Name Key Date

Topic 4.1 Summary

What ideas, observations, and evidence led to the theory of plate tectonics?

Use with textbook pages 272–287.

Check for Understanding

As you read, stop and reread any parts you do not understand. Highlight all the sentences that help you get a better understanding.

Reading Check

1. What are Earth's interior layers?

crust
mantle
core

2. What are two things that the theory of plate tectonics explains?

• movement of the continents
• formation of earthquakes, volcanoes & mountains

The Theory of Plate Tectonics

The theory of plate tectonics states that the lithosphere (see below) is made up of huge, slowly moving rocky slabs called plates. The theory explains Earth processes such as the movement of the continents and the formation and occurrence of earthquakes, volcanoes, and mountains.

The Layers of Earth's Interior

Earth's interior is made up of three main layers.

- The crust is a thin layer of solid rock. The part under the oceans is called oceanic crust. The part under the continents is called continental crust.
- Most of the upper part of the mantle is solid rock. Most of the lower part of the mantle is also solid rock. Between the upper and lower parts of the mantle is a region that is partly melted, so it is able to flow.
- The outer part of the core is liquid. The inner part of the core is solid.

The Earth Layers That Are Important for Plate Tectonics

Together, Earth's crust and the upper part of the mantle are called the lithosphere. The lithosphere is solid rock.

The partly melted portion of the mantle is called the asthenosphere. The lithosphere floats on the asthenosphere.

Some of the Evidence for the Theory of Plate Tectonics

- The shape of the continents suggests that they were once joined together long ago as a single supercontinent. This huge land mass broke apart and its pieces (the continents) have been moving away from each other ever since. The continental drift hypothesis explains this idea.
- Evidence from sonar and other technologies shows that parts of the ocean floor are moving away from each other at mid-ocean ridges. New crust forms from lava erupting at these ridges. This process is called sea floor spreading. Continents are carried away from each other as part of this process.

Considering Evidence for Continental Drift

Use with textbook pages 284 and 285.

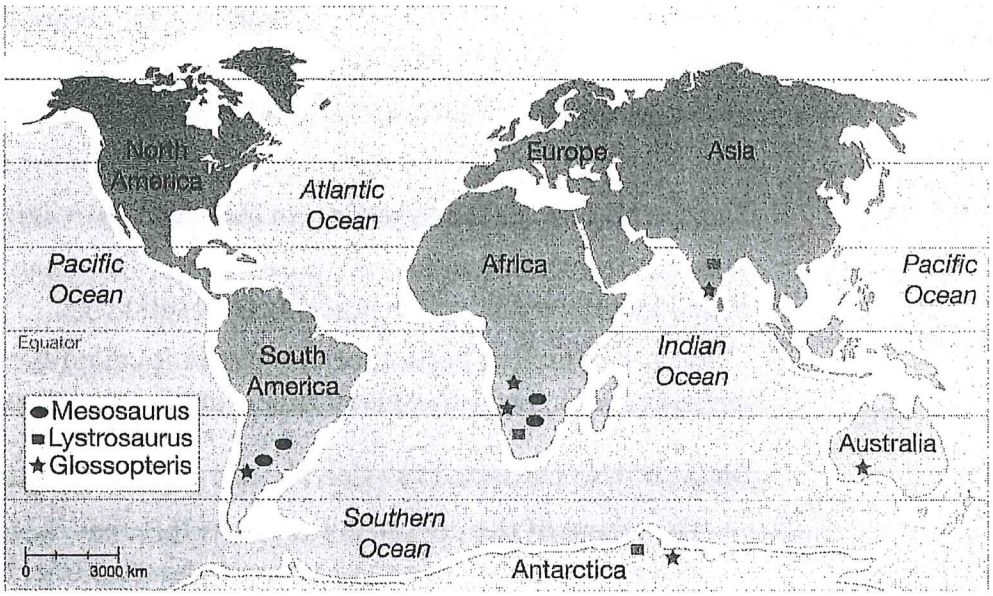
Read the information below, and answer the questions in the spaces provided.

Alfred Wegener noticed that the continents look like their coastlines match up like puzzle pieces. He hypothesized that all the continents were joined together long ago as a huge land mass called Pangaea. He suggested that Pangaea broke apart about 200 million years ago. The pieces of this land mass, which we know today as our continents, have been moving away from each other ever since.

This continental drift hypothesis depended on more than just the shape and fit of the continents. Wegener collected other kinds of evidence to support his ideas.

Fossil Evidence

Fossils of the reptile *Mesosaurus* have been found on two continents. *Mesosaurus* lived in fresh water and on land. It probably could not swim the great distance between continents. Fossils of other extinct organisms, *Lystrosaurus* and *Glossopteris*, also appear on different continents.

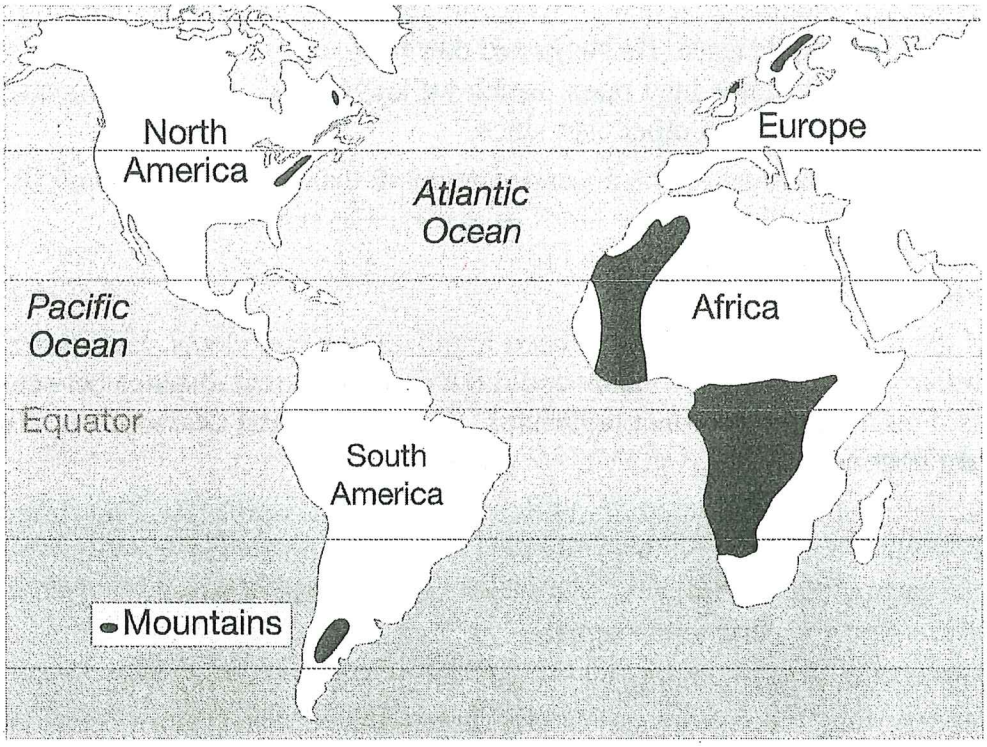


1. Why would Wegener have been interested in the fossil evidence described and shown above? What do you think he was thinking?

Wegener would have been interested because similiar fossils are found on continents that are now separated by great distances and across oceans. He might have thought the fossils formed on Pangaea and were separated due to continental drift.

Rock Evidence

The Appalachian Mountains in eastern North America are made of the same kind of rock as a mountain range in Britain and Norway. There are similarities between rock found in Quebec and rock found in northern Britain. There are also similarities between rock found in South America and rock found in Africa.



2. Why would Wegener have been interested in the rock evidence described and shown above? What do you think he was thinking?

Wegener would have been interested because it seems as though rocks that formed on the same continent are now separated by great distances and ocean. He might have thought the rocks formed on Pangaea and were separated by continental drift.

Climate Evidence

In order for coal to form, there has to be lots of plant life in a tropical, swampy environment. When the plants die and are compressed under many layers of sediment for millions of years, coal is formed. Today, however coal deposits are found in moderate to cold environments. These include Canada, northern Europe, and Antarctica. Wegener also learned that some places that have warm environments today, such as Africa, India, and Australia, were partly covered long ago by glaciers.

3. What possible explanations are there for the information described above? What do you think Wegener was thinking?

It is possible that coal found in cold environments formed when those continents were near to the equator. Also, glacial evidence in areas that have warm climates today indicate that these areas were once closer to the poles. Wegener would have thought that continental drift could be responsible.

Biological Evidence

Marsupials are mammals that are born before they develop completely. They continue to grow and develop in a pouch on their mother's body. Marsupials are found in Australia, North America, and South America. Kangaroos are examples of Australian marsupials. Opossums are North American marsupials.

Earthworms from the same biological families have been found on South America and Africa. Earthworms cannot swim and cannot survive the cold and salt of ocean water.

Similar kinds of coniferous trees are found in Australia, in South Africa, and in Brazil and Chile of South America.

4. What possible explanations are there for the information described above? What do you think Wegener was thinking?

It is possible these organisms evolved on the same continent (Pangaea), and later became separated. Wegener would have thought continental drift could be responsible for these observations.

Name Date

Processing and Analyzing
Topic 4.1

Layers of Earth

Use with textbook page 277.

1. What is the difference between direct and indirect evidence?

Direct evidence can be observed and no inferring is necessary; indirect evidence is not directly observed. but can be used to make inferences.

2. Why was indirect evidence used to infer Earth's interior structure?

It is not possible to directly observed Earth's interior, below the top few KM from Earth's surface.

3. Why can we only infer details of the inner structure of Earth?

Technologies to drill that deep are through the types of materials are not available.

4. What was the indirect evidence used to infer Earth's layers?

The speed and behaviour of seismic waves as they travel through Earth.

5. Use the table to summarize the structure and composition of Earth's four layers.

Layer (Outside to Inside)	State (Solid or Liquid)	Description
crust	solid	• thin layer of solid rock that surrounds Earth • thinner under oceans, thicker under continents
mantle	solid, but upper part acts like liquid	• top part of upper is solid and just below is made of rock that is soft and can flow like taffy • remainder of upper mantle made of denser and more liquid material
outer core	liquid	• liquid layer
inner core	solid	• solid layer that is deepest and hottest (5000°C)

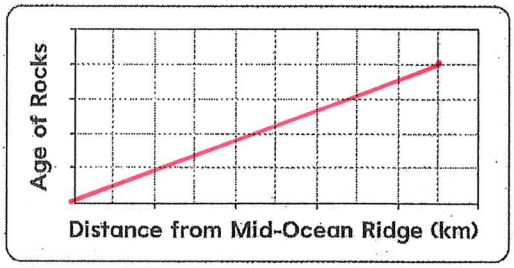
Name Date

Applying and Innovating
Topic 4.1

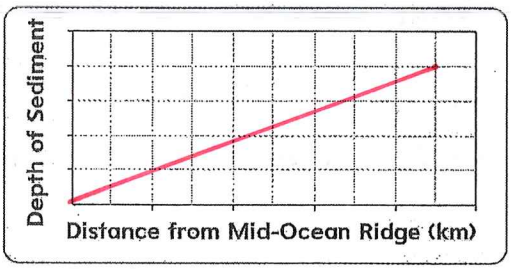
Sea Floor Spreading

Use with textbook pages 278–280.

1. Sketch a graph that shows how the age of rock changes as you move away from the mid-ocean ridge in both directions.



2. Sketch a graph that shows how the depth of sediment changes as you move away from the mid-ocean ridge in both directions.



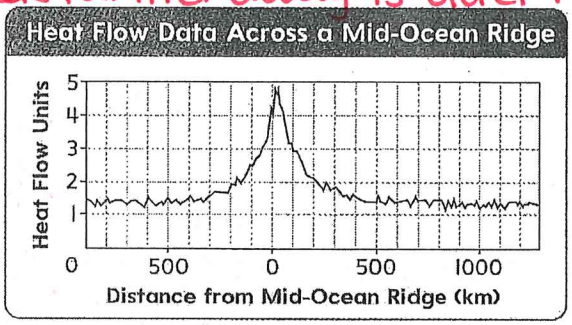
3. How does the age of rocks at the mid-ocean ridge help explain how continents move?

The age of rocks at mid-ocean ridges show that molten rock at the mid-ocean ridge is continuously pushing older rock aside in both directions and moving continents like a conveyor belt.

4. How do changes in sediment depth at the mid-ocean ridge help explain how continents move?

The increasing depth of sediment away from the mid-ocean ridge shows the sediment has been accumulating for longer the further you move away from the mid-ocean ridge. This supports the idea that the rock further away is older.

5. The graph at right shows how heat (thermal energy) changes as it moves from below the crust at a mid-ocean ridge to the water surrounding the ridge. This change in the amount of heat is called heat flow. Interpret the graph. How does it help to explain what happens at a mid-ocean ridge?



The graph shows there is more heat closer to the mid-ocean ridge. It help explains that magma rises through the rift (the valley at the center of the ridge)

6. Summarize the process of sea floor spreading.

At the center of the mid-ocean ridge is a rift where magma rises to the surface. The magma erupts and creates new rock. This new rock pushes older rock away from the ridge. The result is the formation of new oceanic crust.