NAME _____

Geologic Processes Warm-ups

HOUR _____

Date	Answer warm-up by restating the question below:

Name_____ Date_____

STUDENT SHEET 1.1

CONSIDERING WHERE TO STORE NUCLEAR WASTE

Considerations	Recommended action	Explanation

Name_____ Date_____

STUDENT SHEET 3.1

ANTICIPATION GUIDE: LANDSLIDE VIDEO

Before starting the activity, mark whether you agree (+) or disagree (—) with each statement below.

After completing the activity, mark whether you agree (+) or disagree (—) with each statement below. Under each statement, explain how the activity gave evidence to support or change your ideas.

BEFORE	AFTER	
_____	_____	1. When scientists conduct an experiment, they change one thing and observe if the change has an effect.
_____	_____	2. If a landslide is going to happen, it will happen as soon as rain starts falling on the ground.
_____	_____	3. Landslides are too big and happen too fast for scientists to be able to study them.

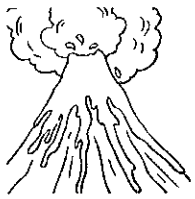
Name_____ Date_____

STUDENT SHEET 4.1

DIRECTED READING TABLE: NATURAL HAZARDS CAUSED BY EARTHQUAKES AND VOLCANOES

	What was the natural hazard?	What caused this natural hazard?	What were the effects?	How can the damage from this hazard be minimized?
Haiti (2010)				
Nepal (2015)				
Mt. St. Helens (1980)				
Mammoth Mountain				

SOME GO "POP" SOME DO NOT!



Background: Volcanic eruptions range from mild to violent. When volcanoes erupt the rocks left behind provide information to scientists studying Earth's crust.

Mild or Non-Explosive Volcanoes: COLOR YELLOW
- Produce lava that is low in silica (silicon and oxygen) and has a low viscosity (very thick)
- Lava simply flows down the side of volcanoes
- Typically occur in Oceanic Crust composed of Basalt

Explosive Volcanoes: COLOR RED
- Produce very little lava
- The explosions hurl ash, cinder bombs and debris into the air
- The rocks left behind are light in color, reflective, high in silica and have a high viscosity (runny and thin)
- Typically occur on Continental Crust composed of Granite

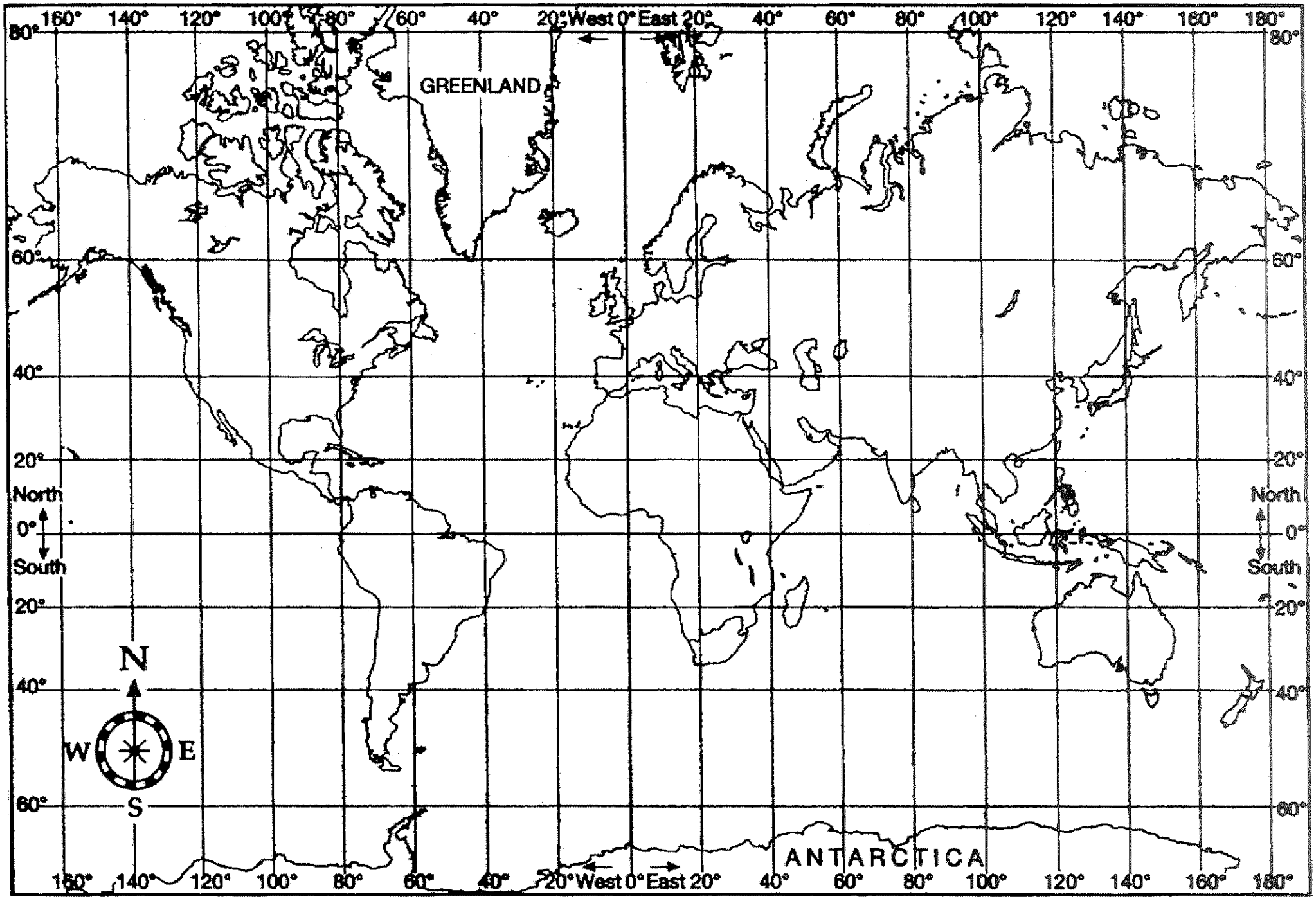
Volcanoes that erupt BOTH ways: COLOR ORANGE
- Produce pyroclastic flow, explosive ash and debris and have lava flowing out of side vents
- These volcanoes occur in areas where oceanic crust subducts underneath continental crust.

Earthquakes COLOR BLUE
- Occur at transform boundaries where plates move side to side.
- Earthquake seismic waves can be amplified by sandy or loose soil
- Can occur near or before a volcanic eruption

Volcano Name	Location	Description	Type of Volcano
Mt. Rainer	47 N 122 W	Mount Rainier is a stratovolcano characterized by layers of ash from explosive eruptions and cooled lava flows from successive eruptions.	
Mt. St. Helens	48 N 122 W	An explosive eruption blew the top off the mountain. Light colored ash covered thousands of square kilometers. Another eruption sent a lava flow down the southeast side of the mountain.	
Crater Lake	43 N 122 W	The eruptions of the last ~70,000 years were highly explosive; the eruptive magma were silica-rich (dacite and rhyodacite).	
Parlculin, Mexico	19 N 102 W	Pyroclastic activity during the eruption had generated a 50-m-high scoria cone. Within a week, it had grown to a height of 100 m from the accumulation of bombs and lapilli, and finer fragments of ash were raining down on the village of Paricutin.	
Popocatepetl, Mexico	19 N 98 W	The volcano's crater produced an explosion which ejected a large column of smoke and ash about 3 km (1.9 mi) into the atmosphere and vented a large amount of lava.	
Santa Marta, GA	15 N 90 W	Following the cone-building eruptions, activity seems to have changed to a pattern of long periods of repose followed by the emission of small lava flows from vents on the mountain.	
Misa, Peru	16 S 71 W	It is one of Peru's most active volcanoes, with a 1.4 km wide caldera at the summit containing an ash cone with a 200 m deep vent.	
Kalmal, Alaska	56 N 155 W	It said that during a previous eruption in 2013, ash plumes rose 27,000 feet. Other eruptions have generated ash plumes as high as 49,000 feet.	
Umnak Is, Alaska	53 N 169 W	The 1817 eruption deposited several feet of ash and "scoria" rock debris on the northeastern caldera rim, with ash falling on Unalaska Island. In the recent 1997 eruption, the ash clouds traveled 6 miles (9.7 km) across the volcano's caldera floor.	
Kamchatka, Soviet Union	57 N 160 E	The shield volcano emits thin, runny lava flows easily, forming low and broad flows similar to those in Hawaii. The lava remains hot enough to glow in near-infrared light.	
Ayokya Islands, Japan	26 N 128 E	Periodic water discoloration and lava-spouting have been observed from the volcano since 1975, which have helped enlarge the landmasses over time.	
Mt. Fuji, Honshu	35 N 139 E	The early history of Fuji appears to have extensive lava flows accounting for a quarter of the volcano's volume but sometime between 8,000 and 4,500 years ago the activity became more explosive - with a mix of larger explosive events and intermittent, smaller effusive eruptions.	

Volcano Name	Location	Description	Type of Volcano
Krakatoa, Indonesia	6 S 105 E	Thousands of people were killed from pyroclastic) explosions (bombs and cinders) and the ash spread around the globe which created glorious sunsets and unusually cool weather.	
Papua, New Guinea	3 S 144 E	The explosive volcano on emitted smoke and ash prompting the evacuation of more than 500 people to nearby islands.	
Canlaon, Phillipines	10 N 123 E	A brief ash eruption occurred at Canlaon volcano on 21 January 2005, producing a 500 m high ash plume. A fine layer of ash fell on the town of Cabagnaan 5.5 km SW of the crater.	
Mayon, Phillipines	13 N 124 E	In 1991, Lava spilled and flowed from this Philippine volcano and sent columns of ash over farmland and towns, coating them in grey during a nearly two-week eruption.	
Mauna Loa, Hawaii	19 N 156 W	It is an active shield volcano with relatively gentle slopes. Lava eruptions from Mauna Loa are silica-poor and very fluid, and they tend to be non-explosive.	
Mariana Islands	18 N 145 E	The eruptions produced two lava domes from vents near the south crater rim. Lava flows from the domes reached the coast and extended out to sea, forming irregular shorelines.	
Galapagos Islands	1 S 91 W	The composition of the lava flows of the Galápagos shields volcanoes are strikingly similar to those of the Hawaiian volcanoes in that they have very little silica content and have mild eruptions.	
North Island, New Zealand	38 S 176 E	A shield volcano formed from the eruption of basalt columns on the eastern side of the island. They were nicknamed "the organ pipes" because of the pipe-like lava that flowed out of vents.	
Tahiti	18 S 149 W	Dangerous flying rocks and volcanic gas were experienced within 6.5 km of the volcano's crater; ash falls have been reported across the island. Other hazards include acid rain and pyroclastic mud flows.	
American Samoa	13 S 172 W	In Samoa, major eruptions occurred in 1905 when lava flows destroyed a village. In the Manu'a Islands, subsurface volcanic eruptions and earthquakes occurred in 1866, causing dense clouds of smoke and pumice to erupt from the ocean's surface for several months.	

Earthquake Area	Location	Magnitude
Prince William Sound, Alaska	61 N 146 W	9.2
Sumatra, Indonesia	6 N 95 E	9.1
Kamchatka, Russia	53 N 158 E	9.0
Lima, Peru	12 S 77W	7.7
Luzon, Philippine Islands	16 N 121E	7.4
Hokkaido, Japan	43 N 143E	6.6


160° 140° 120° 100° 80° 60° 40° 20° West 0° East 20° 40° 60° 80° 100° 120° 140° 160° 180°
80°
60°
40°
20°
North
0°
South
GREENLAND
ANTARCTICA
N
W
E
S

Process Questions: (answer in COMPLETE sentences)

1. According to your map, where are volcanoes that always have non-explosive eruptions located? (identify the type of crust and specific geographic locations)

2. Where are volcanoes that always erupt explosively located? (identify the type of crust and specific geographic locations)

3. Where are the volcanoes that erupt in both ways located (identify the type of crust and specific geographic locations)?

4. If volcanoes get their magma from the crust below them, what can you infer about the silica content of the Earth's crust under the oceans?

5. What is the composition of the crust under the continents? What kind of volcanoes typically are formed in these regions?

6. What causes a volcano to erupt with BOTH explosive ash and lava flow?

7. Where do the biggest earthquakes tend to occur (identify the type of crust and specific geographic locations)?

8. Why do earthquakes tend to occur close to volcanic regions?

9. In your opinion, identify 3 of the most geologically dangerous places to live. Explain why these places are so dangerous.

MILK CHOCOLATE MOVEMENT:

Follow directions for # 1, 5 & 8, Answer questions for # 2, 3, 7,10 & 11
Draw pictures for # 4, 6, 9

1. Create 2-3 cracks by carefully bending the bar from side to side. 2. What are the cracks called? 3. What kind of plate boundary does this represent? 4. Draw a picture of your bar from an overhead (bird's eye) view.	2. 3. 4.
5. Carefully and slowly pull the candy bar apart. 6. Draw a picture of what is happening to your bar 7. What kind of plate boundary does this action represent?	6. 7.
8. Push your candy bar back together with enough pressure to form "mountain-like" bumps 9. Draw what you observe. 10. What kind of plate boundary does this imitate? 11. What effect does continuous movement of plates have on the Earth's crust? (two sentences)	9. 10. 11.

Name _____ Hour _____

Mountain Maker/Earthshaker

A. largennewman.weebly.com
B. SCIENCE RESOURCES (drop down menu)
C. HELPFUL WEBSITES
D. Scroll down to Plate Tectonics then find and click on **Mountain Maker/Earthshaker**

1. When was the theory of continental drift first proposed and who came up with the idea? What is this theory now called?

2. Make sure that Shockwave is installed, if not download it. If that doesn't work, click TEXT VERSION. Click on the link called **Plate Tectonics activity.** Play around with blue arrows. **Summarize** (in two sentences) and draw a picture for EACH of the following types of boundaries:

A. **Divergent (sea floor spread)**:
2 sentence summary:

Picture:

B. **Convergent (continental slide)**:
2 sentence summary:

Picture:

B. **Convergent (continental crush)**:
2 sentence summary:

Picture:

D. **Transform (slippin' and sliding):**
2 sentence summary:

Picture:

3. Go back to the main page and click on the link: **Intro to Plate Tectonic Theory**

A. Describe the continents 225 million years ago in 2 complete sentences.

2 sentence description:

What was all the continents together called? _____

B. What two *possible* forces drive plate tectonics? _____ and _____

4. Go down to the bottom of the webpage and summarize in FOUR COMPLETE SENTENCES EACH 2 of the 4 topics below:

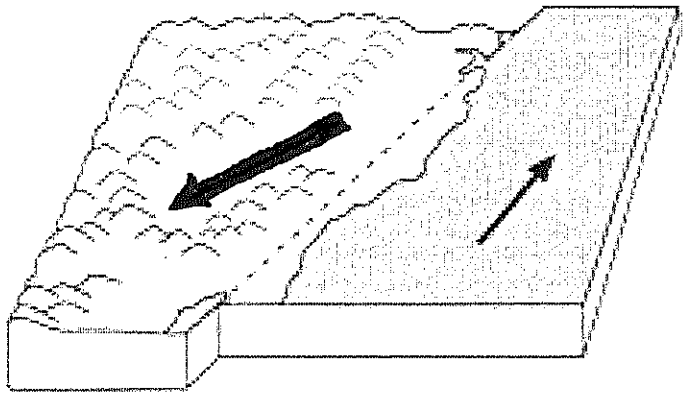
Great Global Rift is discovered
Hess proposes sea-floor spreading
Magnetic bands provide evidence of sea-floor spreading
Life is found near deep ocean vents

TOPIC 1 _____
4 Sentence Description:

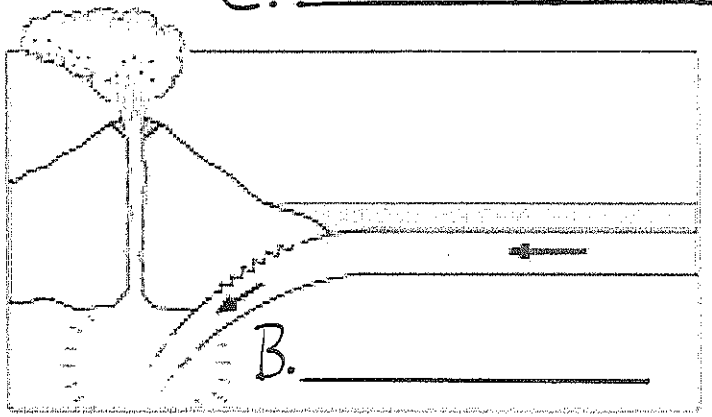
TOPIC 2 _____
4 Sentence Description:

NAME(S) _____

A. _____



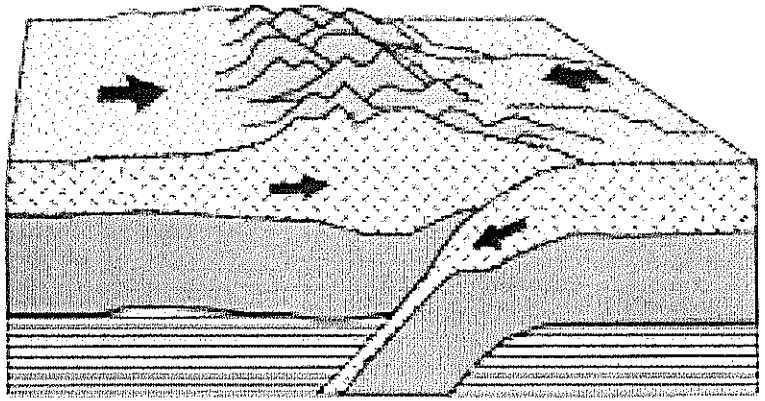
C. _____



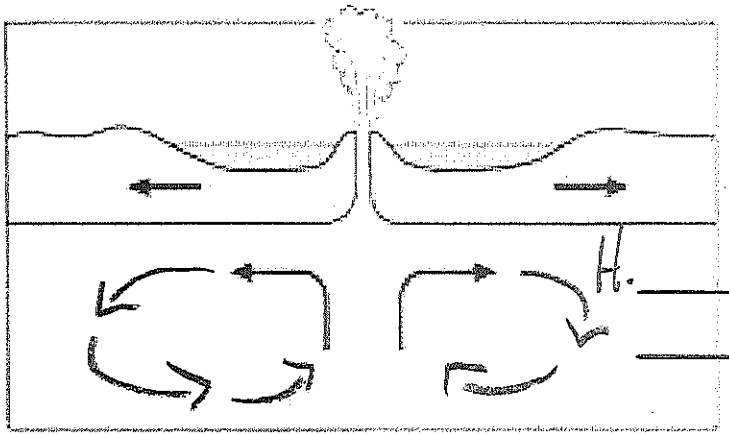
B. _____

E. _____

D. _____



G. _____



H. _____

F. _____

I. _____

Name _____ Date _____

STUDENT SHEET 11.1

DIRECTED READING TABLE: UNDERSTANDING PLATE BOUNDARIES

Type of plate motion	Scientific term for boundary type	At this type of plate boundary, which of the following geological processes are likely to occur? • earthquakes • volcanoes • mountain forming	At this type of plate boundary, what happens to lithosphere? Is it • formed? • destroyed? • neither?	Example (location) of this type of plate boundary
Moving away from each other				
Moving toward each other				
Moving past each other				

Name_____ Date_____

STUDENT SHEET 12.1

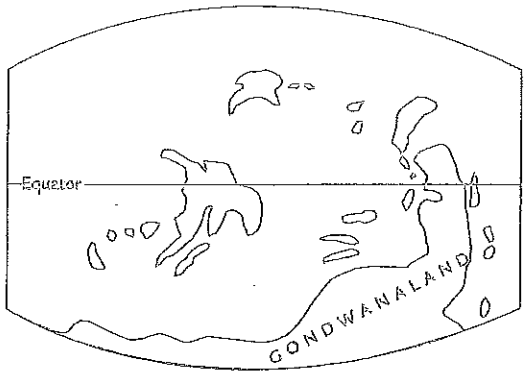
WORLD PUZZLE

Name_____ Date_____

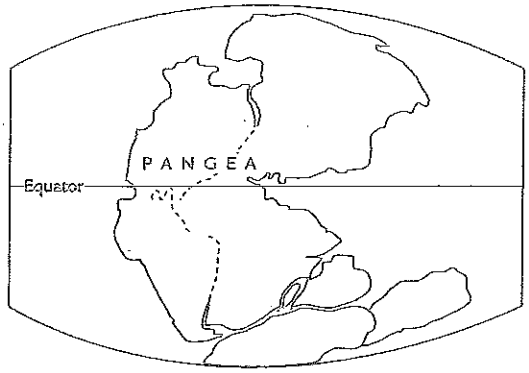
STUDENT SHEET 12.2

EARTH'S SURFACE THROUGH GEOLOGICAL TIME

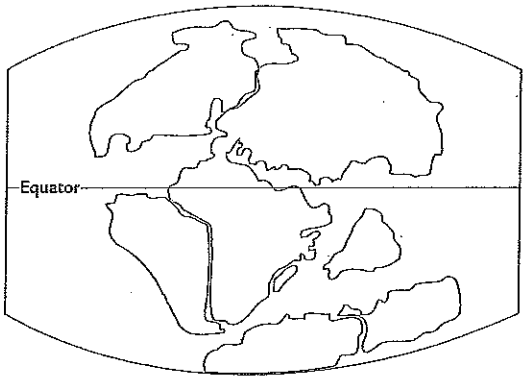
425 million years ago



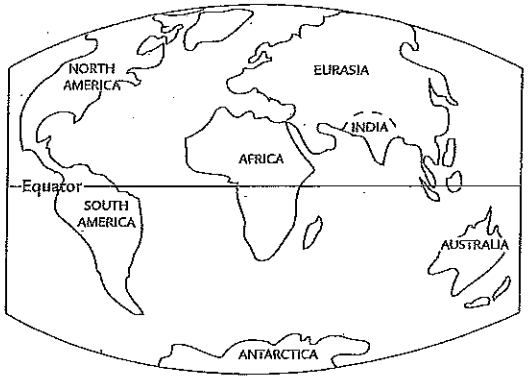
230 million years ago



135 million years ago



PRESENT DAY



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.
   _____ Fossils of the lizard-like *Mesosaurus* were found in both Brazil and South Africa.
   _____ Maps of the continental shelf below the ocean's surface show how Africa and South America fit together.
   _____ There are glacier marks in South Africa.
   _____ 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.
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.
   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.

Name________________________________ Date__________

STUDENT 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		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_____ Date_____

STUDENT SHEET 15.2

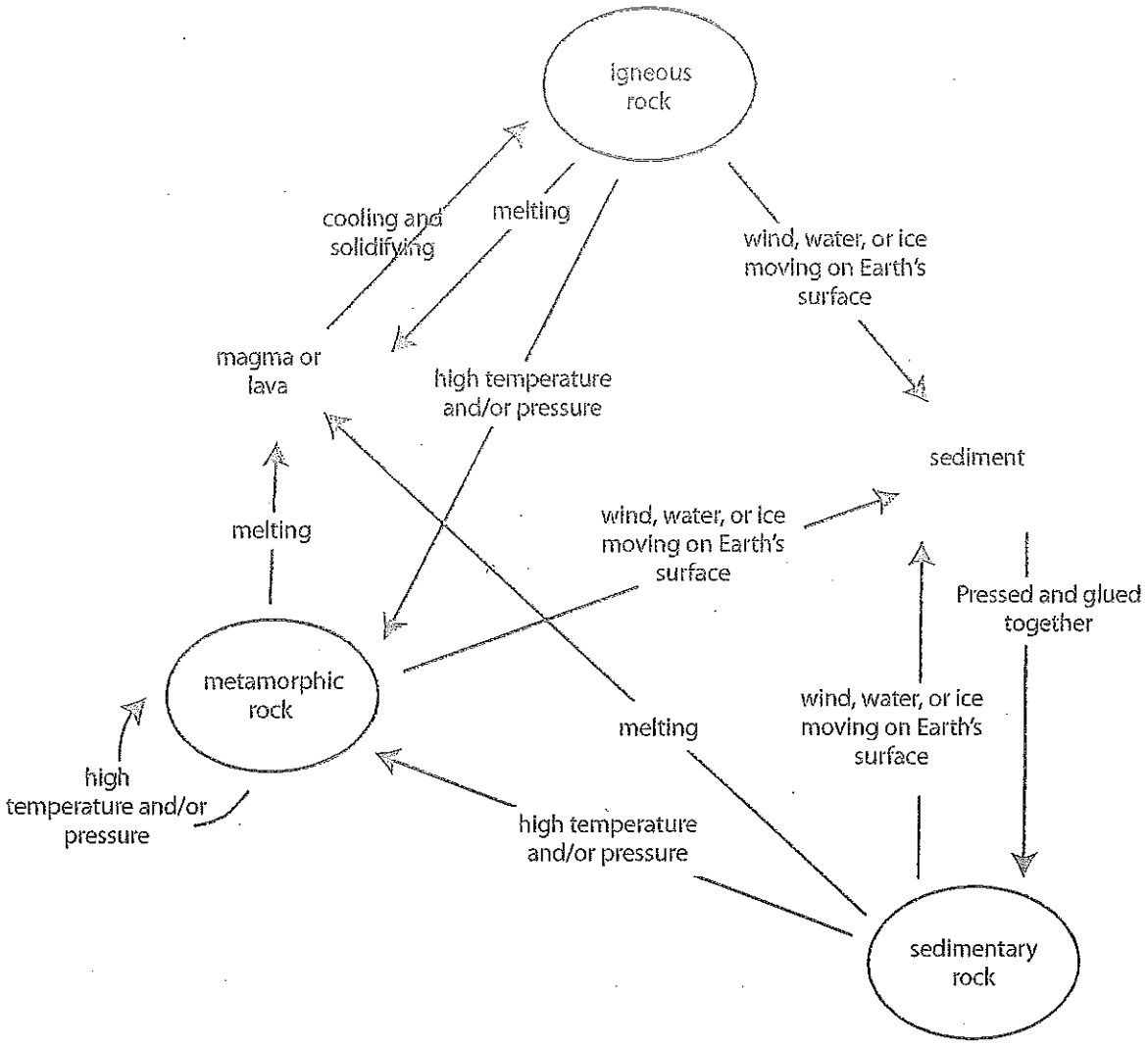
ROCK FORMATION

Type of rock	How does this rock form? *(Remember: Use information from all group members' Student Sheet 15.1, "Geologist's Notes.")*	What rocks can become this rock? *(Mark all possible answers.)*
Igneous		❑ Igneous ❑ Metamorphic ❑ Sedimentary
Metamorphic		❑ Igneous ❑ Metamorphic ❑ Sedimentary
Sedimentary		❑ Igneous ❑ Metamorphic ❑ Sedimentary

Name_____ Date_____

STUDENT SHEET 15.3

ROCK CYCLE DIAGRAM



Name_____ Date_____

STUDENT SHEET 16.1

DIRECTED READING TABLE: ROCKS AS A RESOURCE

Name of natural resource	What kind of rock or natural resource?	How does it form?	Where is it found?	What are its uses?
Granite				
Copper				
Petroleum				

Name_____ Date_____

STUDENT SHEET 17.1

AQUIFER INPUTS AND OUTPUTS

Inputs *If the card asks you to add chips, record the information here.*	
Activity on the card	Number of chips added

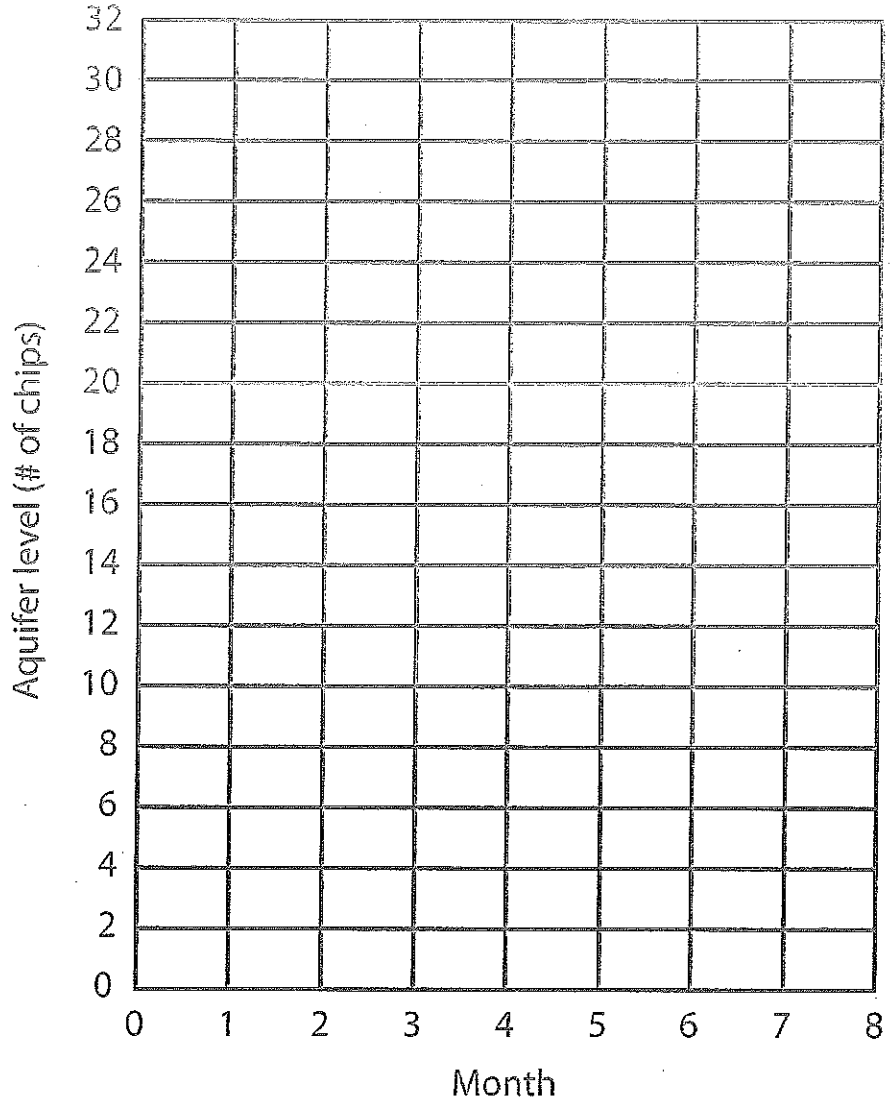
Outputs *If the card asks you to remove chips, record the information here.*	
Activity on the card	Number of chips removed

Name_____ Date_____

STUDENT SHEET 17.2

GRAPH OF GROUNDWATER LEVEL IN OUR AQUIFER

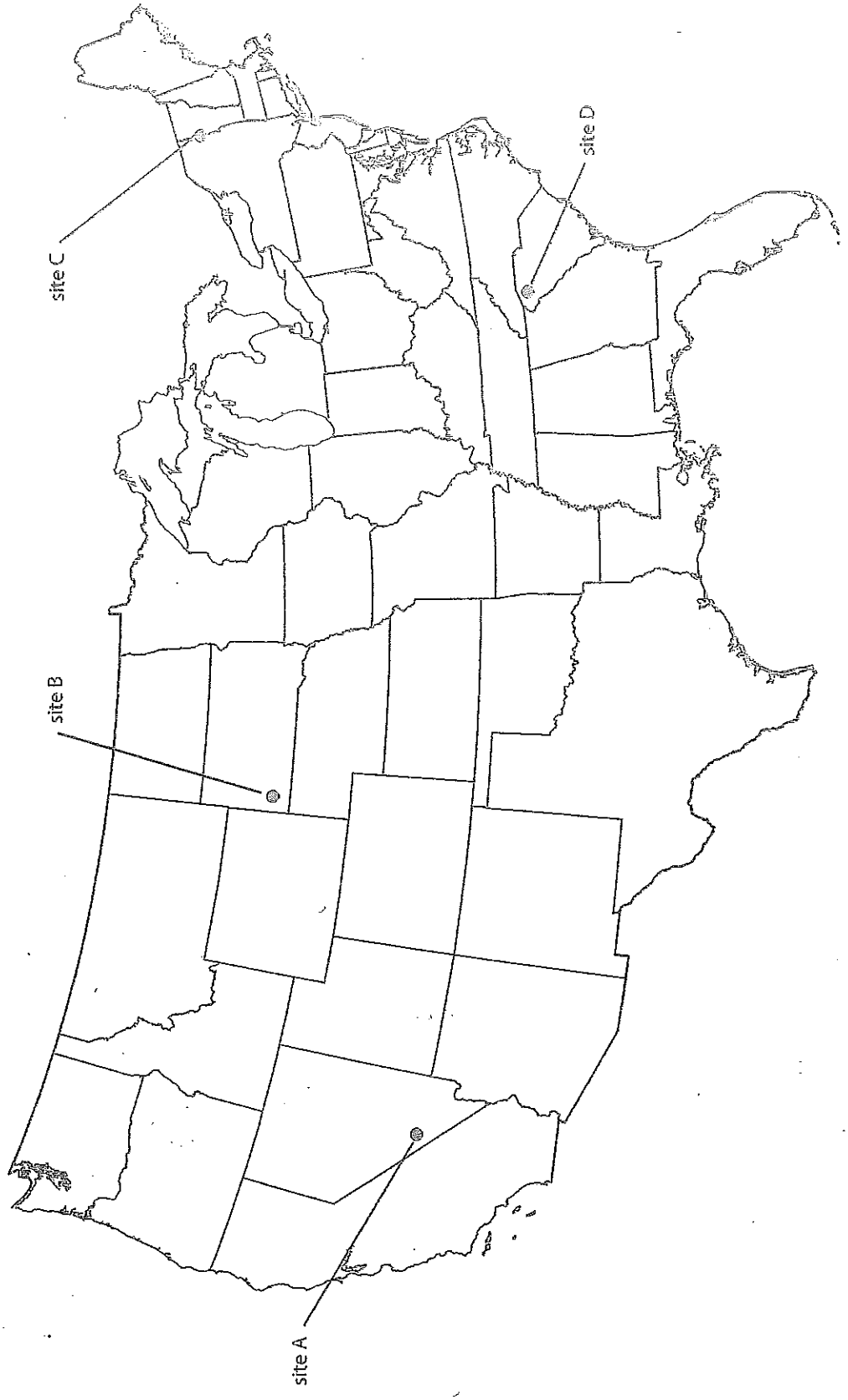
Groundwater Level in Our Aquifer Over 7 Months



Name_____ Date_____

STUDENT SHEET 18.1

FOUR PROPOSED SITES



Name_____ Date_____

STUDENT SHEET 18.2

COMPARING FOUR PROPOSED SITES

Site A: Southern Nevada	Site B: Southwest South Dakota	Site C: New York–Vermont Border	Site D: Western South Carolina

Name_____ Date_____

STUDENT SHEET 18.3

DISCUSSION WEB: EVALUATING SITE RISK