SCIENCE GRADE 8

Spring Break Learning

March 10-14

2025

The Department of Curriculum & Instruction

Hello MSCS Family,

This resource packet was designed to provide students with activities that can be completed during the Spring Break Academy independently or with the guidance and supervision of family members or other adults. The activities are aligned to the TN Academic Standards for Science and will provide additional practice opportunities for students to develop and demonstrate their knowledge and understanding.

A suggested pacing guide is included; however, students can complete the activities in any order over three days. Below is a table of contents that lists each activity.

Table of Contents

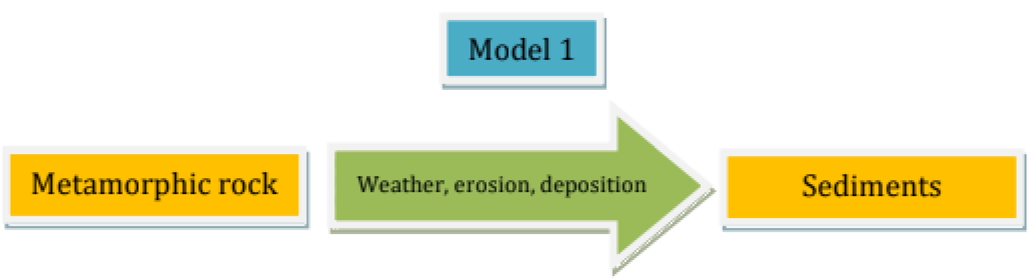
A View from Below	
Grade Level Standard(s)	8.ESS2.3 Describe the relationship between the processes and forces that create igneous, sedimentary, and metamorphic rocks. 8.ESS2.4 Gather and evaluate evidence that energy from the earth's interior drives convection cycles within the asthenosphere which create within the lithosphere include plate movements, plate boundaries, and sea floor spreading.
Caregiver Support Option	Provide support as needed with reading and discussing questions.
Materials Needed	writing utensil (pencil, paper, etc.)
Essential Question(s)	How do rocks form?
Student Directions	Directions for you to follow are provided. Answer any questions for which space is not provided on a separate sheet of paper.

Phenomenon: Evidence of ways that matter is cycled through the earth can be seen in even the biggest cities and busiest neighborhoods.

The picture shown here in New York City's Coney Island. The sand came from a 1.1-billion-year old metamorphic rock. A glacier broke the rock into pieces (sediments or sand) and moved it to this beach.

In this task, you will use what you know about the processes that change the earth to show evidence of billions of years of cycling matter through the earth that can be seen all over New York City.

Begin with the sand on Coney Island. To understand how this sand is an example of the cycling of matter, look at Model 1 below.



1. Describe what Model 1 shows about how matter was changed to form sand on Coney Island.

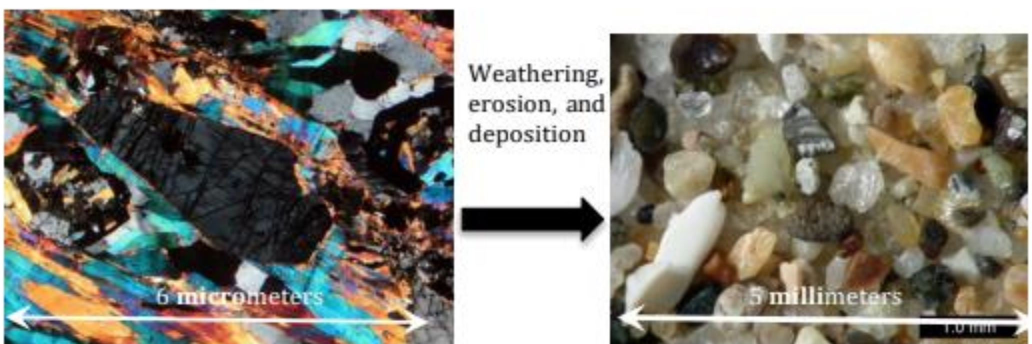
When you are exploring how rocks changed over time it can help to show changes at different scales. The models below show the changes that the Coney Island sand went through at a large scale and a small scale.

Large-scale model

An outcrop (solid rock) of metamorphic rock.

Sand on a beach.

Small scale model (pictures were taken through a microscope)



A metamorphic rock viewed through a microscope. The picture shows the different minerals that make up the rock.

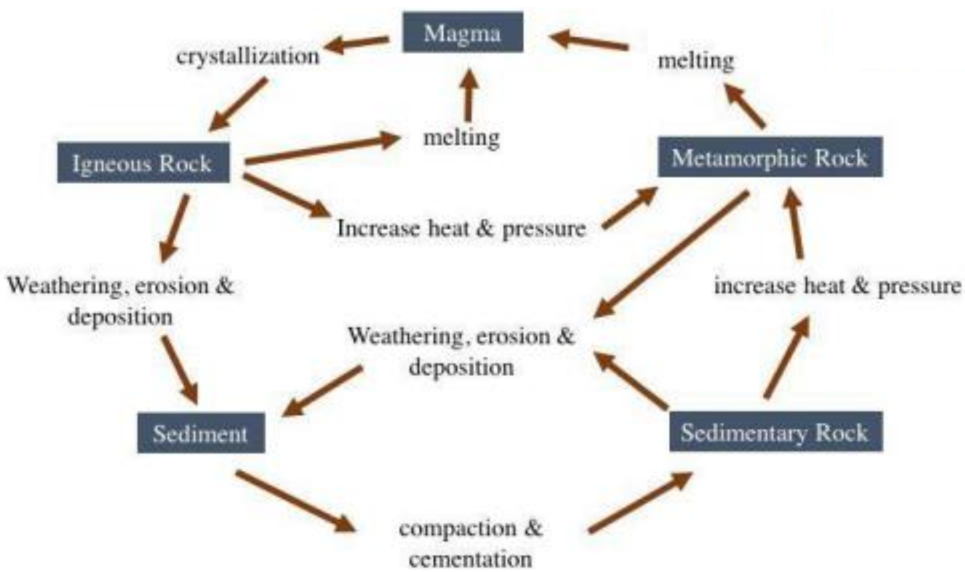
Grains of sand viewed through a microscope, showing the different rocks that make up the sand.

2. You have already used one kind of model to describe how matter changed. What new information can you get from examining models at different scales? Use evidence from the model to support your ideas.
   a. What does the large-scale model show about how the sand formed?
   b. What does the small-scale model show about how the sand formed?

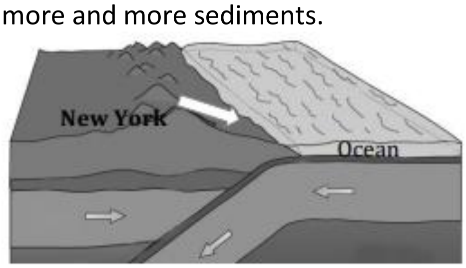
3. Glaciers changed some of the bedrock into sand in New York, but some bedrock is still there. In fact, most of the tall buildings in the city sit on parts of the 450-million-year old bedrock shown here, called Manhattan Schist.

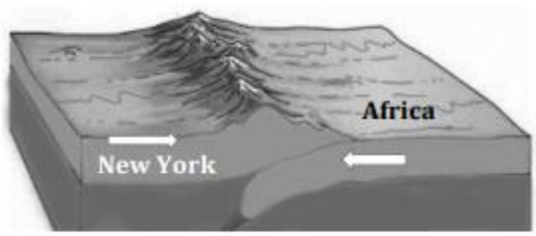
This rock did not always look the way it does today. Two processes that formed it are described in the table below. Answer the questions in the table to describe some of the ways matter was changed over time to form the Manhattan Schist.

Rock Cycle Model



Use the rock cycle model **above** to help you answer the questions in the second column of the table.

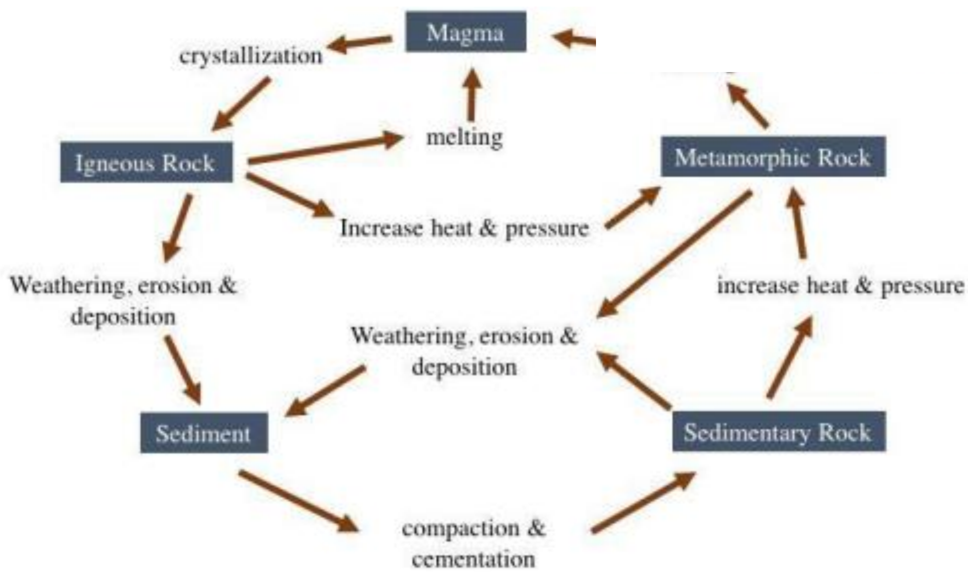
How the Manhattan Schist formed	**Analysis of changes**
Sediments were broken from the land by wind and water and were moved into the ocean at the edge of New York. The sediments were buried deeper under more and more sediments.  	What type of new rock formed? ______________________________________ What process caused the new rock to form? ______________________________________

Later, the African Plate began moving toward the North American Plate until the two continents collided. This collision compressed all of the rock at the edges of the continents, including the new rock that had formed under the ocean next to New York.  	What type of new rock formed? ____ What process caused the new rock to form? ____

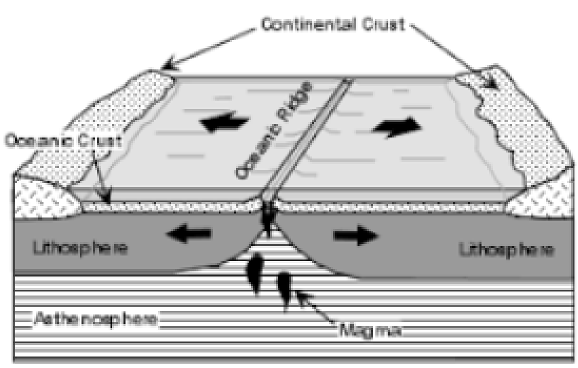
4. The processes that changed the rocks over time and eventually formed the Manhattan Schist are an example of the movement of matter through the earth system.

   Develop (draw) a model with arrows and labels that shows how matter was changed over time to form the Manhattan Schist. Your model should use the information you wrote in the table above.

5. The North Atlantic Ocean ranges from New York to Rhode Island. The Mid-Atlantic Ridge is a midocean ridge located along the floor of the Atlantic Ocean and part of the longest mountain range in the world. In the North Atlantic, the ridge separates the Eurasian and North American plates.



Use the rock cycle model **above** to help you answer the questions in the second column of the table.

<table>
<tr><th>How the Mid-Atlantic Ridge formed</th><th>Analysis of changes</th></tr>
<tr><td>As the North American and Eurasian plates slowly separate, they leave gaps in the earth's crust. This allows molten rock from beneath the earth's crust to reach the surface, forming a new part of the ocean floor.

</td><td>What type of new rock formed?
____

What process caused the new rock to form?
____</td></tr>
</table>

Explain (in words and/or a model) what caused the North American and Eurasian plates to separate and form new ocean floor.

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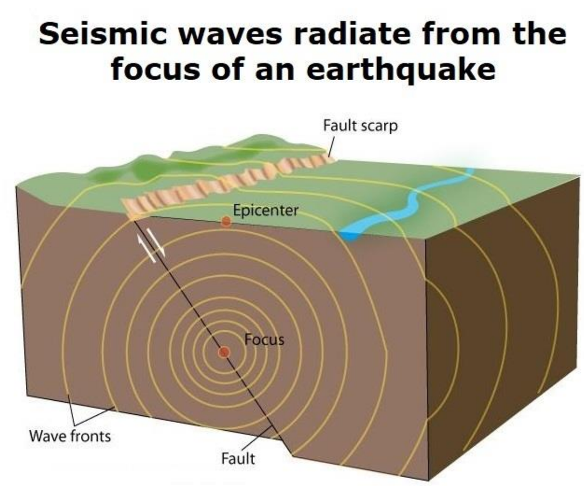
What's Inside?	
Grade Level Standard(s)	**8.ESS2.2** Evaluate data collected from seismographs to create a model of Earth's structure.
Caregiver Support Option	Provide support as needed with reading and discussing questions.
Materials Needed	writing utensil (pencil, pen, etc.)
Essential Question(s)	What is known about Earth's interior?
Student Directions	Directions are provided for you to follow. Answer any questions for which space is not provided on a separate sheet of paper.

Background Information

When an earthquake occurs, the shockwaves of released energy that shake the Earth and temporarily turn soft deposits, such as clay, into jelly (liquefaction) are called seismic waves, from the Greek 'seismos' meaning 'earthquake'. Seismic waves are usually generated by movements of the Earth's tectonic plates but may also be caused by explosions, volcanoes and landslides.



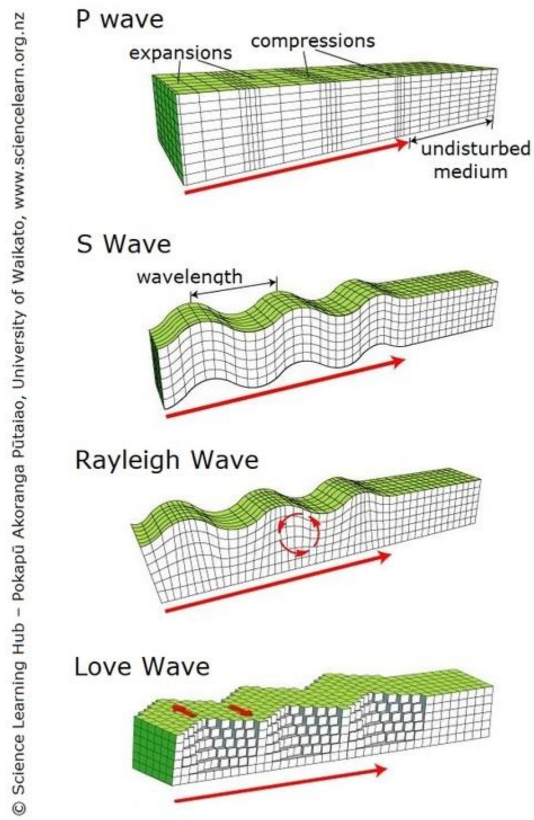
Seismologists use seismographs to record the amount of time it takes seismic waves to travel through different layers of the Earth. As the waves travel through different densities and stiffness, the waves can be refracted and reflected. Because of the different behavior of waves in different materials, seismologists can deduce the type of material the waves are traveling through.

The results can provide a snapshot of the Earth's internal structure and help us to locate and understand fault planes and the stresses and strains acting on them.

This wave behavior can also be used on a smaller scale by recording waves generated by explosions or ground vibrators in the search for oil and gas.

Types of seismic waves

There are three basic types of seismic waves – P-waves, S-waves, and surface waves. P-waves and S-waves are sometimes collectively called body waves.



P-waves

P-waves, also known as primary waves or pressure waves, travel at the greatest velocity through the Earth. When they travel through the air, they take the form of sound waves – they travel at the speed of sound (330 ms^{-1}) through the air but may travel at 5000 ms^{-1} in granite. Because of their speed, they are the first waves to be recorded by a seismograph during an earthquake.

They differ from S-waves in that they propagate through a material by alternately compressing and expanding the medium, where particle motion is parallel to the direction of wave propagation – this is rather like a slinky that is partially stretched and laid flat, and its coils are compressed at one end and then released.

S-waves

S-waves, also known as secondary waves, shear waves, or shaking waves, are transverse waves that travel slower than P-waves. In this case, particle motion is perpendicular to the direction of wave propagation. Again, imagine a slinky partially stretched, except this time, lift a section and then release it, a transverse wave will travel along the length of the slinky.

Earth waves

Seismic waves are waves that travel through or over Earth. They are usually generated by movements of the Earth's tectonic plates (earthquakes) but may also be caused by explosions, volcanoes, and landslides. They can tell us much about the Earth's structure.

S-waves cannot travel through air or water but are more destructive than P-waves because of their larger amplitudes

Surface waves

Surface waves are similar in nature to water waves and travel just under the Earth's surface. They are typically generated when the source of the earthquake is close to the Earth's surface. Although surface waves travel more slowly than S-waves, they can be much larger in amplitude and can be the most destructive type of seismic wave. There are two basic kinds of surface waves:

- Rayleigh waves, also called ground roll, travel as ripples similar to those on the surface of water. People have claimed to have observed Rayleigh waves during an earthquake in open spaces, such as parking lots where the cars move up and down with the waves.
- Love waves cause horizontal shearing of the ground. They usually travel slightly faster than Rayleigh waves

What can seismic waves tell us?

Studies of the different types of seismic waves can tell us much about the nature of the Earth's structure. For example, seismologists can use the direction and the difference in the arrival times between P-waves and S-waves to determine the distance to the source of an earthquake. If the seismographs are too far away from the event to record S-waves, several recordings of P-waves can be crunched in a computer program to give an approximate location of the source.

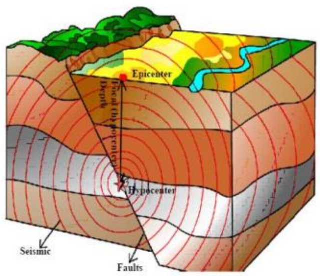


Figure 1. Seismic waves traveling from the origin or focus of the earthquake through the earth.

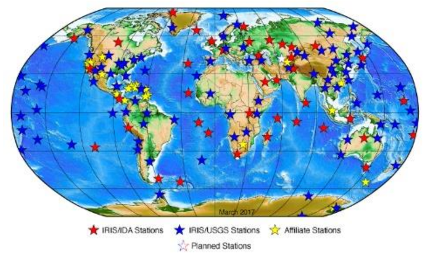


Figure 2. Locations of seismograph stations around the world.

Part 1: Analyzing Seismic Data

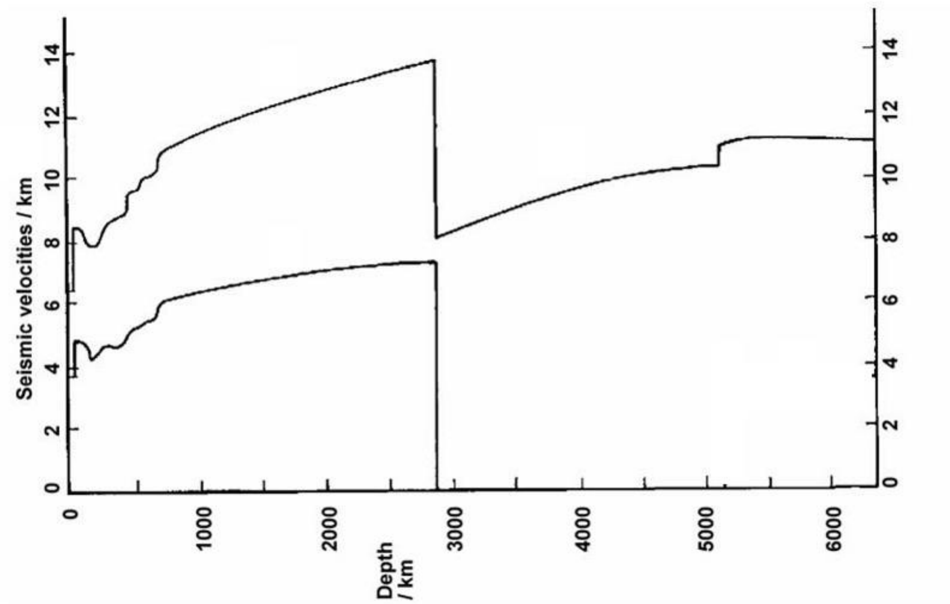
1. Analyze the data in the table and draw lines between depths where you see changes in the pattern of the speed of the wave.

Seismic P and S Wave Data

Wave Type	Depth (km)	Speed (km/s)	Wave Type	Depth (km)	Speed (km/s)
P	0	6	S	0	3.5
P	50	9	S	50	5
P	200	8	S	200	4
P	500	9	S	500	5
P	1000	11	S	1000	6
P	2000	13	S	2000	7
P	2900	14	S	2900	7.5
P	2900	8	S	2900	0
P	4000	9	S	4000	-----------
P	5200	10	S	5200	-----------
P	5200	11	S	5200	-----------
P	5500	11	S	5500	-----------
P	6000	11	S	6000	-----------

P	6400	11		S	6400	-----------

2. Analyze the graph and draw vertical dotted/dashed lines through the graph where you see changes in the pattern of the speed of the waves. Make sure to look at the depth at which these speeds change.



3. Decide on a design for a model for the composition of the Earth's layers in the form of a two-dimensional diagram and draw it below or on separate paper. The layers should be drawn proportionally correct (within reason and estimations), and each layer should be labeled.

Part 2: Seismologists: Determining the Layers of the Earth

1. Based on the data that was provided, what patterns or changes in patterns did you see?
____
____
____

2. How did these patterns help you develop your model?
____
____
____

3. Which model of the Earth below is more accurate according to our data and why?

Model A

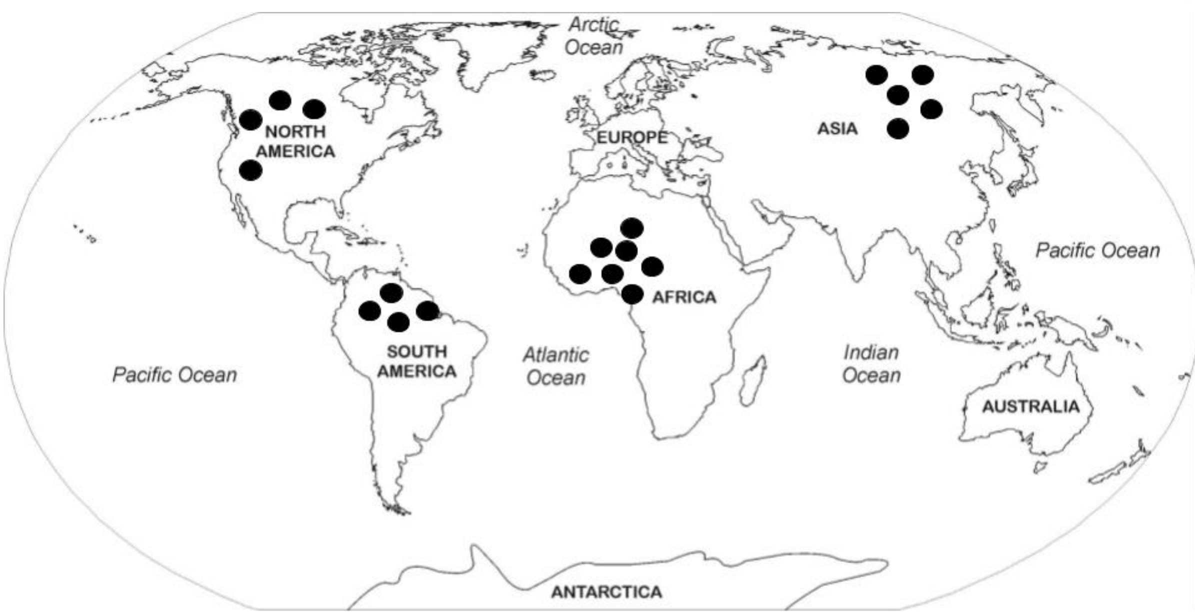
Model B

____
____
____

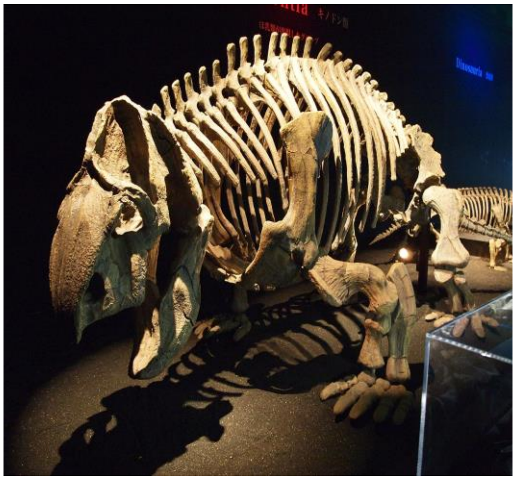
4. What is another model of the Earth you could use?
____
____

Traveling Kannemeyeria	
Grade Level Standard(s)	**8.ESS2.5** Construct a scientific explanation using data that explains that the gradual processes of plate tectonic accounting for A) the distribution of fossils on different continents, B) the occurrence of earthquakes, and C) continental and ocean floor features (including mountains, volcanoes, faults, and trenches).
Caregiver Support Option	Provide support as needed with reading and discussing questions.
Materials Needed	writing utensil (pencil, pen, etc.)
Essential Question(s)	How and why is Earth constantly changing? What is plate tectonics?
Student Directions	Directions are provided for you to follow. Answer any questions for which space is not provided on a separate sheet of paper.

One of the greatest survivors in all of Earth's history was a humble creature named *Kannemeyerid (Kannemeyeria in groups)*. Fossils of Kannemeyeria are currently found in rock layers across North America, South America, Africa, and Asia.

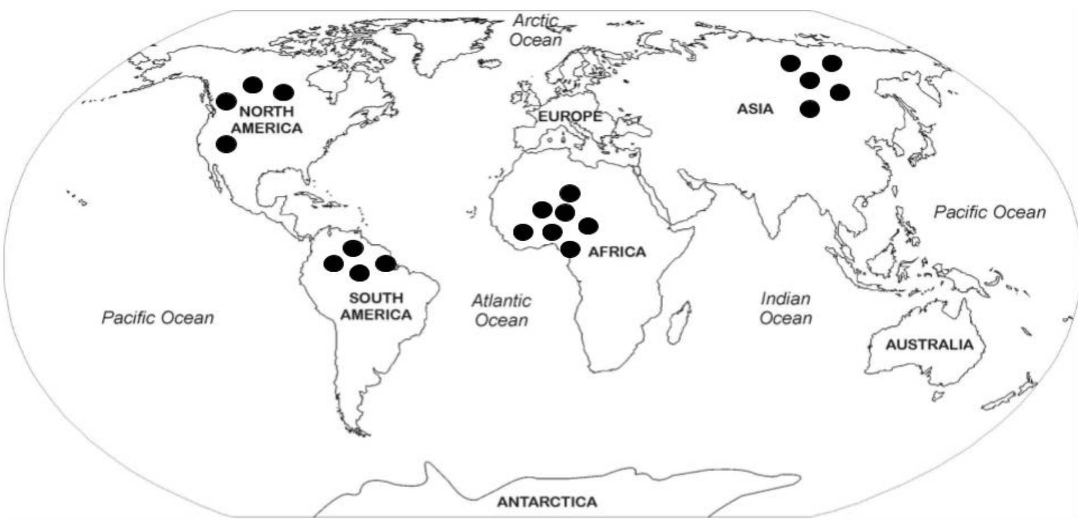


The dots on the map above show the current location of most Kannemeyeria fossils.



Kannemeyeria are extinct therapsid (mammal-like reptiles) that lived approximately 250 million to 230 million years ago, during the Early to Middle Triassic Period. Data from the fossils describe Kannemeyeria as herbivores (plant eaters). They were about the size of an ox or large cow, about 3 meters long, and weighed approximately 90 kg (about 200 pounds). Kannemeyeria were land-dwellers that traveled throughout plains and swamps. They stayed in warm, dry climates ***close to the equator*.** Finding these fossils in so many places is very puzzling, especially since these continents are all separated by oceans and do not all have warm, dry climates.

The locations of the fossils of Kannemeyeria show an interesting pattern. The ● images on the map represent the Kannemeyeria fossils. Examine the image below to collect evidence of this pattern.



Fossil Key
Kannemeyeria Fossils

●

1. What do you observe about the Kannemeyeria fossils above and the pattern of fossil distribution from the map above?

____
____
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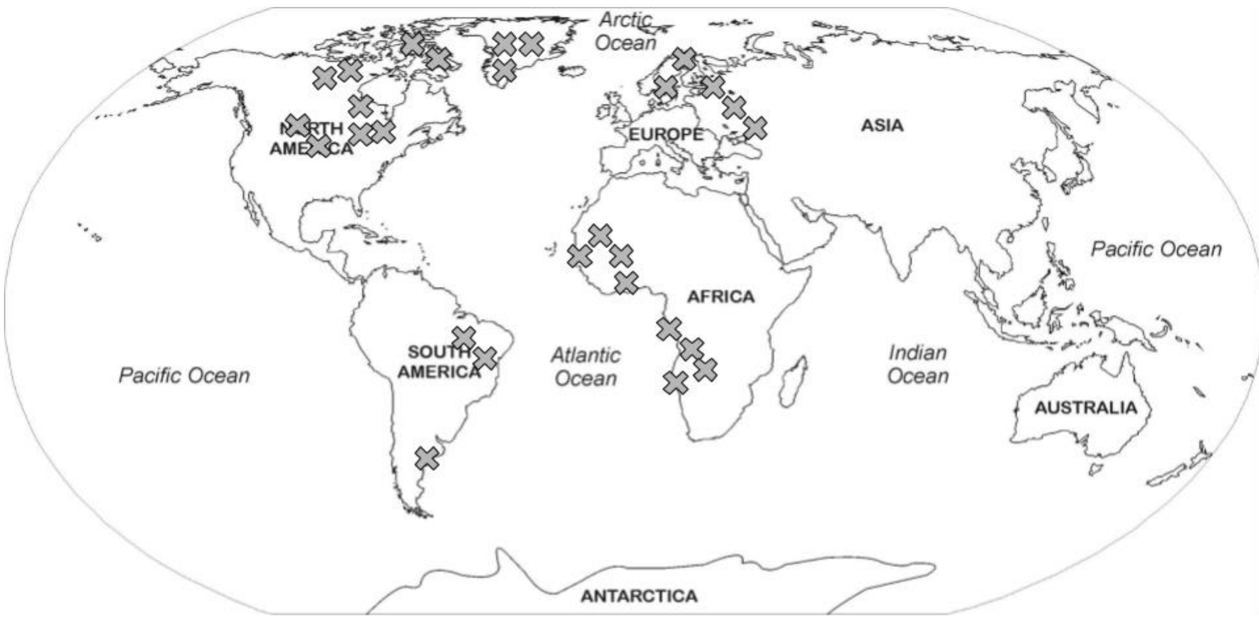
____

How could the Kannemeyeria, which were land dwelling animals, have traveled to these different continents if they were unable to swim? Explain.

____
____
____
____

Rock types near and around the location of the fossils of Kannemeyeria show an interesting pattern. The "X" images on the map represent the same rock types. Examine the image below to collect evidence of this pattern.



Fossil/Rock Key

Common Rock Types

2. What patterns do you notice in the locations of the matching rock types? What could cause these particular patterns?

   Evidence (Patterns):

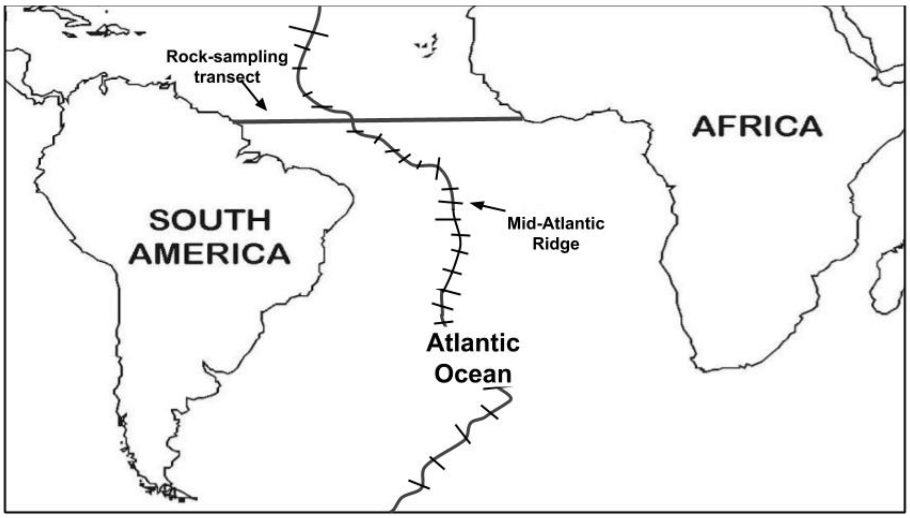
   ____
   ____
   ____

   Evidence (Cause):

   ____
   ____
   ____

Diagram 1 below shows data from an investigation in which scientists sampled rocks along a transect, a straight line of travel, across the Mid-Atlantic Ridge from South America to Africa. Data Table 1 shows the data collected from this investigation.

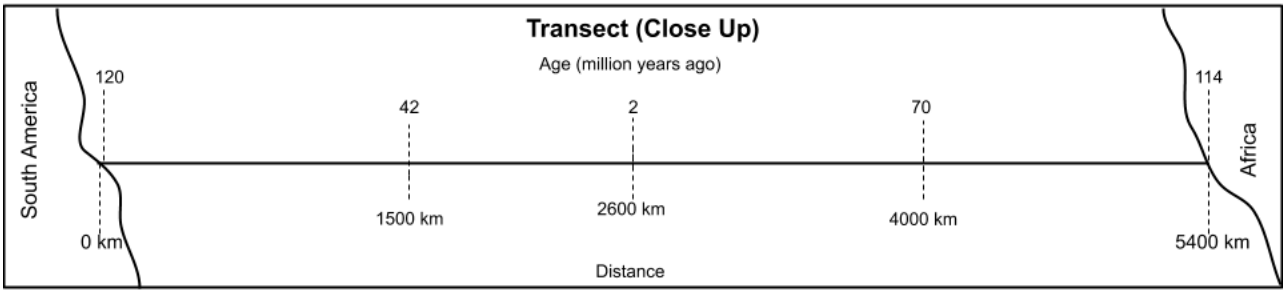
Diagram 1



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

Some of the data from Data Table 1 is plotted along the transect below. Use the data table information and the transect below to describe the pattern of the age of the Atlantic Ocean floor from South America to Africa. What pattern can you observe?



3. What pattern can you observe? Evidence (Patterns)

____
____
____

What caused these patterns to occur? Evidence (Cause)

____
____
____

4. Construct an explanation to describe how Kannemeyeria fossils have been found in such varied locations. Be sure to include the evidence you collected about Kannemeyeria fossils being found in such varied locations, rock type locations, and the pattern of seafloor rock ages between South America and Africa as evidence in your explanation.

____
____
____
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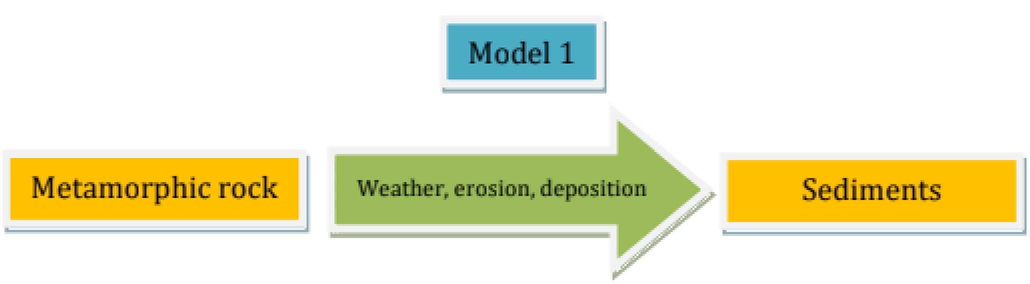
A View from Below	
Grade Level Standard(s)	8.ESS2.3 Describe the relationship between the processes and forces that create igneous, sedimentary, and metamorphic rocks. 8.ESS2.4 Gather and evaluate evidence that energy from the earth's interior drives convection cycles within the asthenosphere which create within the lithosphere include plate movements, plate boundaries, and sea floor spreading.
Caregiver Support Option	Provide support as needed with reading and discussing questions.
Materials Needed	writing utensil (pencil, paper, etc.)
Essential Question(s)	How do rocks form?
Student Directions	Directions for you to follow are provided. Answer any questions for which space is not provided on a separate sheet of paper.

Phenomenon: Evidence of ways that matter is cycled through the earth can be seen in even the biggest cities and busiest neighborhoods.

The picture shown here in New York City's Coney Island. The sand came from a 1.1-billion-year old metamorphic rock. A glacier broke the rock into pieces (sediments or sand) and moved it to this beach.

In this task, you will use what you know about the processes that change the earth to show evidence of billions of years of cycling matter through the earth that can be seen all over New York City.

Begin with the sand on Coney Island. To understand how this sand is an example of the cycling of matter, look at Model 1 below.



1. Describe what Model 1 shows about how matter was changed to form sand on Coney Island.
   Weathering caused the metamorphic rock to change into sediments. Erosion carried the rocks. Deposition settled the sand on Coney Island Beach.

When you are exploring how rocks changed over time it can help to show changes at different scales. The models below show the changes that the Coney Island sand went through at a large scale and a small scale.

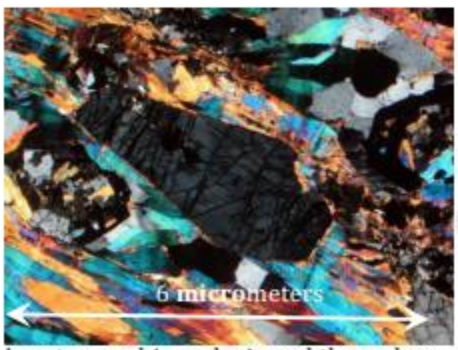
Large-scale model

An outcrop (solid rock) of metamorphic rock.

Weathering, erosion, and deposition

Sand on a beach.

Small scale model (pictures were taken through a microscope)



A metamorphic rock viewed through a microscope. The picture shows the different minerals that make up the rock.

Weathering, erosion, and deposition

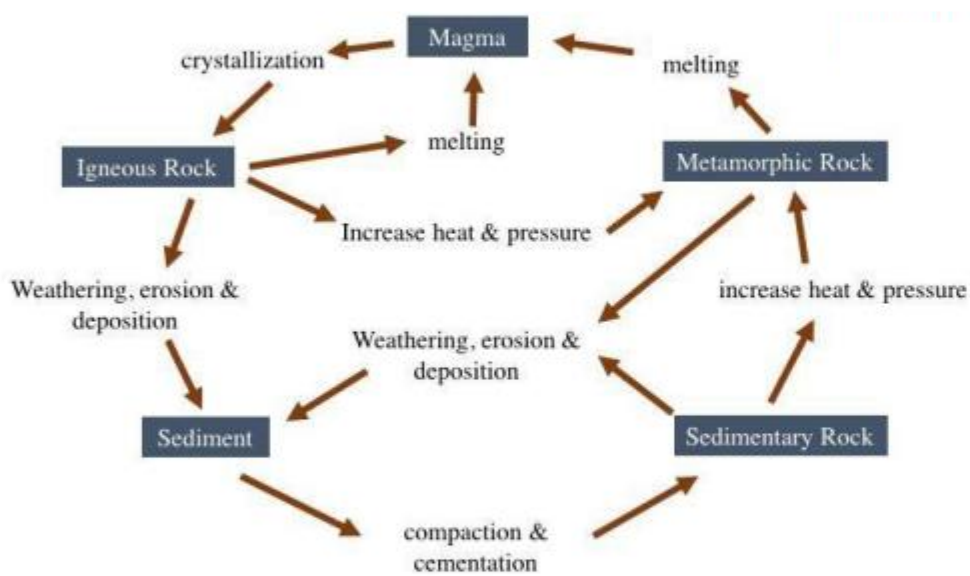
Grains of sand viewed through a microscope, showing the different rocks that make up the sand.

2. You have already used one kind of model to describe how matter changed. What new information can you get from examining models at different scales? Use evidence from the model to support your ideas.
   a. What does the large-scale model show about how the sand formed?
      The big model can help me show that the sand on the beach is made of tiny pieces of a metamorphic rock that was broken down and moved to the beach by weathering, erosion, and deposition.
   b. What does the small-scale model show about how the sand formed?
      The small model helps me show that the metamorphic rock is made out of many different minerals and the sand made from weathering that rock is made of those same minerals.

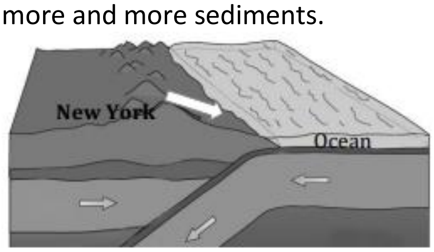
3. Glaciers changed some of the bedrock into sand in New York, but some bedrock is still there. In fact, most of the tall buildings in the city sit on parts of the 450-million-year old bedrock shown here, called Manhattan Schist.

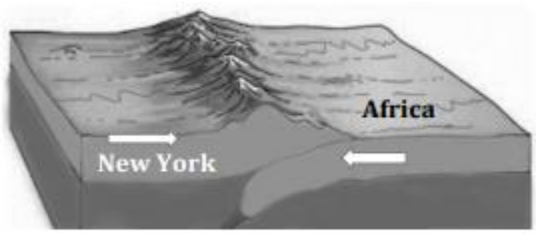
This rock did not always look the way it does today. Two processes that formed it are described in the table below. Answer the questions in the table to describe some of the ways matter was changed over time to form the Manhattan Schist.

Rock Cycle Model



Use the rock cycle model **above** to help you answer the questions in the second column of the table.

How the Manhattan Schist formed	Analysis of changes
Sediments were broken from the land by wind and water and were moved into the ocean at the edge of New York. The sediments were buried deeper under more and more sediments.  	What type of new rock formed? metamorphic rock What process caused the new rock to form? Temperature increases (heat) can be caused by layers of sediments being buried deeper and deeper under the surface of the Earth. The great weight of these layers also causes an increase in pressure. Ultimately, heat and pressure formed the metamorphic rock.

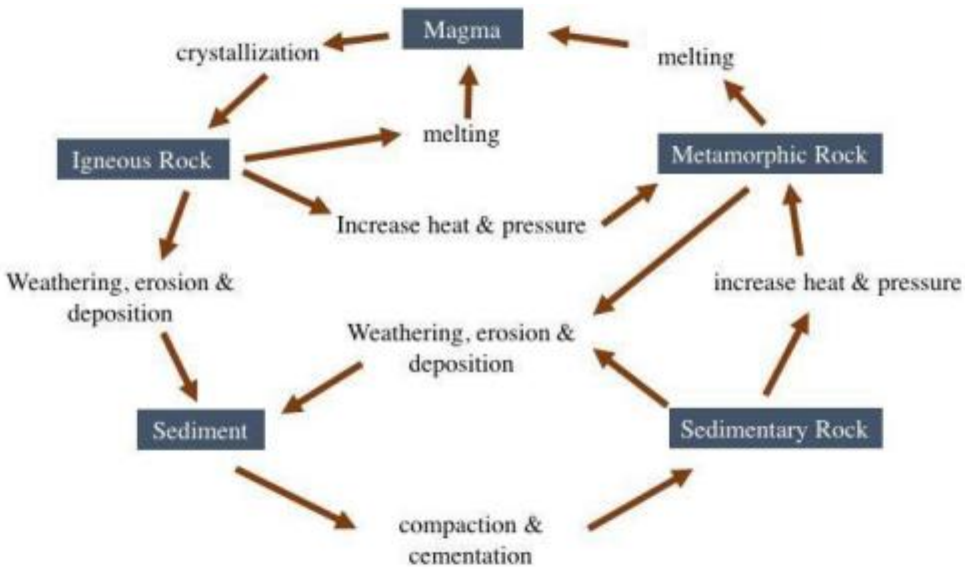
Later, the African Plate began moving toward the North American Plate until the two continents collided. This collision compressed all of the rock at the edges of the continents, including the new rock that had formed under the ocean next to New York.  	What type of new rock formed? <u>metamorphic rock</u> What process caused the new rock to form? <u>Metamorphic rocks are most abundant at convergent plate boundaries but can occur in other areas where there are increased pressures and/or temperatures (heat and pressure).</u>

4. The processes that changed the rocks over time and eventually formed the Manhattan Schist are an example of the movement of matter through the earth system.

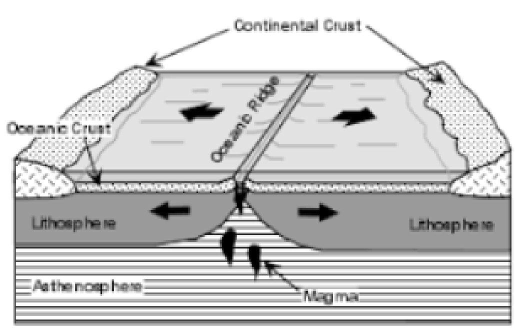
   Develop (draw) a model with arrows and labels that shows how matter was changed over time to form the Manhattan Schist. Your model should use the information you wrote in the table above.

   Model is complete, accurately and clearly representing all of the changes to the rock and the processes that drove them AND the model presents the changes in a sequence that accurately demonstrates the changes to matter over time.

5. The North Atlantic Ocean ranges from New York to Rhode Island. The Mid-Atlantic Ridge is a midocean ridge located along the floor of the Atlantic Ocean and part of the longest mountain range in the world. In the North Atlantic, the ridge separates the Eurasian and North American plates.



Use the rock cycle model **above** to help you answer the questions in the second column of the table.

How the Mid-Atlantic Ridge formed	**Analysis of changes**
As the North American and Eurasian plates slowly separate, they leave gaps in the earth's crust. This allows molten rock from beneath the earth's crust to reach the surface, forming a new part of the ocean floor. 	What type of new rock formed? igneous rock What process caused the new rock to form? Magma rose from the gaps in the earth's crust and was cooled by the ocean water and crystalized/hardened into igneous rock.

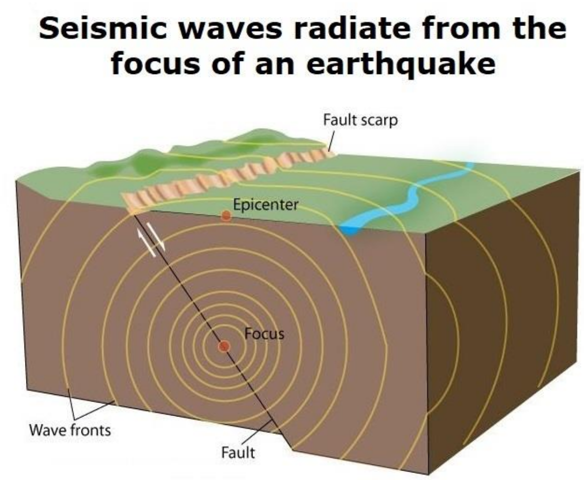
Explain (in words and/or a model) what caused the North American and Eurasian plates to separate and form new ocean floor.

Convection currents in the asthenosphere caused the North American and Eurasian plates to separate and form new ocean floor. The circular motion of the cycling asthenosphere drags the plates that make up Earth's floating lithospheres. The floating plates are moved together or apart at boundaries. Where plates move apart, liquid rock from earth's interior reaches the surface and solidifies.

What's Inside?	
Grade Level Standard(s)	**8.ESS2.2** Evaluate data collected from seismographs to create a model of Earth's structure.
Caregiver Support Option	Provide support as needed with reading and discussing questions.
Materials Needed	writing utensil (pencil, pen, etc.)
Essential Question(s)	What is known about Earth's interior?
Student Directions	Directions are provided for you to follow. Answer any questions for which space is not provided on a separate sheet of paper.

Background Information

When an earthquake occurs, the shockwaves of released energy that shake the Earth and temporarily turn soft deposits, such as clay, into jelly (liquefaction) are called seismic waves, from the Greek 'seismos' meaning 'earthquake'. Seismic waves are usually generated by movements of the Earth's tectonic plates but may also be caused by explosions, volcanoes and landslides.

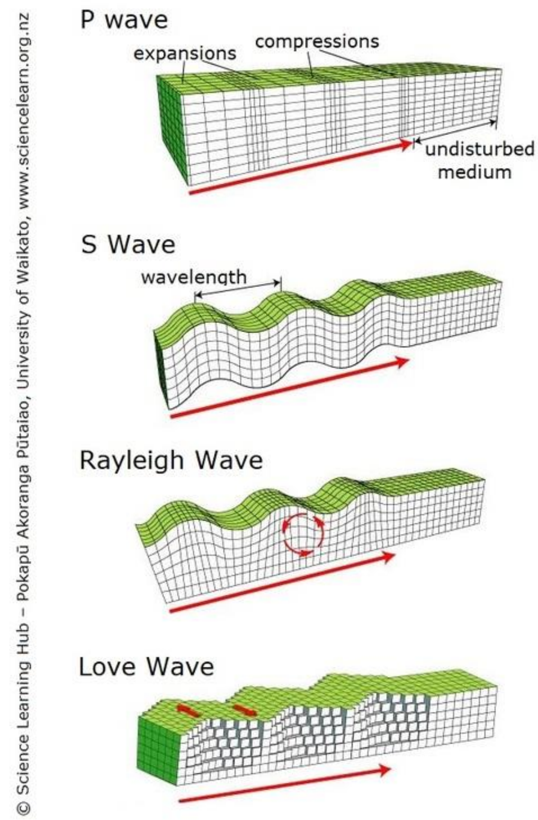


Seismologists use seismographs to record the amount of time it takes seismic waves to travel through different layers of the Earth. As the waves travel through different densities and stiffness, the waves can be refracted and reflected. Because of the different behavior of waves in different materials, seismologists can deduce the type of material the waves are traveling through.

The results can provide a snapshot of the Earth's internal structure and help us to locate and understand fault planes and the stresses and strains acting on them.

This wave behavior can also be used on a smaller scale by recording waves generated by explosions or ground vibrators in the search for oil and gas.

Types of seismic waves
There are three basic types of seismic waves – P-waves, S-waves, and surface waves. P-waves and S-waves are sometimes collectively called body waves.



P-waves
P-waves, also known as primary waves or pressure waves, travel at the greatest velocity through the Earth. When they travel through the air, they take the form of sound waves – they travel at the speed of sound (330 ms^{-1}) through the air but may travel at 5000 ms^{-1} in granite. Because of their speed, they are the first waves to be recorded by a seismograph during an earthquake.

They differ from S-waves in that they propagate through a material by alternately compressing and expanding the medium, where particle motion is parallel to the direction of wave propagation – this is rather like a slinky that is partially stretched and laid flat, and its coils are compressed at one end and then released.

S-waves
S-waves, also known as secondary waves, shear waves, or shaking waves, are transverse waves that travel slower than P-waves. In this case, particle motion is perpendicular to the direction of wave propagation. Again, imagine a slinky partially stretched, except this time, lift a section and then release it, a transverse wave will travel along the length of the slinky.

Earth waves
Seismic waves are waves that travel through or over Earth. They are usually generated by movements of the Earth's tectonic plates (earthquakes) but may also be caused by explosions, volcanoes, and landslides. They can tell us much about the Earth's structure.

S-waves cannot travel through air or water but are more destructive than P-waves because of their larger amplitudes

Surface waves
Surface waves are similar in nature to water waves and travel just under the Earth’s surface. They are typically generated when the source of the earthquake is close to the Earth’s surface. Although surface waves travel more slowly than S-waves, they can be much larger in amplitude and can be the most destructive type of seismic wave. There are two basic kinds of surface waves:

- Rayleigh waves, also called ground roll, travel as ripples similar to those on the surface of water. People have claimed to have observed Rayleigh waves during an earthquake in open spaces, such as parking lots where the cars move up and down with the waves.
- Love waves cause horizontal shearing of the ground. They usually travel slightly faster than Rayleigh waves

What can seismic waves tell us?
Studies of the different types of seismic waves can tell us much about the nature of the Earth's structure. For example, seismologists can use the direction and the difference in the arrival times between P-waves and S-waves to determine the distance to the source of an earthquake. If the seismographs are too far away from the event to record S-waves, several recordings of P-waves can be crunched in a computer program to give an approximate location of the source.

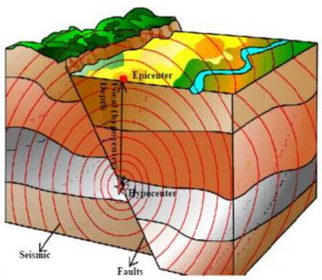


Figure 1. Seismic waves traveling from the origin or focus of the earthquake through the earth.

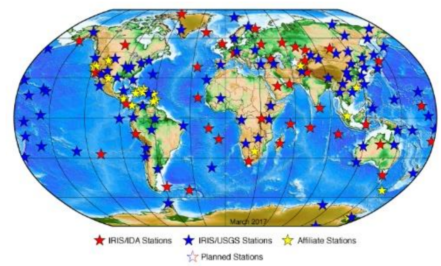


Figure 2. Locations of seismograph stations around the world.

Part 1: Analyzing Seismic Data

1. Analyze the data in the table and draw lines between depths where you see changes in the pattern of the speed of the wave.

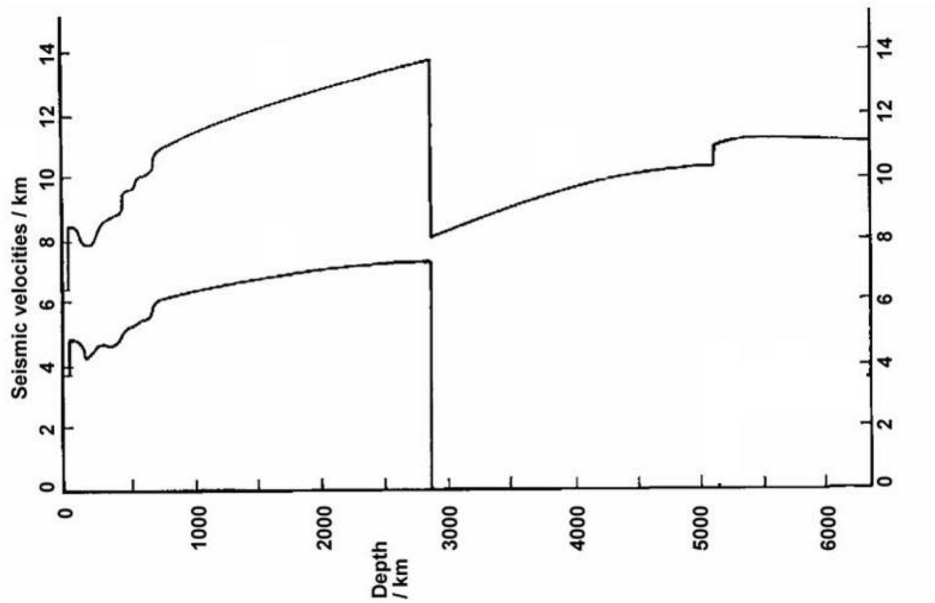
Seismic P and S Wave Data

Wave Type	Depth (km)	Speed (km/s)
P	0	6
P	50	9
P	200	8
P	500	9
P	1000	11
P	2000	13
P	2900	14
P	2900	8
P	4000	9
P	5200	10
P	5200	11
P	5500	11
P	6000	11
P	6400	11

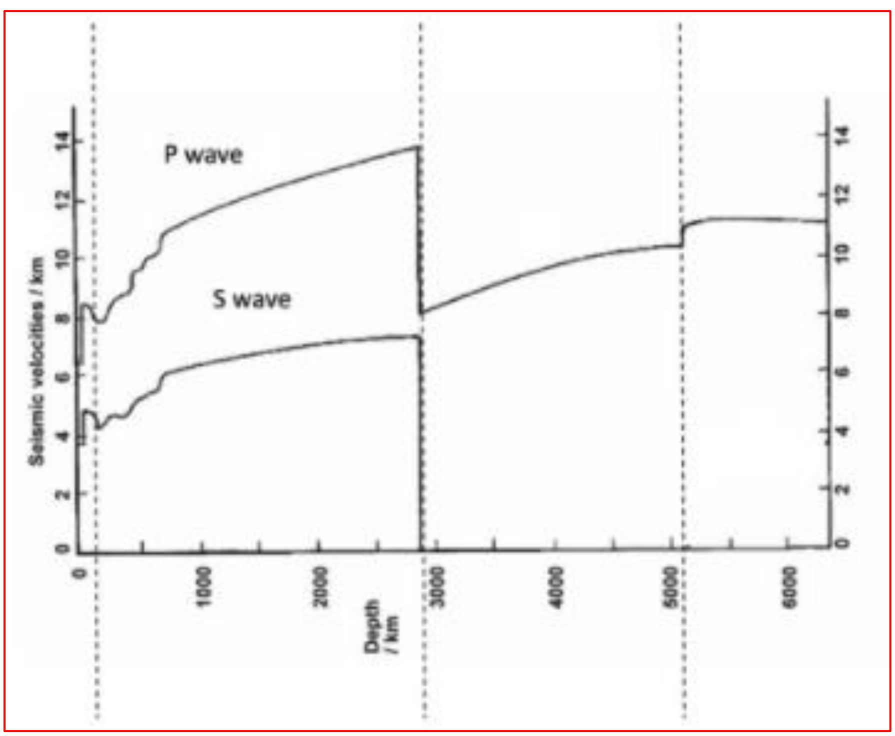
Wave Type	Depth (km)	Speed (km/s)
S	0	3.5
S	50	5
S	200	4
S	500	5
S	1000	6
S	2000	7
S	2900	7.5
S	2900	0
S	4000	-----------
S	5200	-----------
S	5200	-----------
S	5500	-----------
S	6000	-----------
S	6400	-----------

Lines should be drawn between the depths of 50 km and 2900 km for both S and P waves. Another line should be drawn for P waves between depths of 5200 km, 10 km/s and 5200 km, 11 km/s. Students may need prompting to compare graph to chart data here, as the data can be confusing that the speed changes in the same depth range. It becomes clearer on the graph when the increase in speed is more noticeable.

2. Analyze the graph and draw vertical dotted/dashed lines through the graph where you see changes in the pattern of the speed of the waves. Make sure to look at the depth at which these speeds change.



Vertical lines should be drawn like the following graph.



3. Decide on a design for a model for the composition of the Earth's layers in the form of a two-dimensional diagram and draw it below or on separate paper. The layers should be drawn proportionally correct (within reason and estimations), and each layer should be labeled.

   Student designs may vary.

Part 2: Seismologists: Determining the Layers of the Earth

1. Based on the data that was provided, what patterns or changes in patterns did you see?
   P waves travel faster than S waves. There is an increase in speed for both types of waves until 50 km. There is another increase in speed for both waves until 2900 km when the speed of the P wave decreases dramatically. At 2900 km, the S wave stops. At 5200 km, the P wave speed increases by 1 km and stays constant as depth increases.

2. How did these patterns help you develop your model?
   Both types of waves change speed when they change the medium they travel through, so changes in speed would mean there is a new layer the wave is traveling through. The S wave stops at 2900 km showing that S waves do not travel through liquids so this layer is probably a liquid. When the P wave speeds up again at 5200 km, there is probably another layer.

3. Which model of the Earth below is more accurate according to our data and why?

Model A

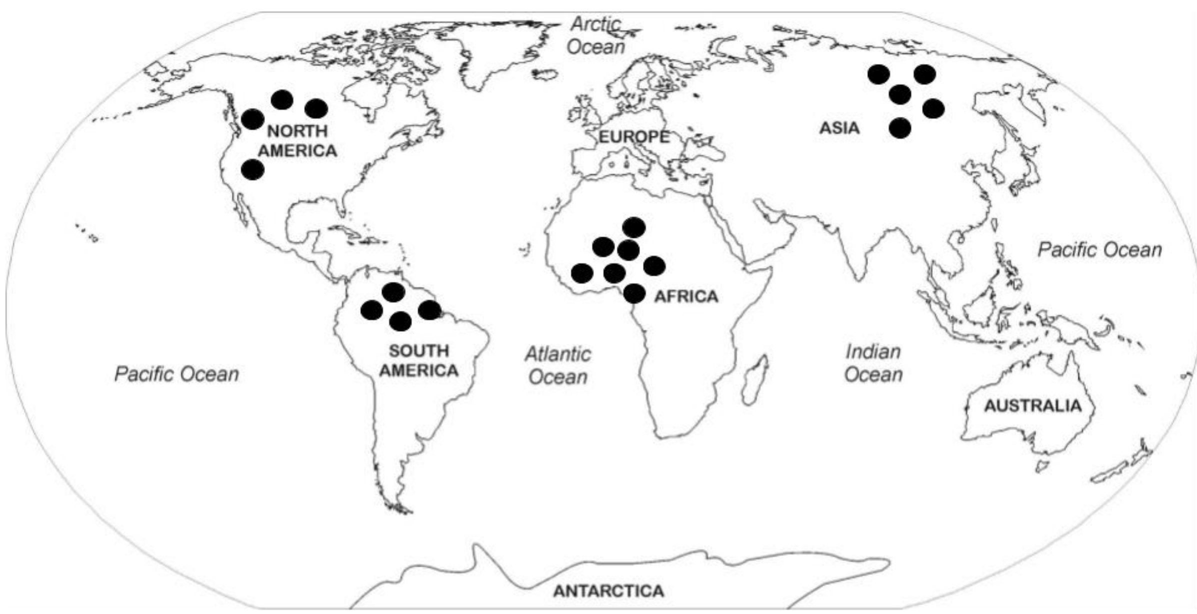
Model B

   Students should choose model A but give reasoning supported with evidence that the depths at which the waves changed speeds are not equal and are better represented by model A.

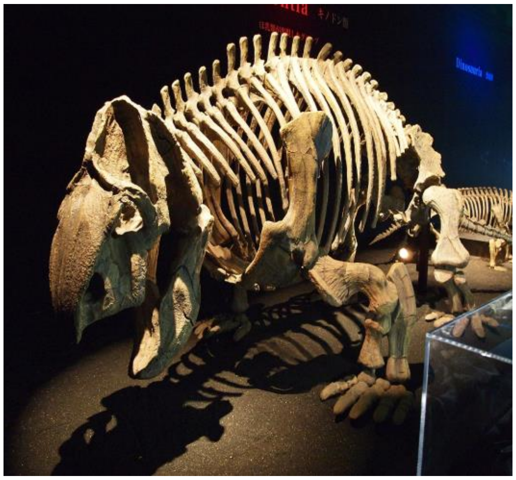
4. What is another model of the Earth you could use?
   Students may suggest representative models, such as a hard boiled egg, a birthday cake, etc., that have similarities in layers to Earth's layers. They may want to create a clay model or draw the model again more three-dimensionally.

Traveling Kannemeyeria	
Grade Level Standard(s)	**8.ESS2.5** Construct a scientific explanation using data that explains that the gradual processes of plate tectonic accounting for A) the distribution of fossils on different continents, B) the occurrence of earthquakes, and C) continental and ocean floor features (including mountains, volcanoes, faults, and trenches).
Caregiver Support Option	Provide support as needed with reading and discussing questions.
Materials Needed	writing utensil (pencil, pen, etc.)
Essential Question(s)	How and why is Earth constantly changing? What is plate tectonics?
Student Directions	Directions are provided for you to follow. Answer any questions for which space is not provided on a separate sheet of paper.

One of the greatest survivors in all of Earth's history was a humble creature named *Kannemeyerid (Kannemeyeria in groups)*. Fossils of Kannemeyeria are currently found in rock layers across North America, South America, Africa, and Asia.

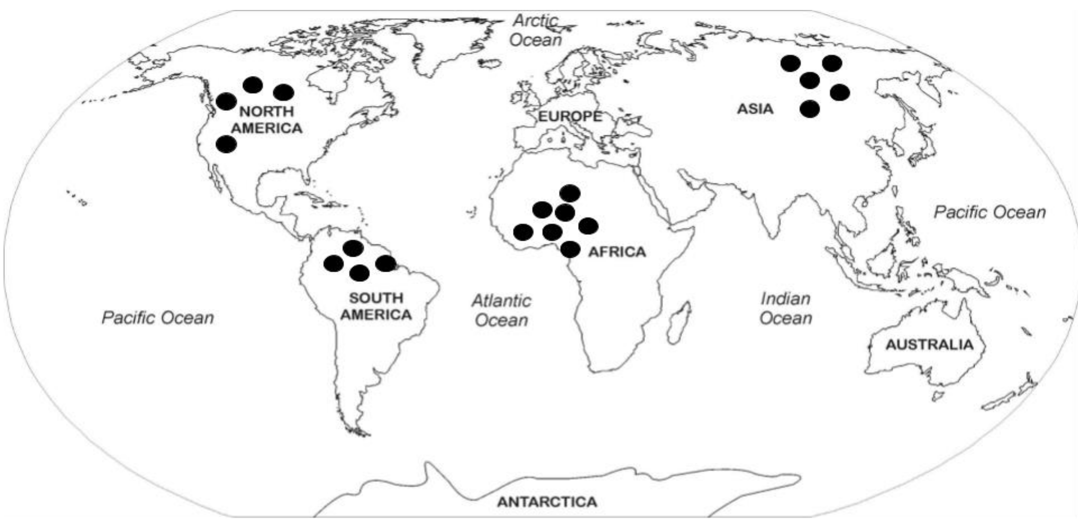


The dots on the map above show the current location of most Kannemeyeria fossils.



Kannemeyeria are extinct therapsid (mammal-like reptiles) that lived approximately 250 million to 230 million years ago, during the Early to Middle Triassic Period. Data from the fossils describe Kannemeyeria as herbivores (plant eaters). They were about the size of an ox or large cow, about 3 meters long, and weighed approximately 90 kg (about 200 pounds). Kannemeyeria were land-dwellers that traveled throughout plains and swamps. They stayed in warm, dry climates ***close to the equator.*** Finding these fossils in so many places is very puzzling, especially since these continents are all separated by oceans and do not all have warm, dry climates.

The locations of the fossils of Kannemeyeria show an interesting pattern. The ● images on the map represent the Kannemeyeria fossils. Examine the image below to collect evidence of this pattern.



Fossil Key

Kannemeyeria Fossils

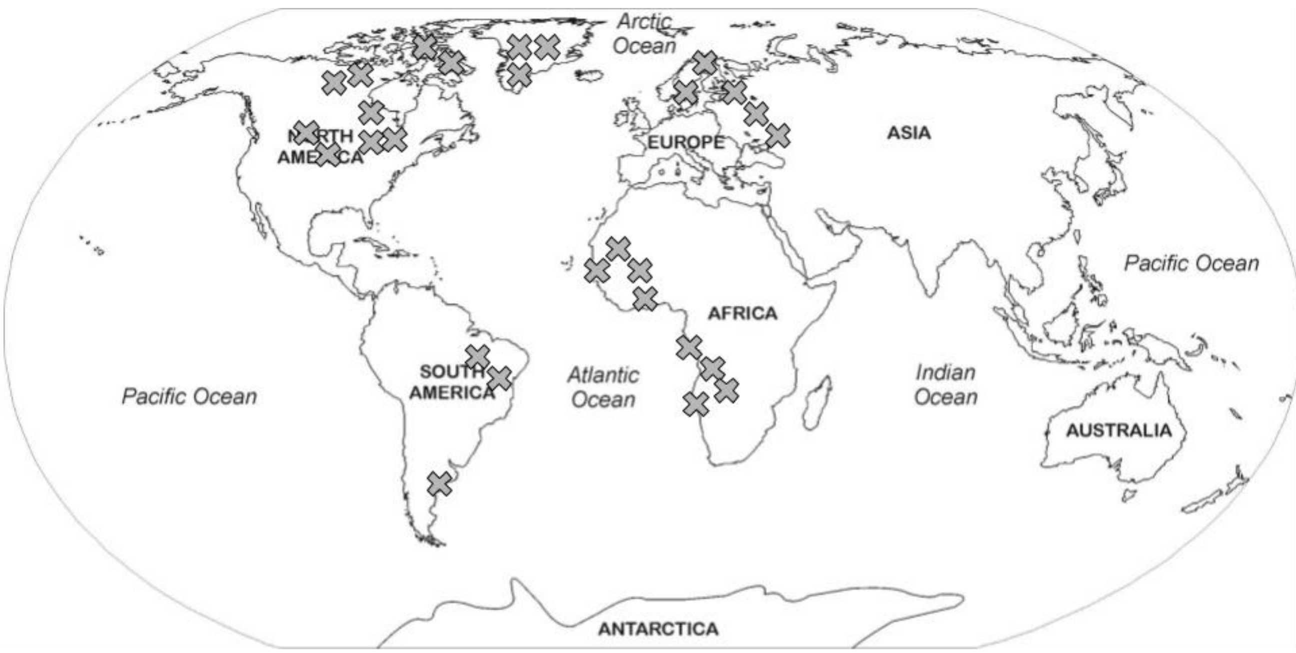
●

1. What do you observe about the Kannemeyeria fossils above and the pattern of fossil distribution from the map above?
   Position of fossils
   Environment where species lived
   Separation of Fossils across bodies of water

How could the Kannemeyeria, which were land dwelling animals, have traveled to these different continents if they were unable to swim? Explain.

The fossils of the Kannemeyeria found on different continents that were once together millions of years ago show that the continents drifted apart due to plate movement or seafloor spreading (plate tectonics).

Rock types near and around the location of the fossils of Kannemeyeria show an interesting pattern. The "X" images on the map represent the same rock types. Examine the image below to collect evidence of this pattern.



Fossil/Rock Key

Common Rock Types
▭
✖

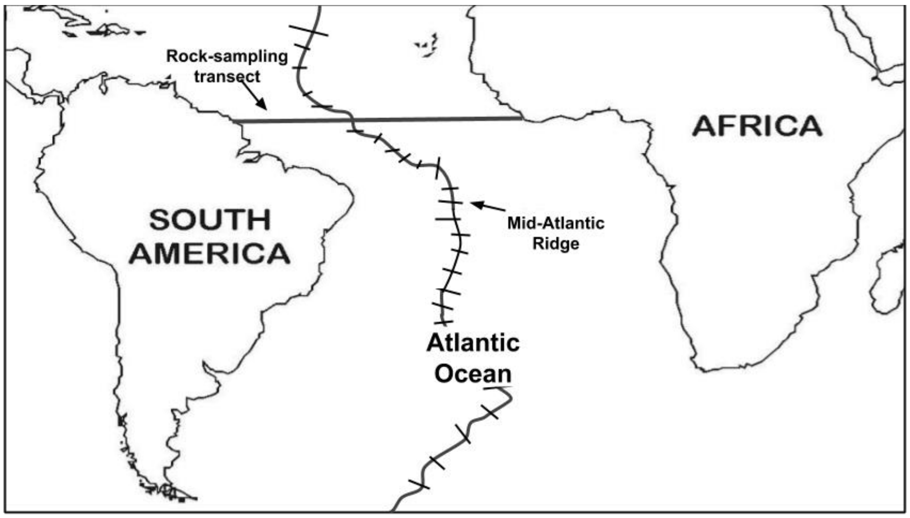
2. What patterns do you notice in the locations of the matching rock types? What could cause these particular patterns?

   Evidence (Patterns):
   Sample answer: Matching rock types are located along the coast of South America and Africa as well as Europe and North America and in areas that were once located near the equator.

   Evidence (Cause):
   Sample answer: The continents must have been connected in the past for these matching rock types to have formed where they did.

Diagram 1 below shows data from an investigation in which scientists sampled rocks along a transect, a straight line of travel, across the Mid-Atlantic Ridge from South America to Africa. Data Table 1 shows the data collected from this investigation.

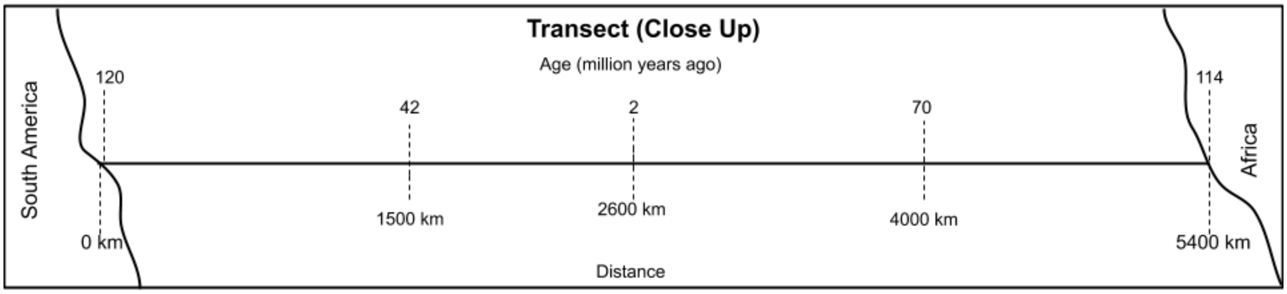
Diagram 1



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

Some of the data from Data Table 1 is plotted along the transect below. Use the data table information and the transect below to describe the pattern of the age of the Atlantic Ocean floor from South America to Africa. What pattern can you observe?



3. What pattern can you observe? Evidence (Patterns)
   Sample answer: The oldest rock (120 million years ago and 114 million years ago) is located on the edges of South America and Africa. The age of the rock gets younger the closer it is to the Mid Atlantic Ridge with the youngest rock (2 and 8 million years ago) located on either side of the ridge. The rock gets older as you move from the ridge toward the continents.

   What caused these patterns to occur? Evidence (Cause)
   Sample answer: The newer rock at the mid-atlantic ridge is pushing the older rock away. The seafloor is spreading apart (divergent plate boundary). Because continents are located on plates, this plate movement is causing the continents to separate or spread apart. The age of the oldest rock indicates this process has been occurring for millions of years. Because continents are located on plates, this plate movement is causing the continents to separate or spread apart.

4. Construct an explanation to describe how Kannemeyeria fossils have been found in such varied locations. Be sure to include the evidence you collected about Kannemeyeria fossils being found in such varied locations, rock type locations, and the pattern of seafloor rock ages between South America and Africa as evidence in your explanation.
   Sample answer: Kannemeyeria have been found on South America, Africa, North America, and Asia which are all separated by oceans. Kannemeyeria were land dwelling reptiles so they were not able to swim across these oceans to these locations.

   Matching rock types have also been located on the edges of South America, Africa, North America, and Europe which indicates that these continents must have been connected in the past. The pattern of seafloor rock ages between South America and Africa indicates that the seafloor is spreading apart causing South America and Africa to move away from each other. The matching rock types prove that South America and Africa were once connected and the sea floor rock ages prove that South America and Africa have since moved apart.

   That is how the Kannemeyeria fossils have been found in such varied locations. They lived on the continents when they were connected (250 million years ago) but their fossils have been spread out by the movement of the plates and continents over millions of years.