earth's surface.

DIVERGENT BOUNDARY



cracks forming → faults
chocolate layer = lithosphere
caramel = asthenosphere

CONVERGENT BOUNDARY (of two continental plates)

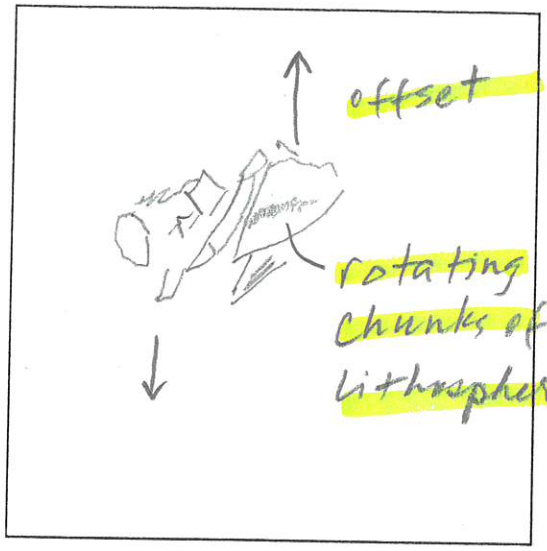
LAB-LOG

Na
Pe

D

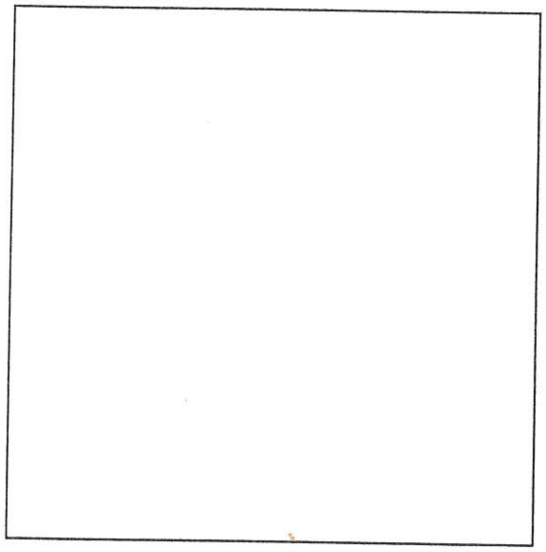
S

TRANSFORM BOUNDARY



CONVERGENT BOUNDARY (of oceanic/continental plates or oceanic/oceanic plates)

(which can't be shown with Milky Way bars, but it can with Oreos . . .)



How else could you model these processes using food materials?

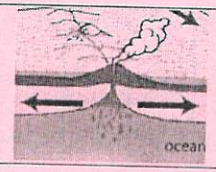
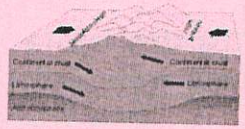
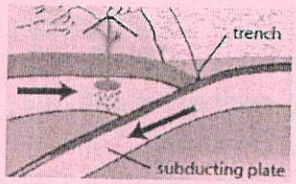
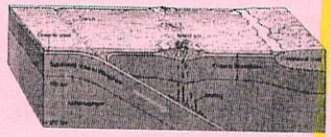
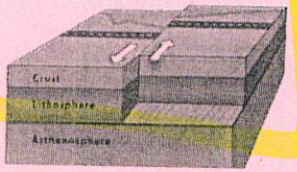
ACTIVITY 11: Understanding Plate Boundaries | Date 12/2 | Page 28

LaB-L

Observations | Questions?

Name: ANSWER KEY

Activity 11: Understanding Plate Boundaries
Directed Reading Table / Reading Outline

Type of Plate Motion	Scientific Name for Boundary Type	At this type of plate boundary, which of the following geological processes are likely to occur, and why? - earthquakes - volcanoes (and what kind) - mountain formation	At this type of plate boundary, what happens to the lithosphere? It is . . . - created - destroyed - neither	Example (location) of this type of plate boundary	Other notes / diagrams
Spreading Apart from Each Other	*Divergent*	*Earthquakes (usually smaller) as rocks are pulled apart.* *Volcanoes as lithosphere thins and weakens and magma can get through.*	*Lithosphere is created as lava erupts through thinner lithosphere and cools.*	*Mid-ocean ridges, Great Rift Valley in Africa*	
Coming Towards Each Other CO = continental OC = oceanic	*CO- CO Convergent*	*Earthquakes when lithosphere of equal density is pushed together and multiple faults are formed.* *Non-volcanic mountain formation.*	*Lithosphere is destroyed as it crumples together and gets shoved upwards*	*Himalayan mountains*	
	OC-CO Convergent	*Earthquakes are created (deep, crustal, or subduction zones.)* *Volcanoes above the subduction zone – different types, but definitely stratovolcanoes.* *Mountain formation as edge of continental margin is pushed inland and upwards.* *Also forms trenches.*	*Oceanic lthosphere is destroyed as the subducting plate moves down into the mantle*	*Juan de Fuca plate subducting under the North American plate.* *Nazca plate subducting under South American plate.*	
	OC-OC Convergent	*Earthquakes are created (deep, crustal, or subduction zones quakes)* *Volcanoes above the subduction zone – different types, but definitely stratovolcanoes* *Volcanic mountain chain formation.* *Also forms trenches.*	*Oceanic lithosphere is destroyed as the subducting plate moves down into the mantle*	*Pacific plate subducting under New Zealand.* *Pacific plate subducting under Asian plate to form Marianas.*	
Sliding Past Each Other	*Transform*	*Lots of earthquakes as edges of plates grind past one another.* *Not mountains per se, but crumpling of edges of plates.*	*Neither destroyed not created – just shifting around.*	*San Andreas Fault in CA between Pacific Plate (moving northwest) and NA plate (basically standing still)*	

ACTIVITY 11: Understanding Plate Boundaries
Date 12-12
Page 28

Describe how Hawaii and the new island of Loihi are thought to have formed.

At a 'hot spot' magma rises up from the mantle through weaker lithosphere. This hot spot is a relatively stationary place in the mantle. As the tectonic plate moves and the hot spot remains, a chain of volcanoes is formed over the hot spot. Loihi is the newest of the Hawaiian Islands as the Pacific Plate moves northwest over the hot spot.

What is a tsunami and how are tsunamis formed?

A tsunami is a giant wave formed when the seafloor shifts upwards in large earthquakes (can also be caused by underwater landslides or meteor impacts). It is an extremely large wave, more like a wall of water, which can rush more than a mile inland.

ANALYSIS QUESTIONS

2. **Trenches form at convergent plate boundaries, whereas mid-ocean ridges form at divergent plate boundaries. How are these landforms similar and different?**

Only True of Trenches	Similarities of Trenches and Mid-Ocean Ridges	Only True of Mid-Ocean Ridges
Form at convergent subduction zones where plates are coming towards each other and one subducts under the other. Does not involve magma/lava.	Both occur due to plate motion. Both occur at edges of plates. Both occur underwater. Both are deformations of the Earth's surface.	Underwater mountain chain that forms due to oceanic plates diverging and being pulled apart. Magma rises and cools.

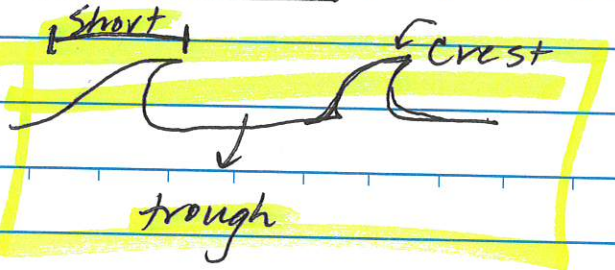
3. **Should nuclear waste be stored deep underground near plate boundaries? Explain using evidence from the reading.**

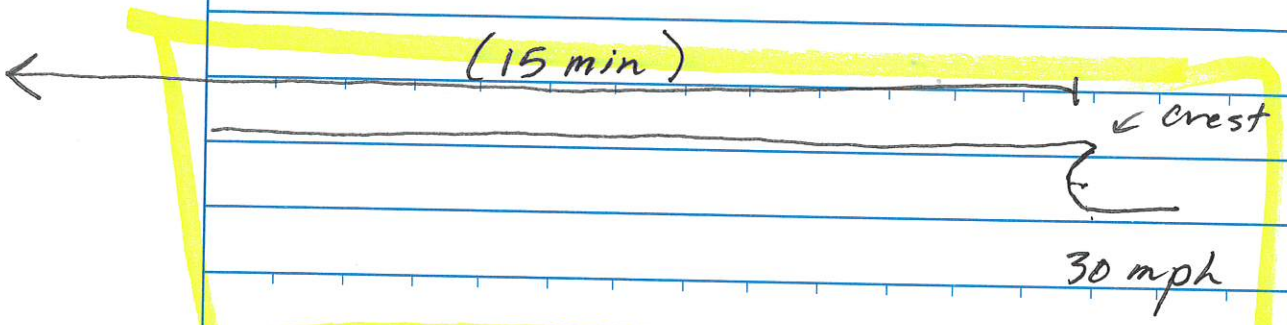
Nuclear waste should definitely not be stored anywhere near plate boundaries, primarily due to the potential of earthquakes and land deformation. There is also a large potential of volcanic activity at many plate boundary types. These processes will continue as plates constantly move over the surface of the Earth.

Name: _____

View of tsunami

wind waves





Summary of Understanding

- how they form?
- Why they're dangerous?
- What can you do?

Name: _____

Period: _____ Date: _____

FRIDAY NOTEBOOK REVIEW # 3

Learning Summary of Last Week: Notebook Pages 19 to 29 (Activities 8 to 11)

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:

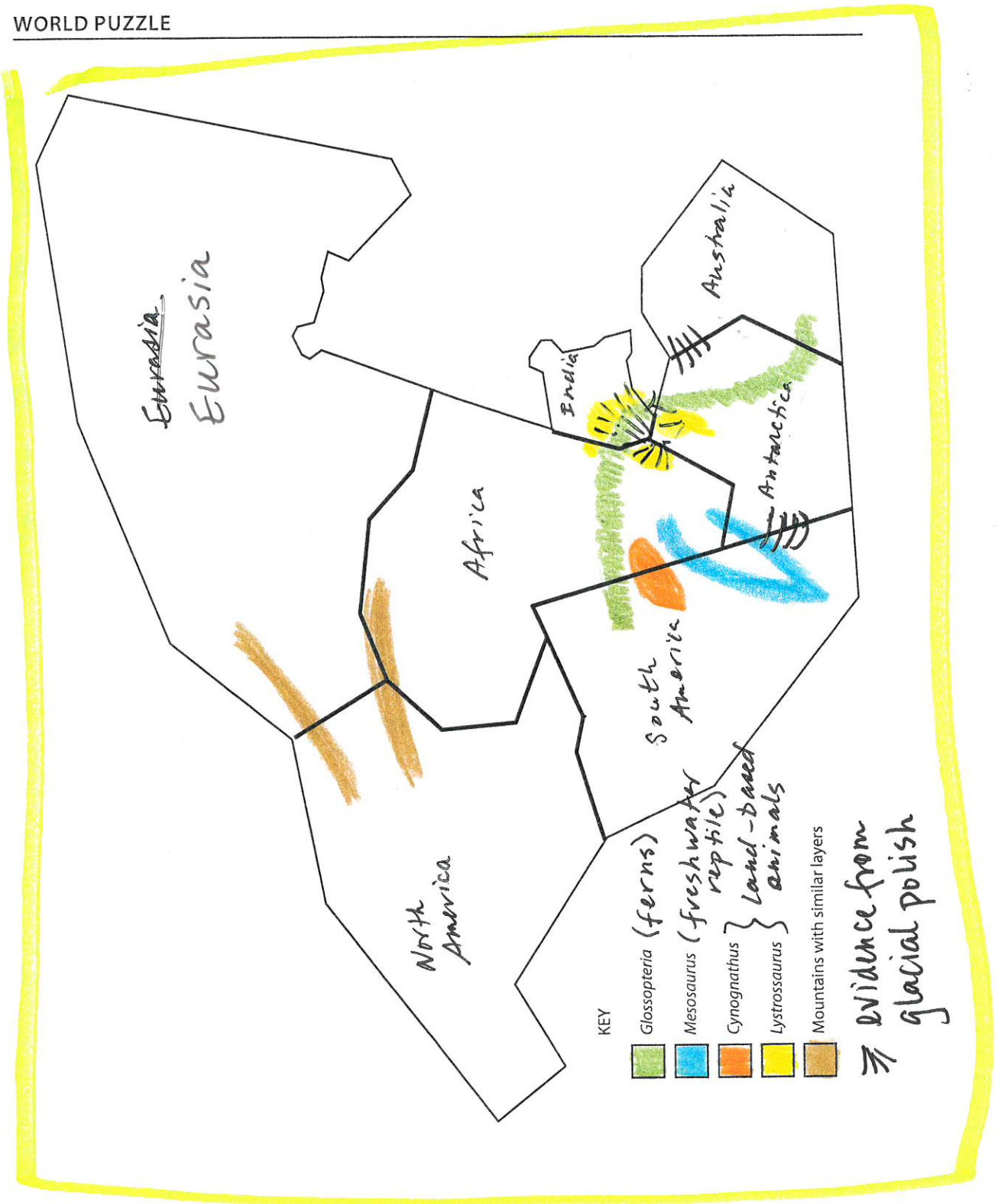
Question(s) that I have related to the topics learned: (you must come up with something!)

Name: _____

Period: _____

ACT 12: THE CONTINENT PUZZLE

WORLD PUZZLE



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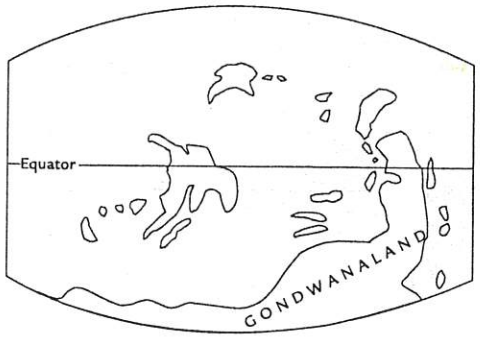
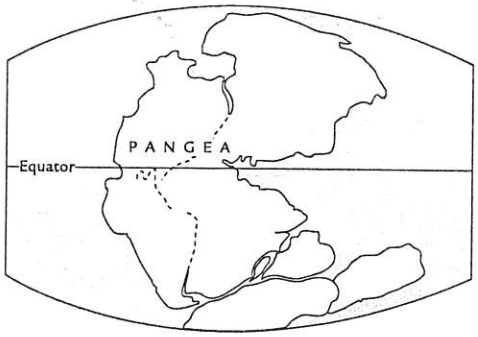
EARTH'S SURFACE THROUGH GEOLOGICAL TIME

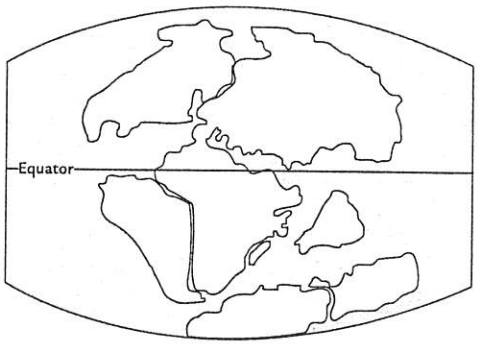
425 million years ago



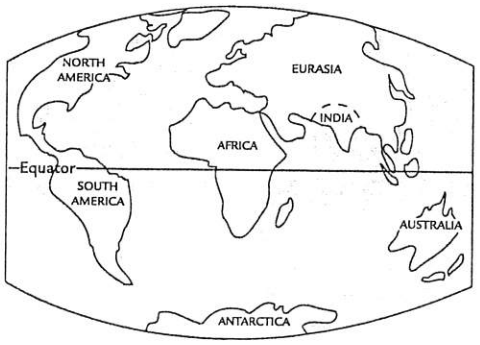
230 million years ago



135 million years ago



PRESENT DAY



ACTIVITY 12: The Continent Puzzle | Date 12/10 | Page 31

Notes/? from video

Marie Tharp - helped Wegener's idea of continental drift.

Analysis Questions (#2, 3)

ANALYSIS

1. There are six continents and there were seven puzzle pieces. One of the puzzle pieces was different from the others in that it did not represent a continent. Why do you think this difference was part of the model?

   Hint: Think about how you used the puzzle pieces to model changes on Earth's surface.

2. Explain how Earth's surface has changed over geological time.

   a. Describe what has happened to the land on Earth's surface over the past 425 million years.

   b. What types of evidence did the puzzle provide about changes on Earth's surface? Choose two pieces of evidence from the model. For each, describe what it is and how it supports the theory that the position of the continents has changed over geological time.

   Hint: Think about how you used the puzzle pieces to model changes on Earth's surface.

3. A friend says that changes to Earth's surface happen only very suddenly, like when the ground shakes during an earthquake or when a volcano erupts. Do you agree or disagree with your friend? Use evidence to support your position and explain your reasoning.

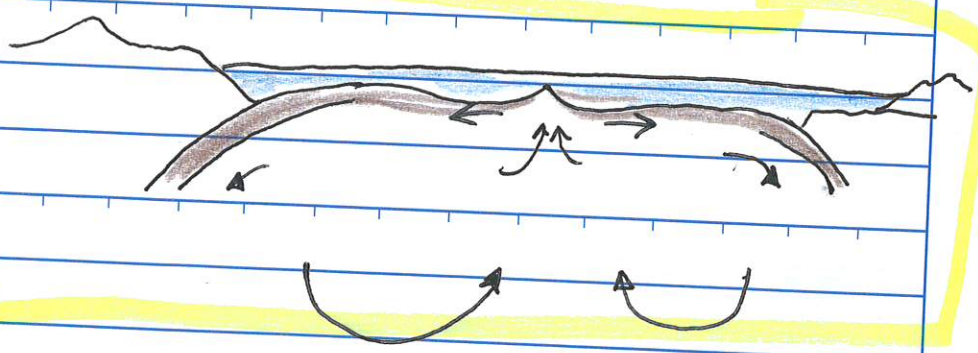
13: The Theory of Plate Tectonics

Seafloor Spreading - 1950s

- idea supported by Harry Hess
- discovered mountain ranges under the ocean using sonar.
- age of seafloor same age on opposite sides of mid-ocean ridges

Theory of Plate Tectonics - 1960s

- Theory in scientific terms is something proven with TONS of evidence.
- J. Tuzo Wilson put all the pieces of continental drift and seafloor spreading to develop plate tectonics.
- recycling Earth materials!



Name_____ Date_____

STUDENT SHEET 13.1

PLATE TECTONICS VIDEO

1. When Alfred Wegener first noticed that the continents fit together like puzzle pieces, this was
   a. an idea.
   b. a theory.
   c. proof of continental drift.

2. Place an "X" next to every piece of evidence that Alfred Wegener used to develop and support his ideas.
   X Fossils of the lizard-like *Mesosaurus* were found in both Brazil and South Africa.
   X Maps of the continental shelf below the ocean's surface show how Africa and South America fit together.
   X There are glacier marks in South Africa.
   X Coal has been found on Arctic islands.

3. Continental drift is the idea that
   a. Earth's lithosphere has cooled and contracted over millions of years.
   b. sections of Earth's lithosphere have collapsed underwater, leaving just the continents.
   c. the continents were once part of a single landmass called Pangea. Pangaea

4. During World War II, what did scientists discover on the ocean floor?
   a. fossils
   b. volcanoes
   c. a new species of shark

5. Plate tectonics is the idea that
   a. Earth's lithosphere is made of large pieces, called plates, that cannot move.
   b. Earth's lithosphere is made of large pieces, called plates, that have moved over time.
   c. the continents float on the oceans like pieces of wood float on water.

6. Which of the following statements about Earth's crust is true?
   a. Earth's lithosphere moves around but is never destroyed.
   b. Old lithosphere falls into the oceans and is destroyed by ocean currents.
   c. Old lithosphere is destroyed and new lithosphere is formed at plate boundaries.

7. Why are there so many earthquakes in the state of California?
   a. California is located in an area where two plates are sliding past each other. San Andreas fault
   b. The ground in California contains a lot of sand and is very unstable.
   c. Large ocean currents sometimes collide with the coast of California.

8. True or False: The lithospheric plates keep moving and are still moving today.

A.Q (#4, 1, 2, 3)

ANALYSIS

1. Why were scientists surprised to find coal in the Arctic?
2. The idea of continental drift eventually led to the modern theory of plate tectonics. To help you remember similarities and differences between these two ideas, create a larger version of the table shown below in your science notebook.
   a. Compare continental drift and plate tectonics by recording unique features of each idea in the column with that label.
      Hint: Think about what you have learned about these ideas in the last two activities.
   b. Record features that are common to both of these ideas in the column labeled "Both."

Continental Drift	*Both*	*Plate Tectonics*

3. Imagine that you are writing an article about what you are learning in science class for your school newspaper. In your own words, explain
   - the theory of plate tectonics.
   - how earthquakes, volcanoes, and mountain formation are related to plate tectonics.

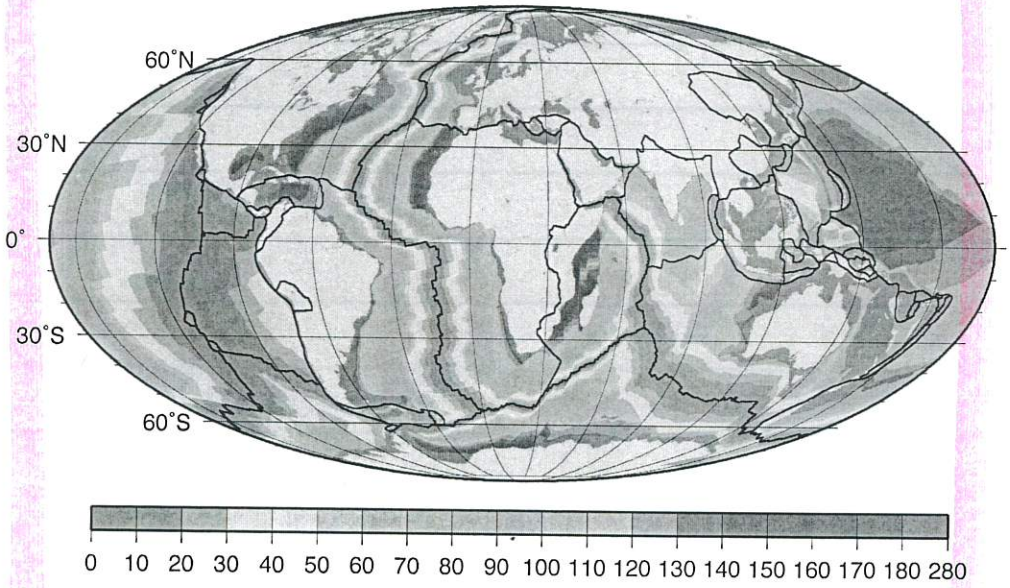
   b. How do the patterns in the map relate to your observations from the video?
   c. Look back at Student Sheet 12.1, "World Puzzle." How would you explain the evidence both in the map below and from Student Sheet 12.1?
5. What surprised or impressed you about Alfred Wegener and his approach to science?

AQ (#4, 1, 2, 3)

- how changes to Earth's surface caused by plate motion can be gradual or sudden, and whether they affect small or large areas of Earth. Explain how scientists know these changes have happened both today and in the past.

Be as specific as you can, and include evidence.

4. Below you will find a map that shows the age of the oceanic lithosphere on the sea floor.



a. Describe the patterns you see on the map. What happens to the age of the lithosphere as you move further from the mid-ocean ridge?

b. How do the patterns in the map relate to your observations from the video?

c. Look back at Student Sheet 12.1, "World Puzzle." How would you explain the evidence both in the map below and from Student Sheet 12.1?

5. What surprised or impressed you about Alfred Wegener and his approach to science?

Name:

GEOLOGICAL PROCESSES QUIZ STUDY GUIDE, ACT 9-15

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

★ Still need to know the basics of the layers of the Earth! ★

ACTIVITY	QUESTIONS YOU SHOULD BE ABLE TO ANSWER AND HANDOUTS	KEY VOCABULARY
Activity 9: Modeling Earthquakes	• How can models help us understand earthquakes? • How does the EQ Machine model real earthquakes? • What are the different types of variables? • What energy transformation happens during an earthquake? • What causes an earthquake to take place? • How does time affect earthquakes? Sudden vs. gradual changes? • What are some effects from earthquakes? • **HANDOUTS:** Cascadia Hidden Fire Video sheet, Modeling EQs Background Information, EQ Machine papers	earthquake seismic waves tsunami liquefaction elastic rebound potential energy kinetic energy energy transformation vs. energy transfer MV, RV, CV epicenter/focus/fault
Activity 10: Plate Boundaries	• What happens where Earth's plates meet? • What happens at convergent, divergent, and transform plate boundaries? How do the plates move? • At what rate do plates move? • How does time affect plate boundaries? • **HANDOUTS:** Computer Simulation Observations, Understand Plate Boundaries (Milky Way sheet) • AQ #1-5 *(chart for #3 important!)*	plate boundary divergent plate boundary mid-ocean ridge rift valley convergent plate boundary transform plate boundary subduction trench
Activity 11: Understanding Plate Boundaries	• Read pages 63-71 ★ in textbook • What processes change the surface of the Earth? • What happens at divergent and transform boundaries? • What are the different types of convergent boundaries, and what happens at each? • How are tsunamis formed? ★ • **HANDOUT:** Directed Reading Table • AQ #2, 3 (on reading table handout)	same as Act 10 rift valley asthenosphere Ring of Fire non-volcanic mountain formation tsunami hot spot volcano ★
Activity 12: The Continent Puzzle	• What evidence can we use to help us understand the movement of Earth's plates over time? • How have plates moved over time? • Why was Alfred Wegener's theory of continental drift not accepted during his lifetime? • **HANDOUT:** The Continent Puzzle with CD evidence • AQ #2, 3	continental drift Alfred Wegener Mesosaurus Glossopteris Lystrosaurus Cynognathus paleoclimate data (coal, glacier evidence)

ancient

ACTIVITY 14: What Makes the Plates Move? | Date 1/6 | Page 35

Glitter Lamp Observations – Convection Model #1

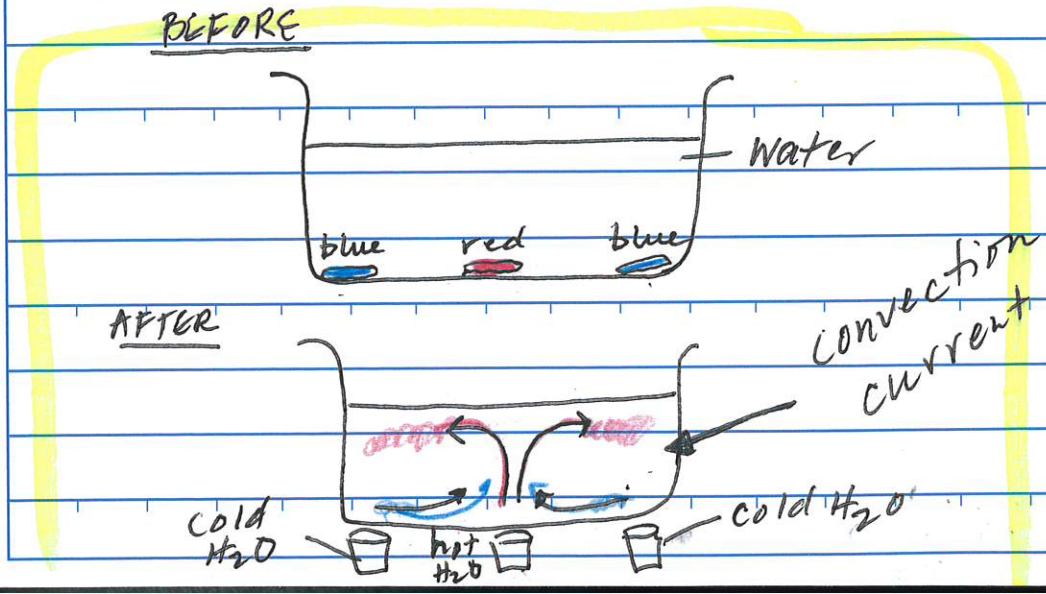
Vocabulary

Convection: when heated fluids rise because they become less dense when heated.

As the fluid cools, the particles slow down, come together, become more dense and then sink.

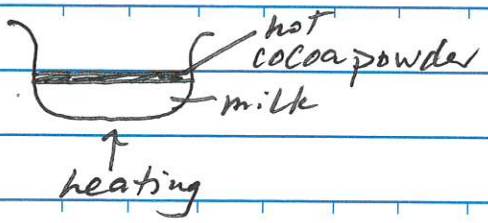
Fluid = gases and/or liquids

Convection Model #2

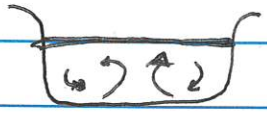


Convection Model #3 - hot chocolate

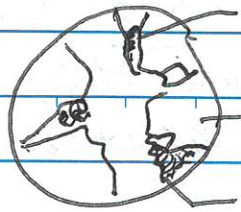
BEFORE



AFTER



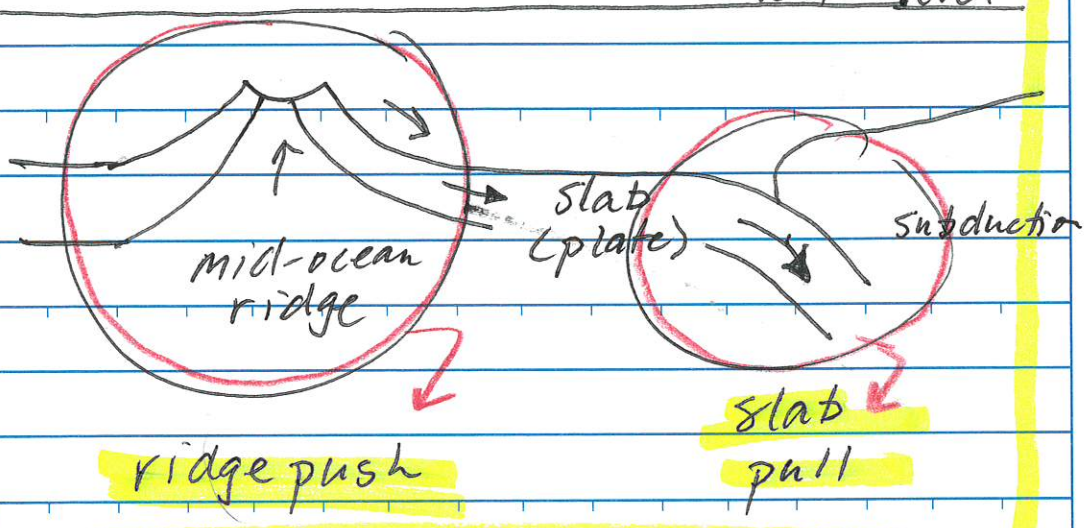
top view



Which model is the best?

- provide evidence
- discuss trade-offs

Slab pull vs. Ridge-Push



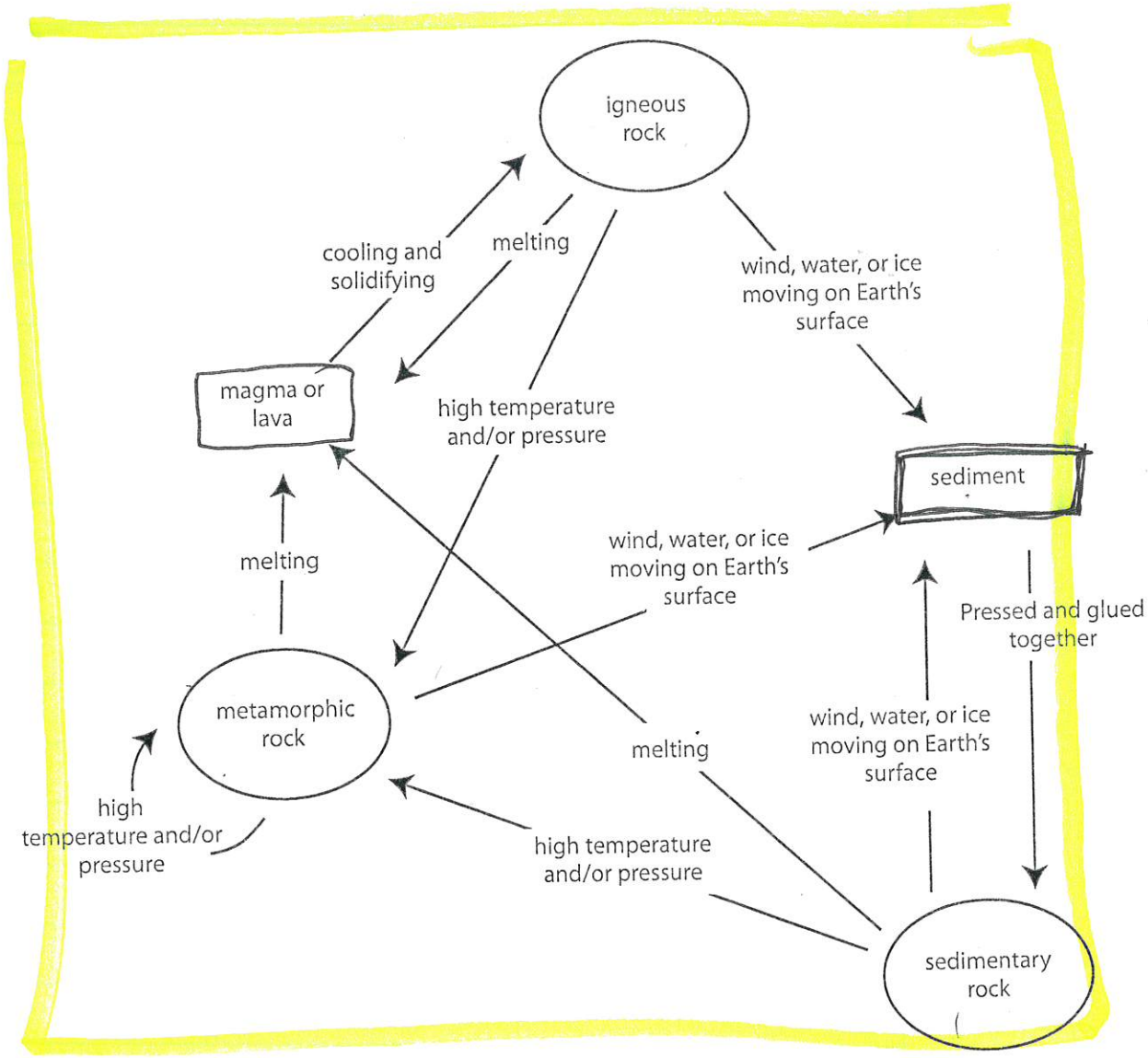
A.

Name: _____

Period: _____

Activity 15: The Rock Cycle

Sheet 15.3: ROCK CYCLE DIAGRAM



Name: ____________________

Period:

Activity 15: The Rock Cycle

Sheet 15.1: GEOLOGIST'S NOTES

What type of rock did you collect, lose, or exchange?					
Igneous		Metamorphic		Sedimentary	
What happened?	What caused that change?	What happened?	What caused that change?	What happened?	What caused that change?
Collected a new rock Lost a rock It became igneous It became metamorphic It became sedimentary	lava cooled	Collected a new rock Lost a rock It became igneous It became metamorphic It became sedimentary		Collected a new rock Lost a rock It became igneous It became metamorphic It became sedimentary	
Collected a new rock Lost a rock It became igneous It became metamorphic It became sedimentary		Collected a new rock Lost a rock It became igneous It became metamorphic It became sedimentary		Collected a new rock Lost a rock It became igneous It became metamorphic It became sedimentary	
Collected a new rock Lost a rock It became igneous It became metamorphic It became sedimentary		Collected a new rock Lost a rock It became igneous It became metamorphic It became sedimentary		Collected a new rock Lost a rock It became igneous It became metamorphic It became sedimentary	
Collected a new rock Lost a rock It became igneous It became metamorphic It became sedimentary		Collected a new rock Lost a rock It became igneous It became metamorphic It became sedimentary		Collected a new rock Lost a rock It became igneous It became metamorphic It became sedimentary	
Collected a new rock Lost a rock It became igneous It became metamorphic It became sedimentary		Collected a new rock Lost a rock It became igneous It became metamorphic It became sedimentary		Collected a new rock Lost a rock It became igneous It became metamorphic It became sedimentary	

Name: _____ FRIDAY NOTEBOOK REVIEW # _____

Period: _____ Date: _____

Learning Summary of Last Week: Notebook Pages _____ to _____ *(Activities _____ to _____)*

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!)

LAB-LOG

ACTIVITY	Date 1/15	Page 41

Leave blank intentionally

ACTIVITY	Date	Page 43
Title Page	1/15	

EROSION & DEPOSITION

BRETZ'S MEGAFLOODS

Name ANSWER KEY Class

Today's Date Due Date:

From **Mystery of the Megafloods**

1. Where are the 'Scablands'?
   Southeastern Washington
2. What was the first main idea used to explain how the Scablands and the other strange and interesting landforms?
   That a river formed the landscape
3. What is an "erratic"? How did erratics play into the second main idea of how the strange landscape was formed?
   An erratic is a stone (large or small) that is somewhere unexpected. Glaciers transport erratics and so glaciers or large chunks of ice were thought to have been involved in the floods.
4. What was the name of the geologist who first put all the pieces together and proposed a radical, new idea?
   J. Harlan Bretz
5. What was his theory?
   He proposed that a flood of massive proportions had come from somewhere and carved out the valleys, swept the valley floor, and left a wave of destruction in its path, all in a very, very short time.
6. What did other geologists think about his idea?
   They thought it was a ridiculous idea and couldn't have been caused so quickly. Geologists thought things happen VERY slowly.
7. What was the central problem with his theory?
   He couldn't provide an explanation of where all the water came from to cause such massive flooding.
8. What was the final piece of evidence found in Missoula, Montana that provided the missing source of water for Bretz?
   The rings along the hillsides that were ancient shorelines from a lake.
9. What did Joseph Pardee notice about the valley floor under where Lake Missoula was?
   Huge ripple marks, like those left on the sand at the ocean.
10. How does Iceland play into this story? What evidence does it offer?
    Iceland had an ice dam break that caused major flooding. The glaciers there offer an explanation of how the ice dam failed.

11. What was the cause of the dam collapsing?
Supercooled water entering cracks, melting them, creating larger cracks which weaken the entire wall.

12. Check out the cool stream table! What did the model show?
It showed that landforms could be created in a very short time.

13. What created the mysterious huge potholes?
A very fast spinning string of bubbles (a vortex of bubbles) caused by water moving very quickly around submerged objects.

14. How far did the floodwaters travel, and how long did it take to get there?
All the way to the ocean (65 miles per hour) which would take about only 48 hours.

15. In 1980, what did J. Harlan Bretz receive for his hypothesis of the floods?
The Penrose Award from the Geological Society of America – their highest award.

16. What did Richard Waitt discover among the layers of Missoula Lake? What did this discovery help to show?
Layers of ash from Mt. St. Helens which showed that there was exposed land between layers of flood deposits. Proved there were multiple floods.

Switching to different video: **The Great Ice Age Floods**

17. Before the floods of water, there were floods of what? How far did these floods travel?
Floods of lava that covered the countryside.

18. There is a difference in appearance for the rivers and streams patterns in Eastern Washington that can only be seen from space. What is the pattern?
Rather than tree-like branching, it was a braided stream bed.

19. Notice how far up the US Bank building in Portland would have been underwater! About how much would have been sticking out?
Only about a quarter was poking out the top.

20. According to this video, what was the missing piece of information that proved the floods created the landscape changes?
The ripple marks on the bottom of the valley where Lake Missoula emptied.

Name: Activity 29: Weathering, Erosion, and Deposition

Three-Level Reading Guide: Weathering, Erosion, and Deposition

1. Check any of the statements below that you think reflect the reading. Sometimes, the exact words found in the reading are used. At other times, other words may be used to communicate the same meaning.

   _____ **a.** Rocks are broken down into smaller pieces by wind, water, and ice.

   _____ **b.** Deposition is a destructive earth process.

   _____ **c.** Sediments eroded by wind or water are deposited somewhere else.

   _____ **d.** Human activity usually slows down the process of erosion.

2. Check any of the statements below that you think represent the intended meaning of the reading.

   _____ **a.** Weathering, erosion, and deposition are the only natural processes on earth.

   _____ **b.** Earth processes can be permanently stopped by human activity.

   _____ **c.** The landforms seen on earth will always be the same in the future.

3. Check the statements below that you agree with, and be ready to support your choices with ideas from the reading and from your own knowledge and beliefs.

   _____ **a.** To prevent additional erosion and deposition, people should not be allowed to build or farm in certain areas.

   _____ **b.** Erosion can be more harmful to humans than deposition.

↳ meanders
↳ lead to oxbow lakes

↳ slow moving water over flat land creates braided streambeds

ACTIVITY 29: Weathering, Erosion, & Deposition | Date 1/15 | Page 45

Procedure and Vocabulary

Between the Introduction and Reading passage, you need to define, give an example, and quickly illustrate the following terms and processes:

- Destructive vs. constructive forces
- Weathering
- Erosion (and how it's different from weathering – beware of the use of the word "cutting" in the book)
- Erosion effects
- Deposition
- Floodplains
- Consequences of human activities

weathering

ers

V-shape

U-shape

Ocean waves - also polish rocks
↳ weathers rocks down to sand & also shells/coral/bones/etc.

River Morphology (shaping)
↳ meanders
↳ lead to oxbow lakes

↳ slow moving water over flat land creates braided streambeds

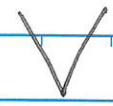
ACTIVITY 29: Weathering, Erosion, & Deposition | Date 1/15 | Page 45

Notes from Slideshow

Water ~~erosion & weathering~~ Erosion & weathering

- rivers
- glaciers
  - ↳ glacial polish
  - ↳ leaves erratics

Erosion patterns

River	Glaciers
	
V-shape	U-shape

Ocean waves - also polish rocks

↳ weathers rocks down to sand & also shells/coral/bones/etc.

River Morphology (shaping)

↳ meanders

↳ lead to oxbow lakes

↳ slow moving water over flat land creates braided streambeds

Depositional Landforms

↳ rockslide

↳ Alluvial Fan