

Learning Objective: Plate Tectonics

NGSS Standard: (MS-ESS2.B) Maps of ancient land and water patterns, based on investigations of rocks and fossils, make clear how Earth's plates have moved great distances, collided, and spread apart.

Objective:

Students will be able to:

1. Explain the process of the motion of the tectonic plates.
2. Recognize and assemble the continents of the supercontinent, Pangea.
3. Understand the importance of convection currents.
4. Explain the significance of convection currents and plate tectonics.

Time Required: 80 minutes

Materials Needed:

- Copies of the Plate Tectonics Handout (attached)
- Ziploc bags or paper clips
- Teacher computer with internet access
- Projector/Smartboard
- 1 computer/laptop/iPad per student with internet access
- 2 test tubes
- Hot plate
- 2 - 250 mL beaker
 - 1 beaker is for warm water and the other beaker is for cold water. Based on time, the teacher may want to set this part of demonstration up while the students are working on the computers.
- Clear container, such as a small aquarium, which will be filled with water
- Red food coloring
- Blue food coloring
- Copies of the Image for the 'Engage' portion of the lesson (one precut image per set of students)

Teacher Preparation:

- Create Playlist 1, a 20 minute [playlist](#) in [Legends of Learning](#) with the following games found in the Plate Tectonics learning objective (in order):
 - *Plate Tectonics*
 - *Flip and Learn: Plate Tectonics*
- Create Playlist 2, a 10 minute [playlist](#) in Legends of Learning with 5 [assessment questions](#) from the Plate Tectonics learning objective
- Make copies of Plate Tectonics Handout (1 per student)
- Make copies of the Image for the Engage portion
 - The image will need to be cut **prior** to the beginning of the lesson. Each set of cut outs will need to be placed in separate ziploc bags or bound together with a paper clip. If durability of materials is needed, copy the image on cardstock and laminate the document prior to cutting the continents apart.

Engage (15 minutes):

1. The teacher will put students in groups of 3 and pass out one ziploc bag with the precut continents of Pangea to each group.
2. The teacher will ask the students to put the puzzle of the continent Pangea together in a way that all the pieces fit comfortably.
3. The teacher will allow the students to work for 5 minutes maximum on this activity.

4. As the students are working in their groups, the teacher will have an answer key available so that the teacher can check for accuracy. In addition, if the class size is large, the teacher may also assign student helpers to help facilitate the checking for accuracy.
5. Once the students have correctly assembled the supercontinent Pangea, the teacher will ask the students to assemble the continents based on their present day locations.
6. As the students are working in their groups, the teacher will ask, "What geologic process are you modeling right now?"
 - a. Allow wait time so that students can process their thoughts. It is appropriate to do a "Think - Pair - Share" at this point. If the teacher wants to increase literacy, the teacher may have the students do a "Think - Ink - Pair - Share". The added component of this strategy is that before sharing their answer with a table/elbow partner, the student will write their answer in their science journal.
 - b. ANSWER: continental drift, which is based off the theory of plate tectonics.
8. The teacher should have a student collect the ziploc bags, which contain the puzzle pieces, and explain to students, "Today you have demonstrated the movement of Earth's tectonic plates. Think about this demonstration during today's lesson as we will refer back to it at the end of class."

Explore (20 minutes):

1. Have your students [sign in to Legends of Learning and enter your teacher code.](#)
2. [Launch](#) Playlist 1 to your students.
3. As students complete *Plate Tectonics*, students should fill out the Plate Tectonics Handout Part I ONLY.
4. Assist students as needed during game play, pause playlist if you need to address content or questions to entire class.

Explain (15 minutes):

1. Review answers to Part I of the Plate Tectonics Handout.
2. What is Pangea? (*The supercontinent that existed millions of years ago.*)
3. In what way have the continents changed? (*The continents have separated or collided.*)
4. How do scientists know how the appearance and locations of the continents have changed if they were not able to see them from space? (*Scientists used evidence from rocks and fossils to provide the age, climate, and topography of the area they were located.*)
5. What are the names of the three types of plate boundaries? (*divergent, convergent, transform*)
6. Using a document camera, the teacher will use student assistance to construct Pangaea.
7. The teacher will place the continents in their correct, present day locations by sliding the various continents apart. While doing this, the teacher will explain that the continents are moving VERY slowly, up to 2 cm per year.
8. Demonstrate how far 2 centimeters is by moving a continent piece 2 centimeters and reiterating that it takes a whole year for a continent to move that much.

Elaborate (20 minutes):

1. Explain to students that the plates are moving due to convection currents in the mantle.
2. For this demonstration, the teacher will need to use a hot plate to warm up 50 mL water in a beaker.
3. Once the teacher has warmed the water up, the teacher will carefully place the some warm water into test tube 1. Teacher will also add 2 drops of red food coloring to test tube 1.
4. The teacher will then pour some cold water into test tube 2. Teacher will also add 2 drops

of blue food coloring to test tube 2.

5. The teacher will use their thumbs to seal the test tubes as they are submerged into a clear

container filled with water.

6. The teacher will simultaneously unseal the test tubes.

7. The teacher will ask the students to draw and explain with text what they are observing in their science journal.

8. This [video](#) illustrates a similar demonstration.

9. Explain to students that convection is an important part of plate tectonics. Show this [short video](#) to

help further explain the process of plate tectonics/continental drift.

10. Students can complete Part II of the Plate Tectonics Handout.

Evaluate (10 minutes):

1. [Launch](#) Playlist 2 to your students. When they finish the assessment questions, any time left is freeplay.

2. [Analyze student results](#) to determine what concepts need to be a focus for reteaching.

Plate Tectonics

Name: _____

Directions: While playing the first game in Legends of Learning called *Plate Tectonics*, use what you learn to answer the questions below.

Part I

1. What is Pangea?
 - A** The name of the major tectonic plate.
 - B** The supercontinent that existed millions of years ago.
 - C** Both A & B are correct
 - D** None of the above
2. In what way have the continents changed?
 - A** The continents have become larger over time.
 - B** The continents have become smaller over time.
 - C** The continents have remained approximately the same size.
 - D** The continents have separated or collided.
3. How do scientists know how the appearance and locations of the continents have changed if they were not able to see them from space?
 - A** Scientists used evidence from hieroglyphics to approximate the location, age, and climate of the area the fossils and rocks were located.
 - B** Scientists used evidence from rocks and fossils to provide the age, climate, and topography of the area they were located.
 - C** Scientists have hypothesized about the locations of the continents based on magnetic readings from areas around the Earth.
 - D** All of the above.
4. What are the names of the three types of plate boundaries?
 - A** destructive, constructive, sliding
 - B** destructive, convergent, transform
 - C** divergent, constructive, transform
 - D** divergent, convergent, transform

Part II

In the space provided, illustrate how the continents will appear in the next 250 million years. Provide a rationale for your illustration.

Rationale:

Image for the Engage portion.

