Edible Plate Tectonics

Kimberly Miller
Original Lesson Plan

Focus on Inquiry

The student will use food to model and observe the plate movement and consequences of plate movement associated with the theory of plate tectonics.

Lesson Content Overview

Students will demonstrate, identify, and explain the movement of the plates at convergent, divergent, and transform boundaries and describe the landforms that result from plate movement.

Duration	Setting	Grouping	PTI Inquiry Subskills
100-120 minutes	classroom	Individuals, partners, groups	3.3, 3.6, 3.7, 4.1, 5.2, 5.8, 7.3

Lesson Components	Estimated Time	Inquiry Subskills Used	Technology Used	Level of Student Engagement	Brief Description
Engage	8 minutes		Computer, projector, cellphones	2	Students will watch video clip from Ice Age which will tie in Earth's layers with plate tectonics.
Explore	30 minutes	3.3, 3.6, 3.7, 4.1, 5.8, 7.3		3	Students will perform an edible plate tectonics lab and start their graphic organizer.
Explain	30 minutes	4.1, 5.2		2-3	Students will finish their graphic organizers and complete the reflection questions from their lab.
Expand	30 minutes	5.2	Computer, projector, cellphones	3	Students will use the strategy group-pair-share. Students will plot their examples on a world map.
Evaluate	2-5 minutes			1	Students will be given a formal assessment.

Level of Student Engagement

1	Low	Listen to lecture, observe the teacher, individual reading, teacher demonstration, teacher-centered instruction
2	Moderate	Raise questions, lecture with discussion, record data, make predictions, technology interaction with assistance
3	High	Hands-on activity or inquiry; critique others, draw conclusions, make connections, problem-solve, student-centered

Next Generation Science Standards – Inquiry

NGSS Practice 2: Developing and Using Models
NGSS Practice 3: Planning and Carrying Out Investigations
NGSS Practice 6: Constructing Explanations
NGSS Practice 8: Obtaining, Evaluating and Communicating Information

Next Generation Science Standards – Earth Science
MS-ESS2-3: Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions.
MS-ESS2-2: Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales
Florida Science Standards – Nature of Science
SC.7.N.3.2: Identify the benefits and limitations of the use of scientific models.
Florida Science Standards – Earth Science
SC. 7.E.6.5: Explore the scientific theory of plate tectonics by describing how the movement of Earth's crustal plates causes both slow an rapid changes in Earth's surface, including volcanic eruptions, earthquakes, and mountain building.

Materials and Advance Preparation

Materials List

Class set:

- 1 box of graham crackers
- 1, 12-20 count box of Fruit Roll-Ups
- Baby wipes if no sink is available
- 1 jar of frosting
- 1 box of wax paper
- 1 box of plastic knives
- 12-15, Dixie or 2-3 oz cups
- Napkins, paper towel, or baby wipes
- 3 different colors of printer paper (for group-pair-share activity sheet)

Student materials (per pair):

- Lab sheet
- Approximately1 foot by 1 foot square of wax paper
- Knife
- Frosting glob (approximately 1/4 cup or 1 heaping glob)
- 1 full graham cracker
- 1 Fruit Roll-Up
- Dixie or 2-3 oz cup with water
- Napkin, paper towel, or baby wipes

Student materials (individual):

- Plate Tectonics Graphic Organizer
- Group-Pair-Share Activity

Blackline Masters

1. **Blackline master #1:** Edible Plate Tectonics Lab Sheet
2. **Blackline master #2:** Plate Tectonics Graphic Organizer

3. **Blackline master #3:** Group-Pair-Share Activity
4. **Blackline master #4:** Formal Assessment: Concept Check
5. **Blackline Master #5:** Landforms Slides
6. **Blackline Master #6:** Answer Keys

Advance Preparation

1. Buy wax paper, knives, frosting, Fruit Roll-Ups, and graham crackers
2. Cut wax paper: 1 square foot per pair of students
3. Fill water cups
4. Make copies of the lab (1 per pair), graphic organizer (1 per student), group-pair-share activity (on colored paper, 1 per student), and assessment (1 per student)
5. Print a copy of the landforms slides or have them ready on your computer to present to the class.

Lesson Information

Learning Objectives

1. Students will be able to create and use models to correctly describe the movement of plate tectonic boundaries by performing the edible plate tectonics lab.
2. Student will be able to correctly identify the landforms created by plate boundaries by performing the edible plate tectonics lab.
3. Students will be able to accurately explain that the movement of Earth's crustal plates causes both slow and rapid changes in Earth's surface by reflecting on their lab activity.
4. Students will be able to accurately explain the purpose, benefits, and limitations of models in science by relating it to their lab experience.

Prior Knowledge Needed by the Students

Students should already know the layers of the Earth.

Background Information

The Theory of Plate Tectonics states that the crust of the Earth is composed of 7 major plates and numerous smaller plates. These plates move on the top of the hot upper mantle called the lithosphere. This theory also says that these plates are in motion, creating a variety of interactions at the plate boundaries. At convergent plate boundaries plates converge or move towards each other. At divergent plate boundaries plates will diverge or move away from each other. At transform boundaries plates will slide past each other in a lateral motion. Convergent boundaries create volcanoes, mountains, deep sea trenches, island arcs, and subduction zones. Divergent boundaries create rift valleys, mid ocean ridges, islands, and volcanoes. Transform boundaries create fault zones and earthquakes. Earth has 4 main layers: crust, mantel, outer core, and inner core. The outer layer is the crust. The crust is the upper part of the lithosphere. Also part of the lithosphere is the cooler, upper part of the mantle. The

mantle layer is the layer below the crust and it is the largest layer. The mantle consists of 3 layers: the outermost layer is the lithosphere, the middle is the asthenosphere, and the inner layer closet to the outer core is the mesosphere. The outer core is made up of molten iron and nickel. The inner core is made of solid iron and nickel.

Oregon State University. (2015) Earth's Layers Lesson #1. Retrieved from http://volcano.oregonstate.edu/earths-layers-lesson-1

Oregon State University. (2015) How Earth's Plates Move Lesson #3. Retrieved from http://volcano.oregonstate.edu/how-earths-plates-move-lesson-3

Lesson Procedure

Engage

1. Have students watch the ice age video clip. https://www.youtube.com/watch?v=TzzGPfVx32M
   - *Make sure to fast forward past the advertisements and display the video "whole screen" so that the web page advertisements located on the bottom and sides will not be seen. In addition, please be on the lookout for pop-up ads while the video is playing.*
2. After watching the video clip ask students the following questions:
   - What did you observe from the video?
     - *Students' responses may vary but could include that they observed the layers of the Earth, the separation and movement of the continents, the "ball" at the center of the Earth, etc.*
   - How does this video relate to Earth's layers?
     - *Students' responses may vary but could include that they saw the squirrel go through the different layers of the Earth, they saw the squirrel land on the inner core, etc.*
   - What did you observe about what was happening to the crust in the video?
     - *Students' responses may vary but could include that they saw it splitting into pieces, they saw pieces moving apart, etc.*
3. Have students re-watch the video and ask them what other details did you notice?
     - *Students' responses will vary.*

Explore

1. Have students perform the lab (Blackline Master #1) to gain a better understanding of plate tectonic motion **without** introducing academic vocabulary such as convergent boundary, divergent boundary, and transform boundary.

Explain

1. After completing the lab, students will fill out the first two rows in their graphic organizer (Blackline Master #2).
    - Students will complete this graphic organizer by continuing to add information throughout the lesson.
2. Upon finishing the lab and the first two rows of their graphic organizer, students will complete the "Additional Reflection Questions" in their lab packet.
3. Possible questions for class discussion could include:
    a. What is responsible for creating the force that moves the Fruit Roll-Ups and graham crackers?
        - *Convection currents in the mantle.*
    b. How might the movement of tectonic plates help build up Earth's crust?
        - *When plates collide, crust is pushed upward and mountains are built. When plates move apart, magma flows up to the surface of the Earth creating new crust. Volcanic eruptions from plate motion allows lava to flow creating new crust.*
    c. How might plate tectonics moving tear down Earth's crust?
        - *When plates collide, sometimes crust is pushed downward (subducted) back into the mantle where it melts.*

4. Show students the attached landforms presentation slides. Ask students the following questions when you get to the slide pertaining to the question. Students will then write the landforms on their graphic organizer in the appropriate area.
    a. Which movement from your plate tectonics boundary graphic organizer caused mountains to form?
        - *Converging continental plates (graham crackers moving toward each other).*
    b. Which movement from your plate tectonics boundary graphic organizer formed the mid-ocean ridge?
        - *Diverging oceanic plates (Fruit Roll-Ups moving away from one another).*
    c. Which movement from your plate tectonics boundary graphic organizer causes a rift valley to form?
        - *Diverging continental plates (graham crackers moving away from one another).*
    d. Which movement from your plate tectonics boundary graphic organizer would cause fault lines?
        - *Transform continental plates (or oceanic plates) (graham crackers or Fruit Roll-Ups sliding past each other).*
    e. Which movement from your plate tectonics boundary graphic organizer would cause trenches?

- *Converging oceanic or oceanic and continental plates (graham cracker and Fruit Roll-Up or two Fruit Roll-Ups moving toward one another) creating a subduction zone.*

f. Which movement from your plate tectonics boundary graphic organizer would cause volcanoes?

- *Converging oceanic or oceanic and continental plates (graham cracker and Fruit Roll-Up or two Fruit Roll-Ups moving toward one another) creating a subduction zone. This results in volcanoes forming on land next to the subduction zone or island arcs to form in the ocean.*

5. State the definition of convergent boundary and have kids match which parts of the lab correspond to this type of boundary. Have them fill out that row in their graphic organizer.
6. State the definition of divergent boundary and have kids match which parts of the lab correspond to this type of boundary. Have them fill out that row in their graphic organizer.
7. State the definition of transform boundary and have kids match which part of the lab corresponded to this type of boundary. Have them fill out that row in their graphic organizer.

Expand

1. In this part students will be divided into 3 different groups to do a type of jigsaw activity.
2. The teacher can choose to print Blackline Master #3 on different colored paper or have some other indicator separating groups. Each group/color corresponds to a type of tectonic boundary (convergent, divergent, transform).
3. Give each group a different colored sheet of Blackline Master #3 on which to write their responses (ex: pink papers are given to the groups researching divergent boundaries).
4. Allow the students 10 minutes to research the landforms that are created by their plate tectonic boundary type. Each student in the group must find a **different** example and the location in which this example is located (no repeats within the group).
5. Have each student write their landform and those that are discovered by their groupmates on the colored paper in the appropriate column.
6. After students have completed their research, have students stand up and walk around the room while the teacher plays the rap video: https://www.youtube.com/watch?v=dkELENdZukI
   - **Play only the AUDIO for the video at this time. Do not allow the students to watch the video, this is only meant to be used for background music.**
7. Every 30 seconds have students stop (also stop the music) and pair up with two other people creating a group of 3 where each colored paper is represented.

8. Have students write down the other students' answers in the appropriate column on their graphic organizer (Blackline Master #3).
9. Allow students to move around and pair up a total of 6 times, allowing students a chance to record 6 additional examples of boundaries on their paper.
10. Have students go back to their graphic organizer (Blackline Master #2) and fill out the landform row based on the information they collected in their Group-Pair-Share Activity (Blackline Master #3).
11. (OPTIONAL) Lastly, you can have students share their examples and place them on a map. This part can be done either posting world maps on classroom walls and mark examples with post it notes or colored stickers, projecting a world map on the smartboard and marking examples with dots, using Google Maps drop pins at example locations.
    a. Ask the students the following questions:
        - What do you know notice about the placement of the dots?
            - *The dots should be around plate boundaries and follow a pattern of the edges of plate boundaries.*
        - What conclusions could scientists make about where these landforms are located?
            - *The location of the landforms should be around plate boundaries and follow a pattern of the edges of plate boundaries.*
12. (OPTIONAL) Play the rap video and this time allow the students to see the video: https://www.youtube.com/watch?v=dkELENdZukI
    - *Make sure to fast forward past the advertisements and display the video "whole screen" so that the web page advertisements located on the bottom and sides will not be seen. In addition, please be on the lookout for pop-up ads while the video is playing.*

Evaluate

FORMAL EVALUTION: **Blackline Master #4**

Supplementary Resources

Teachers

Annanberg Foundation. (2014). *Interactives: Dynamic Earth.* Retrieved from http://www.learner.org/interactives/dynamicearth/

Persad, V. (2014). *Kahoot Quiz Game: Earth's Layers and Plate Tectonics.* Retrieved June 25, 2015, from https://play.kahoot.it/#/k/80ebcf01-35dd-4a61-8f30-f076e8ab7913

USGS. (2015). *This Dynamic Earth: The Story of Plate Tectonics.* Retrieved from *http://pubs.usgs.gov/gip/dynamic/dynamic.html*

USGS. (2015). *This Dynamic Planet: A Teaching Companion. Retrieved from* *http://volcanoes.usgs.gov/about/edu/dynamicplanet/*

Students

Persad, V. (2014). *Kahoot Quiz Game: Earth's Layers and Plate Tectonics.* Retrieved June 25, 2015, from https://play.kahoot.it/#/k/80ebcf01-35dd-4a61-8f30-f076e8ab7913

USGS. (2015). *This Dynamic Earth: The Story of Plate Tectonics.* Retrieved from *http://pubs.usgs.gov/gip/dynamic/dynamic.html*

Based on various Earth Science lessons taught at St. Cloud Middle School in Osceola County Florida by teachers Stephanie Gilledo, Herman Evans, and Kimberly Miller.

Comerford. (N.D.) *Plate Boundary Rap.* Retrieved from https://www.youtube.com/watch?v=dkELENdZukI

Oregon State University. (2015) Earth's Layers Lesson #1. Retrieved from http://volcano.oregonstate.edu/earths-layers-lesson-1

Oregon State University. (2015) How Earth's Plates Move Lesson #3. Retrieved from http://volcano.oregonstate.edu/how-earths-plates-move-lesson-3

Twentieth Century Fox. (2012) *Ice Age 4: Continental Drift Trailer*. Retrieved from https://www.youtube.com/watch?v=TzzGPfVx32M

__✔__ Yes, I cited all materials and resources used in this lesson.

Kimberly Miller

Lesson author signature

Blackline Master #1

Edible Plate Tectonics Lab Sheet

Photo Credits:
https://en.wikipedia.org/wiki/Graham_cracker#/media/File:Graham-Cracker-Stack.jpg
https://www.flickr.com/photos/theimpulsivebuy/15520594478
https://www.flickr.com/photos/curiouslee/4661891018

Purpose: To introduce, model, and demonstrate how Earth's plates move.

Materials:

- Approximately1 foot by 1 foot square of wax paper
- Knife
- Frosting glob (approximately 1/4 cup or 1 heaping glob)
- Full graham cracker
- Fruit Roll-Up
- Dixie or 2-3 oz cup with water
- Napkin, paper towel, or baby wipes

Procedure:

Part 1: Graham Cracker vs. Graham Cracker

1. Break a whole graham cracker in half to make 2 large squares. Set one large square aside.
2. Break the other large square in half so that you have 2 rectangular pieces of graham cracker.
3. Using the knife, spread a thick layer of frosting in the center of the wax paper.
4. Lay the two rectangular pieces of graham cracker side by side on top of the frosting so they are touching.
5. PRESS DOWN on the crackers as you slowly push the graham crackers apart in opposite directions.
6. Once you've made observations of what happened, remove the graham crackers from the frosting and scrape off any frosting and return it to the wax paper. Set these crackers aside.

Part 1: Reflection Questions

- Illustrate what you saw happening during this part of the lab in the space provided below and add arrows to indicate movement.

- What did you observe with the graham crackers and the frosting when you pushed the graham crackers away from each other?

Part 2: Fruit Roll-Up vs. Fruit Roll-Up

1. Using the knife cut the Fruit Roll-Up in half.
2. Using the knife re-spread a thick layer of frosting in the center of the wax paper.
3. Lay the two pieces of Fruit Roll-Up side by side on top of the frosting so they are touching.
4. PRESS DOWN on the Fruit Roll-Ups as you slowly push down and apart in opposite directions.
5. Once you've made observations of what happened, remove the Fruit Roll-Ups from the frosting and scrape off any frosting and return it to the wax paper. Set the Fruit Roll-Ups aside.

Part 2: Reflection Questions

- Illustrate what you saw happening during this part of the lab in the space provided below and add arrows to indicate movement.

- Compare and contrast part 2 and part 1.

Part 3: Graham Cracker vs. Graham Cracker

1. Break the remaining two graham crackers in half (you should now have 4 pieces). Set the pieces to the side.
2. Using the knife re-spread a thick layer of frosting in the center of the wax paper.
3. Using only 2 pieces of cracker, dip one of the short ends of each of the two graham crackers into a cup of water for approximately 3 seconds.
4. Lay the pieces end to end on the frosting with the wet edges touching.
5. Slowly push the two crackers together.
6. Once you've made observations of what happened, remove the graham crackers from the frosting and scrape off any frosting and return it to the wax paper. Set these crackers aside.

Part 3: Reflection Questions

- Illustrate what you saw happening during this part of the lab in the space provided below and add arrows to indicate movement.

- Describe what happened when you pushed the two graham crackers together.

Part 4: Graham Cracker vs. Graham Cracker

1. Using the knife re-spread a thick layer of frosting in the center of the wax paper.
2. Using the graham crackers from part 1 (not the soggy ones), place the two pieces together side by side on top of the frosting on the wax paper. The long edges of the graham crackers should be touching.
3. Place one hand on each of the graham cracker pieces. At the same time, move one graham cracker forward and one backward.
4. Once you've made observations of what happened, remove the graham crackers from the frosting and scrape off any frosting and return it to the wax paper. Set the graham crackers aside.

Part 4: Reflection Questions

- Illustrate what you saw happening during this part of the lab in the space provided below and add arrows to indicate movement.

- Describe what happened when you slid the 2 graham crackers past each other.

Part 5: Fruit Roll-Up vs. Graham Cracker:

1. Using the knife re-spread a thick layer of frosting in the center of the wax paper.
2. Using one of the graham cracker pieces and one of the Fruit Roll-Up pieces, place them on the frosting.
3. Gently push the graham cracker into the Fruit Roll-Up.
4. Once you've made observations of what happened, remove the Fruit Roll-Up and graham cracker from the frosting and scrape off any frosting and return it to the wax paper. Set the Fruit Roll-Up and graham cracker aside.

Part 5: Reflection Questions

- Illustrate what you saw happening during this part of the lab in the space provided below and add arrows to indicate movement.

- Describe what happened when you slid the graham cracker into the Fruit Roll-Up.

Additional Reflection Questions

1. Why is what you did with the graham crackers, Fruit Roll-Ups, and frosting considered a “model” of plate tectonics?

2. Why do we use models in science?

3. Why was it beneficial (helpful) to use a model of the plates and the plate movement?

4. What were some of the limitations of this model? In other words, what are some things that this model cannot demonstrate about plate tectonics?

5. In your model, what did each of the parts of your model represent?

Part of Model	What it Represented
Graham Crackers	
Fruit Roll-Ups	
Frosting	

6. In this lab, we were able to show plate movement in a few seconds. Why is this not necessarily scientifically accurate?

7. Which type of geological processes might take a very short amount of time and which type might take thousands or millions of years.

Blackline Master #2

Plate Tectonics Boundary Graphic Organizer

	Example	Part 1	Part 2	Part 3	Part 4	Part 5
Use your lab sheet to describe what you observed in each part.	*I observed the graham cracker sliding past the other graham cracker and it getting stuck and crumbling at the edges.*					
Based on your observations draw the movement using arrows.						
Which landforms or events are associated with this part?	Faults and earthquakes					
What is the name of the plate tectonic boundary that this part models.	Transform Boundary					

Blackline Master #3

Group-Pair-Share Organizer

Divergent Boundary	Convergent Boundary	Transform Boundary

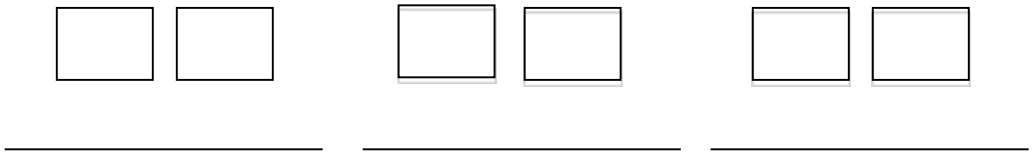
Blackline Master #4

Concept Check: Plate Tectonics

1) Oceanic crust is denser than continental crust. Which of the following is most likely to happen when a plate carrying oceanic crust converges with a plate carrying continental crust? (SC.7.E.6.5)

A. The plates collide and mantle convection stops
B. The denser oceanic plate gradually sinks into the mantle and melts.
C. Both the oceanic and the continental plates sink into the mantle and melt.
D. The less dense continental plate gradually sinks into the mantle and melts.

2) Draw arrows in the boxes and identify the tectonic plate boundary that matches to the type of movement. (SC.7.E.6.5)



_____ _____ _____

3) Directions: Match the tectonic boundary with the landform(s) that it creates:	
Convergent Boundary	Mid-Ocean Ridge
	Volcano
Divergent Boundary	Deep Sea Trench
	Mountain Range
Transform Boundary	Rift Valley
	Fault

4) Jane states that the motion of the tectonic plates causes rapid (fast) changes. Steve states that the motion of the tectonic plates causes slow changes. Who is correct? (SC.7.E.6.5)

A. Jane is correct because changes to Earth's surface happen rapidly.
B. Steve is correct because changes to Earth's surface happen slowly.
C. Neither are correct because changes happen at a moderate pace.
D. Both of them are correct because some changes happen rapidly and some happen slowly.

5) Why would it be necessary to model plate tectonic processes? (SC.7.N.3.2)

a. The processes happen under water so we don't see them happening.
b. The processes happen too fast for us to see them working together.
c. The processes happen over too large of a geographic scale to accurately see them working together.
d. The processes are too dangerous for us to see them working together.

Blackline Master #5

As you look at the following images, reflect on your lab. Which of the plate movements would result in these landforms?

MOUNTAINS

Photo Credit: *https://upload.wikimedia.org/wikipedia/commons/f/f0/Everest_North_Face_toward_Base_Camp_Tibet_Luca_Galuzzi_2006_edit_1.jpg*

I. Himalayas

Nepal and China

Photo Credit: *https://upload.wikimedia.org/wikipedia/commons/c/c5/Moraine_Lake_17092005.jpg*

II. Rocky Mountains

Alberta, Canada

RIDGES

Photo Credit: *https://commons.wikimedia.org/wiki/File:Ca%C3%B1%C3%B3n_Silfra,_Parque_Nacional_de_%C3%9Eingvellir,_Su%C3%B0urland,_Islandia,_2014-08-16,_DD_055.JPG#/media/File:Ca%C3%B1%C3%B3n_Silfra,_Parque_Nacional_de_%C3%9Eingvellir,_Su%C3%B0urland,_Islandia,_2014-08-16,_DD_055.JPG*

III. Mid-Atlantic Ridge

Iceland

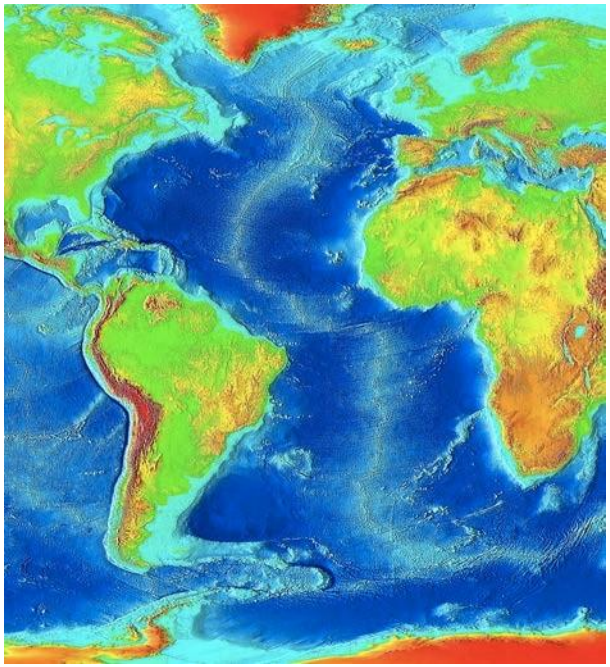


Photo Credit: *https://commons.wikimedia.org/wiki/File:Atlantic_bathymetry.jpg*

IV. Mid-Atlantic Ridge

Atlantic Ocean

FAULT LINE

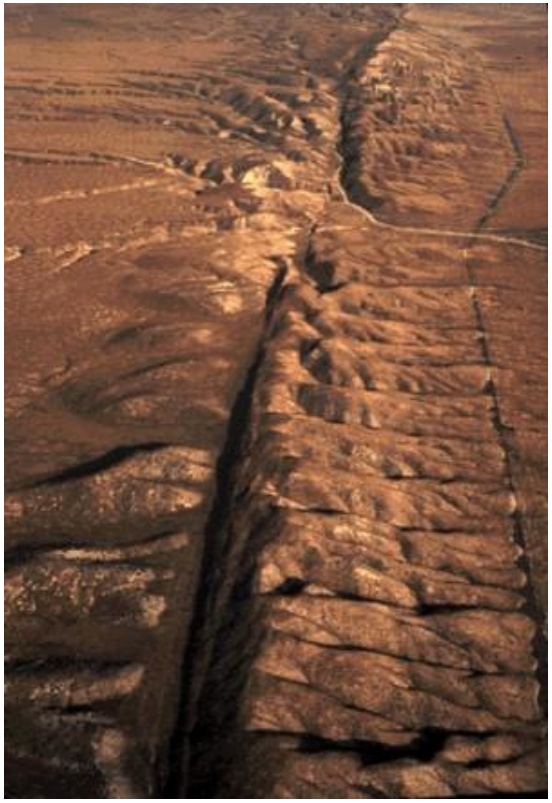


Photo Credit: *https://simple.wikipedia.org/wiki/San_Andreas_Fault*

Photo Credit: *https://simple.wikipedia.org/wiki/San_Andreas_Fault*

V. San Andreas Fault

California

RIFT VALLEY

Photo Credit: *https://en.wikipedia.org/wiki/File:Browncanyonquilotoa.jpg*

VII. Rift Valley
Quilotoa, Ecuador

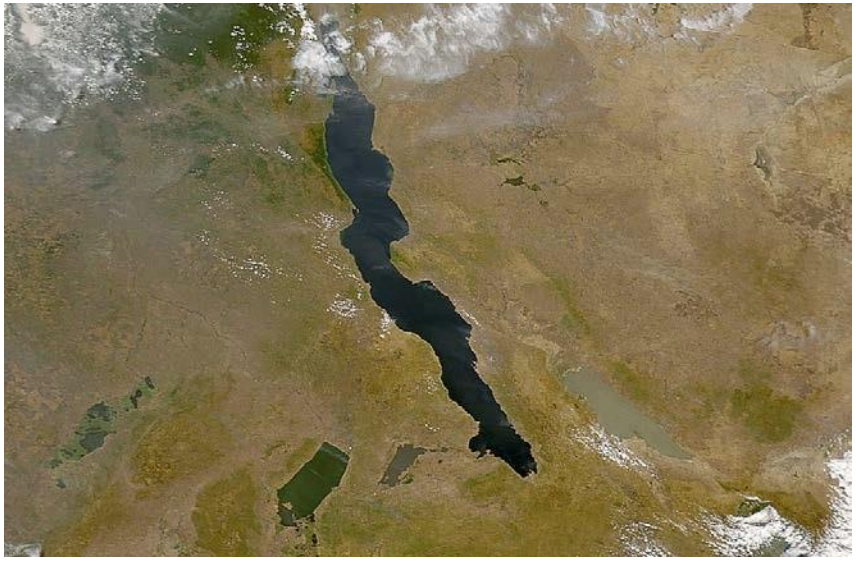


Photo Credit: *https://upload.wikimedia.org/wikipedia/commons/4/42/NASA_-_Visible_Earth,_Lakes_of_the_African_Rift_Valley.jpg*

VI. East African Rift
Africa

VOLCANOES

Photo Credit: *https://en.wikipedia.org/wiki/Arenal_Volcano#/media/File:CostaRica_Arenal_Volcano_%28pixinn.net%29.jpg*

VIII. Arenal Volcano

Costa Rica

Photo Credit: *https://www.flickr.com/photos/cwkarl/17080327630*

IX. Aogashima Volcano

Japan

TRENCHES

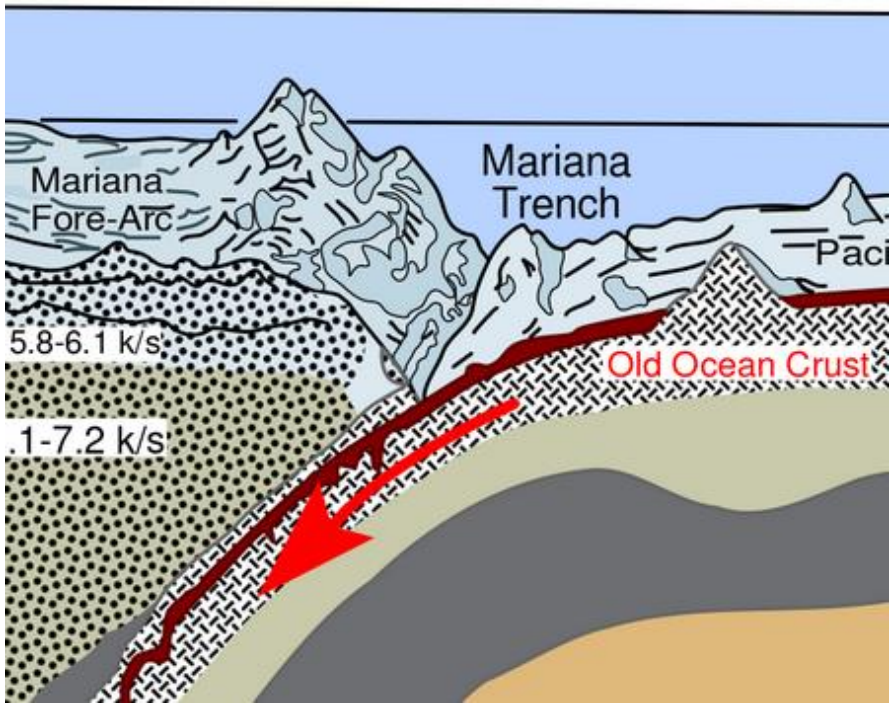


Photo Credit: *https://en.wikipedia.org/wiki/Mariana_Trench#/media/File:Cross_section_of_mariana_trench.svg*

X. Mariana Trench

Pacific Ocean

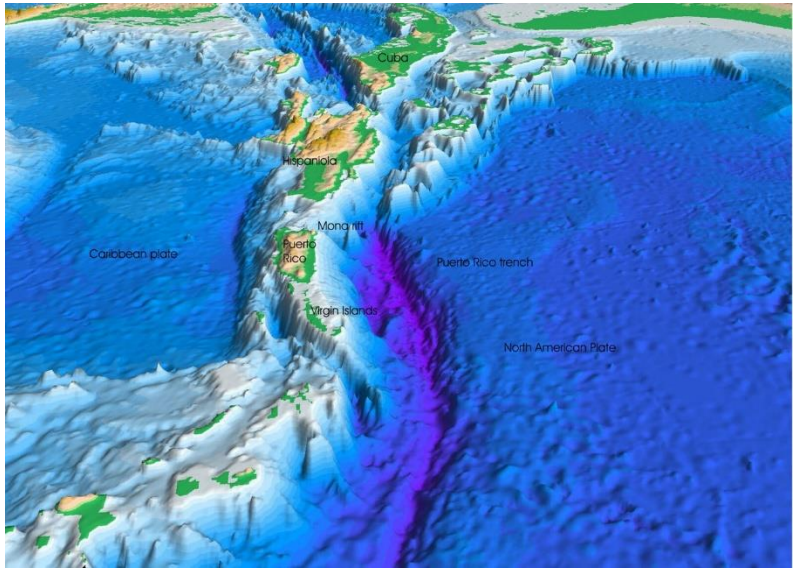


Photo Credit: *https://en.wikipedia.org/wiki/Oceanic_trench#/media/File:Atlantic-trench.JPG*

XI. Puerto Rico Trench

Puerto Rico

Blackline Master #6 ANSWER KEYS

Lab Sheet Answers

Part 1: Reflection Questions

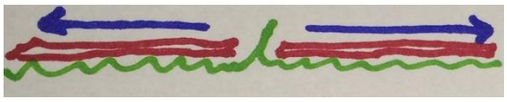
- Illustrate what you saw happening during this part of the lab in the space provided below and add arrows to indicate movement.

- What did you observe with the graham crackers and the frosting when you pushed the graham crackers away from each other?

There was frosting left in the middle and some of it squished up between the graham crackers. The height of the graham cracker left a valley in between the two graham crackers.

Part 2: Reflection Questions

- Illustrate what you saw happening during this part of the lab in the space provided below and add arrows to indicate movement.

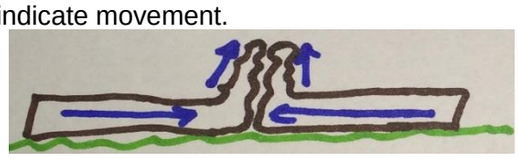


- Compare and contrast part 2 and part 1.

There was frosting left in the middle and some of it squished up between the Fruit Roll-Ups. The height of the Fruit Roll-Up left a ridge in between the two Fruit Roll-Ups because the frosting was higher than the Fruit Roll-Ups.

Part 3: Reflection Questions

- Illustrate what you saw happening during this part of the lab in the space provided below and add arrows to indicate movement.

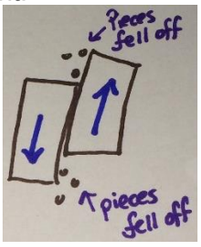


- Describe what happened when you pushed the two graham crackers together.

There graham crackers squished together and pushed upward into the air forming a little mountain.

Part 4: Reflection Questions

- Illustrate what you saw happening during this part of the lab in the space provided below and add arrows to indicate movement.

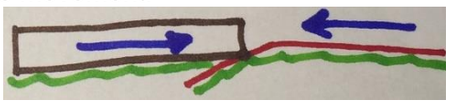


- Describe what happened when you slid the 2 graham crackers past each other.

The graham crackers kind of caught on one another and little pieces of graham cracker broke off where they were rubbing together.

Part 5: Reflection Questions

- Illustrate what you saw happening during this part of the lab in the space provided below and add arrows to indicate movement.



- Describe what happened when you slid the graham cracker into the Fruit Roll-Up.

The graham cracker went over top of the Fruit Roll-Up.

Additional Reflection Questions

1. Why is what you did with the graham crackers, Fruit Roll-Ups, and frosting considered a "model" of plate tectonics?
   The graham crackers, Fruit Roll-Up, and frosting were representing other, real-life objects. We were simulating the plates and their different motions. This represented real-life. Because these are representations, they are considered models.

2. Why do we use models in science?
   Sometimes it is too dangerous to study real-life objects. Sometimes they are too large (planets, solar system), sometimes too small (atoms, cells), sometimes too abstract (weather) to study in real-life. Models are good for showing how multiple parts interact together.

3. Why was it beneficial (helpful) to use a model of the plates and the plate movement?
   The plates are too large and their motion too unpredictable to study directly. Also, some movements happen really quickly and others very, very slowly to study directly. Models allow us to understand all the parts and how they fit together as a whole.

4. What were some of the limitations of this model? In other words, what are some things that this model cannot demonstrate about plate tectonics?
   The model cannot accurately demonstrate how the magma from the mantle interacts in real-life. Also, the model cannot demonstrate earthquakes, volcanic eruptions, and other phenomenon associated with plate movement. We are not able to demonstrate island arcs or get a good representation of trenches.

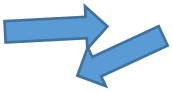
5. In your model, what did each of the parts of your model represent?

Part of Model	What it Represented
Graham Crackers	*continental crust*
Fruit Roll-Ups	*oceanic crust*
Frosting	*magma*

6. In this lab, we were able to show plate movement in a few seconds. Why is this not necessarily scientifically accurate?
   Some of the plate tectonic processes happen over thousands or millions of years. For example, we were able to form our little mountain with the graham crackers in a matter of seconds. This takes millions of years to happen.

7. Which type of geological processes might take a very short amount of time and which type might take thousands or millions of years.
   Transform boundaries can shift and cause earthquakes in a matter of seconds. In areas where seafloor spreading is occurring, magma seeps up to the Earth regularly. Mountain building and the process of subduction is a much more slow and gradual process. The mid-Atlantic ridge is spreading at a rate of 2.5 cm per year. The Cocos and Nazca plates in the Pacific Ocean are moving at a rate of 10 cm per year. These plate motions can cause very slow changes or very fast changes.

Plate Tectonics Boundary Graphic Organizer

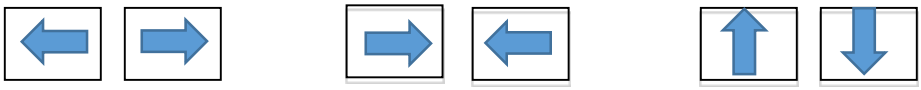
	Example	Part 1	Part 2	Part 3	Part 4	Part 5
Use your lab sheet to describe what you observed in each part.	*I observed the graham cracker sliding past the other graham cracker and it getting stuck and crumbling at the edges.*	*There was frosting left in the middle and some of it squished up between the graham crackers. The height of the graham cracker left a valley in between the two graham crackers.*	*There was frosting left in the middle and some of it squished up between the Fruit Roll-Ups. The height of the Fruit Roll-Up left a ridge in between the two Fruit Roll-Ups because the frosting was higher than the Fruit Roll-Ups.*	*There graham crackers squished together and pushed upward into the air forming a little mountain.*	*The graham crackers kind of caught on one another and little pieces of graham cracker broke off where they were rubbing together.*	*The graham cracker went over top of the Fruit Roll-Up.*
Based on your observations draw the movement using arrows.						
Which landforms or events are associated with this part?	Faults and earthquakes	*Rift Valleys*	*Ridges*	*Mountains*	*Faults and Earthquakes*	*Subduction Zones, Trenches*
What is the name of the plate tectonic boundary that this part models.	Transform Boundary	*Divergent Boundary*	*Divergent Boundary*	*Convergent Boundary*	*Transform Boundary*	*Convergent Boundary*

Concept Check: Plate Tectonics

1) Oceanic crust is denser than continental crust. Which of the following is most likely to happen when a plate carrying oceanic crust converges with a plate carrying continental crust? (SC.7.E.6.5)

A. The plates collide and mantle convection stops
B. The denser oceanic plate gradually sinks into the mantle and melts.
C. Both the oceanic and the continental plates sink into the mantle and melt.
D. The less dense continental plate gradually sinks into the mantle and melts.

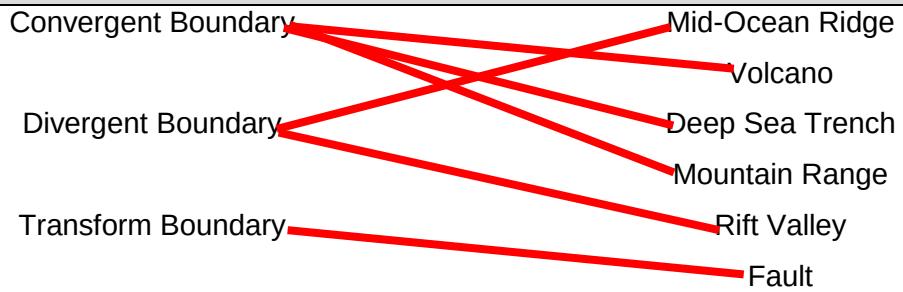
2) Draw arrows in the boxes and identify the tectonic plate boundary that matches to the type of movement. (SC.7.E.6.5)



Divergent Convergent Transform

These can be in any order

3) Directions: Match the tectonic boundary with the landform(s) that it creates:



4) Jane states that the motion of the tectonic plates causes rapid (fast) changes. Steve states that the motion of the tectonic plates causes slow changes. Who is correct? (SC.7.E.6.5)

A. Jane is correct because changes to Earth's surface happen rapidly.
B. Steve is correct because changes to Earth's surface happen slowly.
C. Neither are correct because changes happen at a moderate pace.
D. Both of them are correct because some changes happen rapidly and some happen slowly.

5) Why would it be necessary to model plate tectonic processes? (SC.7.N.3.2)

A. The processes happen under water so we don't see them happening.
B. The processes are too small for us to see them working together.
C. The processes happen over too large of a geographic scale to accurately see them working together.
D. The processes are too dangerous for us to see them working together.