

Date: _____

Your Name: _____



**NEW ENGLAND
COMMON ASSESSMENT PROGRAM**

Released Science Inquiry Task

Plate Tectonics

2016

Grade 8

Student Test Booklet

Science

Directions:

In this task, you will read a story about four students who investigate the movement of tectonic plates. You will analyze the information and data provided by the students in the story as you answer a set of questions.

Plate Tectonics

The students in a science class are excited because their teacher, Ms. Johnson, shared an e-mail she received announcing the opportunity to compete in a technology competition. She read the description of the competition to the class.

*“Plate Tectonics Competition: Participants work in teams to create an application (app) to answer the question ‘**How do data from scientific investigations provide evidence that Earth’s tectonic plates are moving?**’ The app must include information and models that demonstrate evidence of plate movement that can be viewed on a portable electronic device such as a smartphone or tablet.”*

Jacob, Ali, Sarah, and Luke volunteer to participate in the competition. Ms. Johnson provides them with Map 1, the plate movements map shown on the Map Reference Sheet.

Please review Map 1 on the **Map Reference Sheet** before continuing.

Jacob says that before they learn about the process of designing an app, they need to learn more about plate tectonics. Ali suggests they use their textbooks and the Internet to conduct research. Jacob and Ali create the following Word Bank for the four students to refer to while they do their research for the app.

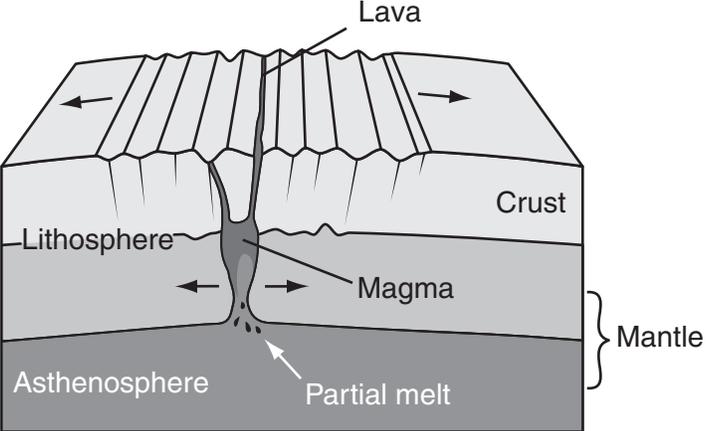
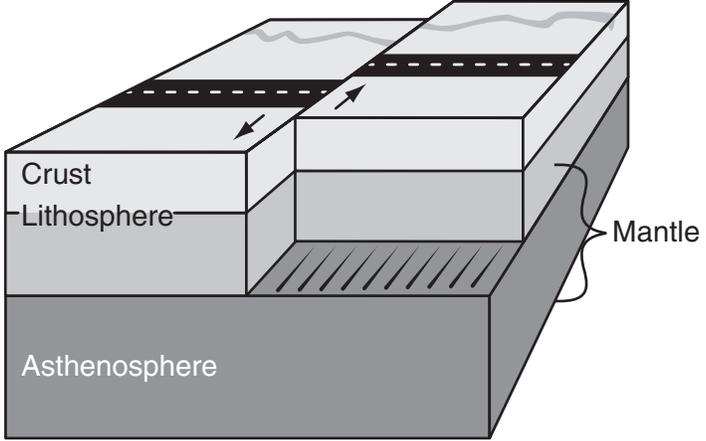
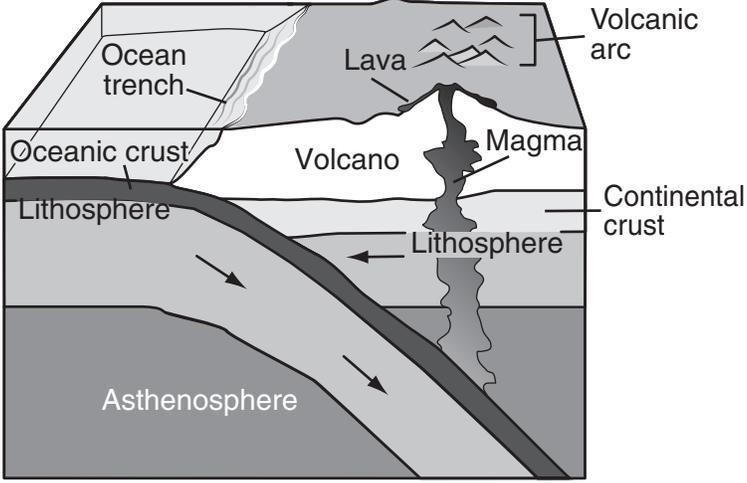
The following Word Bank defines the terms that you will need to understand throughout this investigation. You may refer back to this page throughout the session.

Word Bank

| | |
|-----------------------|---|
| Asthenosphere | a slowly flowing layer of solid and melted rock formed by heat and pressure; the lithosphere floats on the asthenosphere |
| Crust | the outermost layer of Earth |
| Hot spot | is formed when very hot rock rises from the mantle and erupts through Earth's crust |
| Lava | melted rock on Earth's surface |
| Lithosphere | the solid outer part of Earth that includes the crust and upper mantle |
| Magma | melted rock beneath Earth's surface |
| Mantle | the layer of Earth between the core and the crust; the mantle contains the lower part of the lithosphere and all of the asthenosphere |
| Ocean trench | a long, narrow, deep area on the ocean floor that is formed at a convergent plate boundary |
| Plate boundary | an area where two or more tectonic plates meet |
| Tectonic plate | a large piece of the lithosphere that floats and moves on the asthenosphere |
| Transect | a straight line of travel where data is being collected |

Sarah and Luke research plate tectonics and then make the table shown below to highlight the differences between the three types of plate boundaries.

Types of Plate Boundaries

| Type of Boundary | When It Is Formed | Diagram |
|-------------------|---|--|
| Divergent | It is formed when plates move apart. Hot mantle rock melts as it rises and becomes magma. When magma reaches Earth's surface, it becomes lava, which cools and creates a new crust that pushes the old crust to the side. |  <p>The diagram shows a cross-section of a divergent plate boundary. Two tectonic plates are moving apart, as indicated by arrows. In the center, the plates are pulling away from each other, creating a rift. Below the rift, the asthenosphere bulges upward, and a column of magma rises through the lithosphere. At the surface, this magma is labeled as 'Lava'. The layers shown are the Crust, Lithosphere, and Asthenosphere. A bracket on the right side of the diagram labels the Lithosphere and Asthenosphere together as the 'Mantle'. A small area of 'Partial melt' is shown at the base of the rift in the asthenosphere.</p> |
| Transform | It is formed when two plates slide past each other. |  <p>The diagram shows a cross-section of a transform plate boundary. Two tectonic plates are sliding horizontally past each other in opposite directions, as indicated by arrows. The layers shown are the Crust, Lithosphere, and Asthenosphere. A bracket on the right side of the diagram labels the Lithosphere and Asthenosphere together as the 'Mantle'.</p> |
| Convergent | It is formed when two plates move toward each other, and the denser plate sinks below the less dense plate. |  <p>The diagram shows a cross-section of a convergent plate boundary. One tectonic plate, labeled 'Oceanic crust', is moving toward and sinking beneath another tectonic plate, labeled 'Continental crust'. The sinking oceanic plate creates an 'Ocean trench'. As the oceanic plate subducts, it carries the lithosphere down into the asthenosphere. This process creates 'Magma', which rises through the lithosphere to form a 'Volcano' on the surface. A 'Volcanic arc' is shown as a series of volcanoes along the edge of the continental crust. The layers shown are the Crust, Lithosphere, and Asthenosphere. A bracket on the right side of the diagram labels the Lithosphere and Asthenosphere together as the 'Mantle'.</p> |

Jacob says, “The movement of tectonic plates at these boundaries causes changes to Earth’s surface, such as volcanoes and earthquakes.” Jacob’s statement causes Ali to suggest that their app should focus on volcanoes and earthquakes. Ms. Johnson asks the students to divide into two groups to research them. Jacob and Sarah choose to investigate earthquakes, and Ali and Luke choose to investigate volcanoes.

Jacob learns that the movement of tectonic plates at the different types of plate boundaries creates earthquakes with different depths that range from shallower than 50 km to deeper than 250 km. He shares this information with Sarah, who then finds more data to make a map that identifies the locations and depths of earthquakes of the world (Map 2), as shown on the Map Reference Sheet.

Please review Map 2 on the **Map Reference Sheet** before continuing.

Jacob says, “The locations of the plate boundaries on Map 1 and the earthquakes on Map 2 are very similar. We should show this relationship in our app.”

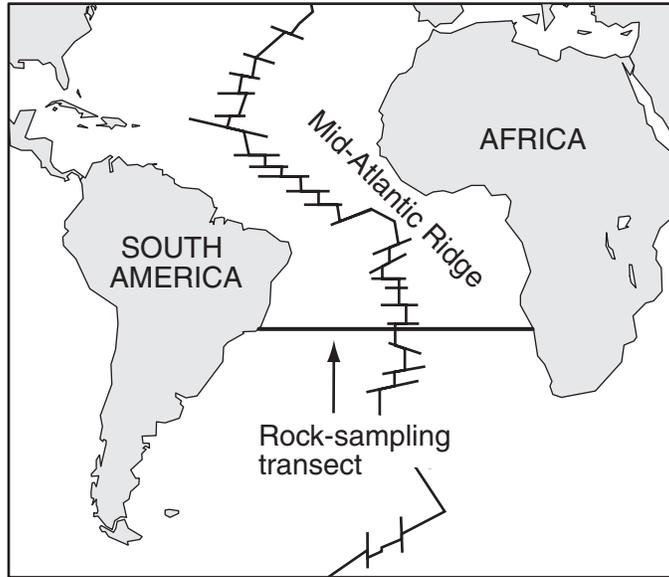
Sarah replies, “I agree. I also noticed that my map supports your data that showed the earthquakes have different depths. I wonder if there is a relationship between the depth of an earthquake and the type of plate boundary nearby.”

Answer question 1 on page 1 of your Student Answer Booklet.

1. Describe **two** observations Sarah could use from Maps 1 and 2 to show the relationship between the depth of an earthquake and the type of plate boundary nearby. Use evidence from Maps 1 and 2 on the **Map Reference Sheet** to support your answer.

As Sarah continues to compare Maps 1 and 2, she observes that the Mid-Atlantic Ridge is a large feature on Map 1 and that there have been many earthquakes along this ridge. She reads about a scientific investigation in which scientists sampled rocks along a transect, or a straight line of travel, across the Mid-Atlantic Ridge from South America to Africa to determine the age of the seafloor rocks. Sarah creates the diagram of the transect (Diagram 1) shown below to help explain the investigation to Jacob.

**Diagram 1:
Transect from South America to Africa**



Sarah shows Jacob Diagram 1 and the data from the investigation (Data Table 1) shown below.

**Data Table 1:
Age of Seafloor Rocks from
South America to Africa**

| Distance from South America (km) | Age of Seafloor Rocks (millions of years) |
|---|--|
| 0 | 120 |
| 500 | 108 |
| 1000 | 70 |
| 1500 | 42 |
| 2000 | 25 |
| 2500 | 8 |
| 2600 | 2 |
| 3000 | 20 |
| 3500 | 42 |
| 4000 | 70 |
| 4500 | 88 |
| 5000 | 105 |
| 5400 | 114 |

Jacob suggests they see if there is any pattern in the data the scientists collected about the age of the seafloor rocks along the transect from South America to Africa. He says, "I think a graph would be the best way to share these data in our app so they are easy to see on a smartphone or tablet."

Sarah creates a line graph that shows the age of the seafloor rocks along the transect between South America and Africa. She suggests that students could use the app to describe the trends shown in her graph.

Answer question 2 on page 2 of your Student Answer Booklet.

2. Use the data from Data Table 1 to create a line graph that shows the age of the seafloor rocks along the transect from South America to Africa.

Sarah concludes that the plate boundary at the Mid-Atlantic Ridge is a divergent plate boundary.

Answer question 3 on page 3 of your Student Answer Booklet.

3. Explain how the evidence from either your graph or Data Table 1 supports Sarah's conclusion that the plate boundary at the Mid-Atlantic Ridge is a divergent plate boundary.

While Jacob and Sarah investigate earthquakes, Ali and Luke investigate volcanoes. Ali shares her research notes with Luke, as shown below:

- Explosive volcanoes occur on the seafloor at convergent boundaries.
- Volcanic eruptions have less explosive forces at divergent boundaries.
- Volcanoes occur at divergent boundaries on the ocean floor, but some of these areas are so deep that the volcanoes cannot be seen from the ocean’s surface and are not easily recorded.
- Some volcanoes form over hot spots in the mantle. These volcanoes form when very hot rock rises and erupts through Earth’s crust.

Luke reads Ali’s notes and says, “Since explosive volcanoes form at convergent boundaries, I wonder if most of the volcanoes are located on convergent boundaries.”

Ali finds some data and generates the map of locations of volcanoes of the world (Map 3) shown on the Map Reference Sheet to investigate Luke’s idea. Ali and Luke study Map 3 and compare it to Map 1. They decide to include Map 3 in their app.

Please review Map 3 and Map 1 on the **Map Reference Sheet** before continuing.

Answer question 4 on page 3 of your Student Answer Booklet.

4. Describe **two** pieces of evidence from Maps 1 and 3 on the **Map Reference Sheet** that support Luke’s idea that most of the volcanoes are located on convergent boundaries.

Ms. Johnson reviews the three maps and says, “The ocean ridges are located at plate boundaries and have many earthquakes, but I do not see volcanoes on them. Map 3 might be missing information.”

Answer question 5 on page 4 of your Student Answer Booklet.

5. Use information from the story on page 7 and the **Map Reference Sheet** to explain why Map 3 is missing information. Describe **two** factors that could explain the lack of evidence of volcanic activity on the ocean ridges.

Ali and Luke join Jacob and Sarah to compare data. Ali notices that the continent of Africa has had many earthquakes and volcanoes. However, when she compares Maps 1, 2, and 3, she observes that many of these earthquakes and volcanoes are not located on a plate boundary. Ali wonders if the earthquakes and volcanoes in Africa occurred recently or a long time ago. She asks, “Where are the most recent earthquakes and volcanic eruptions in eastern Africa located?” Luke helps her investigate this research question. Some of the data they collected are shown in Data Tables 2 and 3 below.

Data Table 2: Seven Recent Earthquakes in Eastern Africa

| Magnitude | Depth (km) | Day | Location |
|-----------|------------|------------|---|
| 5.1 | 14.2 | 12/31/2014 | Malawi |
| 4.6 | 12.6 | 12/13/2014 | Ethiopia |
| 4.3 | 10 | 11/20/2014 | Lake Tanganyika (Tanzania & Democratic Republic of Congo) |
| 4.8 | 15.1 | 11/11/2014 | Lake Tanganyika (Tanzania & Democratic Republic of Congo) |
| 5.3 | 10 | 11/02/2014 | Zambia |
| 5.1 | 10 | 10/31/2014 | Tanzania |
| 4.5 | 10 | 10/31/2014 | Democratic Republic of Congo |

Data Table 3: Five Recent Volcanic Eruptions in Eastern Africa

| Volcano Number | Volcano Name | Year Eruption Started | Month Eruption Started | Country |
|----------------|-------------------|-----------------------|------------------------|------------------------------|
| 223020 | Nyamuragira | 2014 | 6 | Democratic Republic of Congo |
| 223020 | Nyamuragira | 2011 | 11 | Democratic Republic of Congo |
| 222120 | Lengai, Ol Doinyo | 2011 | 6 | Tanzania |
| 221101 | Nabro | 2011 | 6 | Eritrea |
| 221041 | Dallol | 2011 | 1 | Ethiopia |

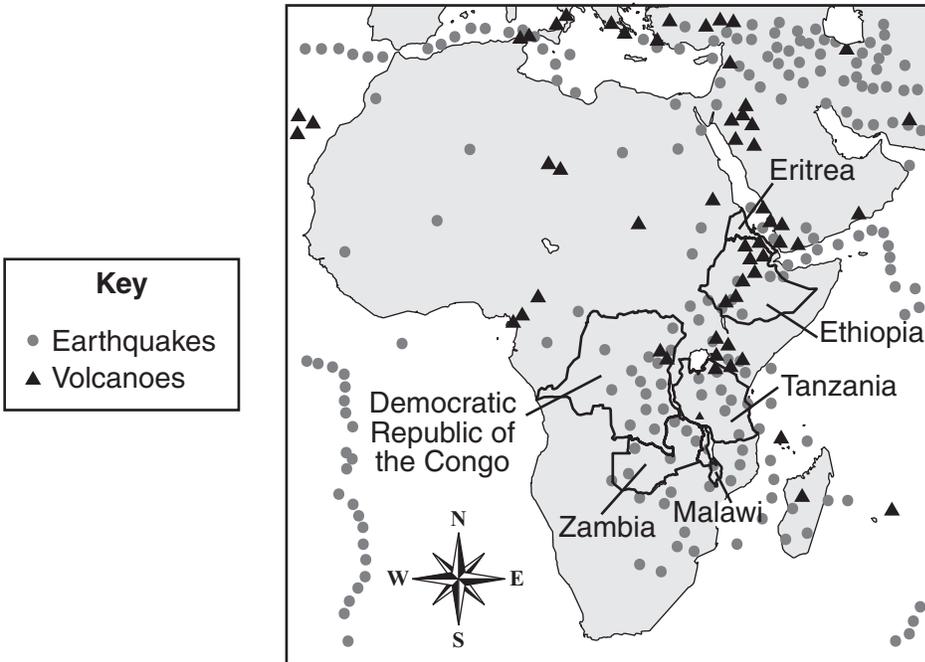
Sarah reviews the data tables and says, “These two data tables contain some helpful information, but some parts of the tables are unnecessary for the app. We cannot use these tables in our app without editing them. We should summarize the data.” The students work together to edit the data tables to only include the information that is important to Ali’s research question, “**Where are the most recent earthquakes and volcanic eruptions in eastern Africa located?**”

Answer question 6 on page 4 of your Student Answer Booklet.

- Identify which information in Data Tables 2 and 3 is the most important to answer Ali’s research question. Explain why the information you chose is important to include in the app.

Luke uses Data Tables 2 and 3 and additional data to create the diagram (Diagram 2) shown below.

**Diagram 2:
Earthquakes and Volcanoes in Africa**



Jacob says, “Diagram 2 reminds me of a research study I just read about.” Jacob finds the article on the Internet and explains, “Scientists collected rock samples from volcanoes in Tanzania and Ethiopia. These rocks were created during volcanic eruptions and still have volcanic gases trapped inside them. The scientists discovered that the gases are all made of the same material and are the same age. I wonder if a new plate boundary is forming in Africa.” The students decide to use their app to explain why there are many recent earthquakes and volcanoes in eastern Africa.

Answer question 7 on page 5 of your Student Answer Booklet.

7. Use the **Map Reference Sheet** and the information from the story to support Jacob’s idea that a new plate boundary is forming in Africa. Use evidence from Data Tables 2 and 3 and Diagram 2 to support your answer.

Jacob, Sarah, Ali, and Luke decide they have gathered enough information to create their app. Ms. Johnson tells them the next step is to learn the process of coding, which involves using a computer to create step-by-step commands to build the app. The students must also complete an entry form for the competition. The final question on the entry form says, “Describe how the app answers the question **How do data from scientific investigations provide evidence that Earth’s tectonic plates are moving?**”

Answer question 8 on page 6 of your Student Answer Booklet.

8. Identify **three** important pieces of information that would best help someone use the app to answer the research question “How do data from scientific investigations provide evidence that Earth’s tectonic plates are moving?” Describe how each piece of information will help support the goal of the app.

