

Slow Motion on Planet Earth

Reading Preview

Key Concepts

- How does the theory of plate tectonics explain the movement of Earth's landmasses?
- How fast do Earth's plates move?

Key Terms

- plate
- theory of plate tectonics

Target Reading Skill

Previewing Visuals Before you read, preview Figure 8. Then write two questions that you have about the diagram in a graphic organizer like the one below. As you read, answer your questions.

What You Know

1. A moving object changes position.
- 2.

What You Learned

- 1.
- 2.

These landmasses would fit fairly well if they were pushed together like puzzle pieces. ▶

Lab
zone

Discover Activity

How Slow Can It Flow?

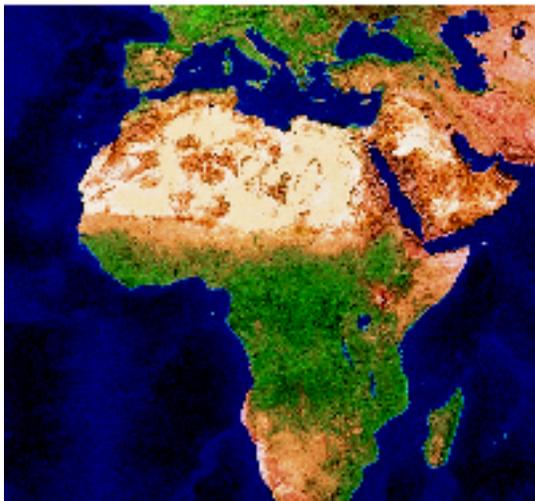
1. Put a spoonful of honey on a plate.
2. Place a piece of tape 4 cm from the bottom edge of the honey.
3. Lift one side of the plate just high enough that the honey starts to flow.
4. Reduce the plate's angle until the honey barely moves. Prop up the plate at this angle.
5. Time how long the honey takes to reach the tape. Calculate the speed of the honey.



Think It Over

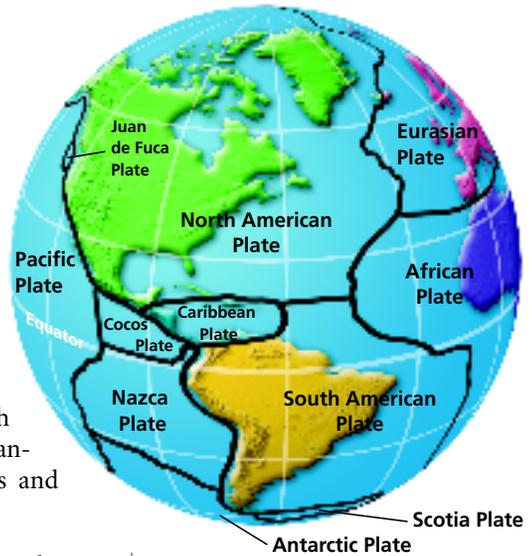
Forming Operational Definitions When an object doesn't appear to be moving at first glance, how can you tell if it is?

Have you ever noticed that Earth's landmasses resemble pieces of a giant jigsaw puzzle? It's true. The east coast of South America, for example, would fit nicely into the west coast of Africa. The Arabian Peninsula would fit fairly well with the northeastern coast of Africa. Since the 1600s, people have wondered why Earth's landmasses look as if they would fit together. After all, land can't move. Or can it?



Earth's Plates

Earth's rocky outer layer consists of pieces that fit together like a jigsaw puzzle. This outer layer is made of more than a dozen major pieces called **plates**. The boundaries between the plates are cracks in Earth's outer layer. As you can see in Figure 7, plate boundaries do not always lie along the edges of continents. The eastern boundary of the North American plate, for example, lies under the Atlantic Ocean. Many plates have both continents and oceans on them.



The Theory of Plate Tectonics Scientists use the concept of plates to explain how landmasses have changed over time. The **theory of plate tectonics** states that Earth's plates move slowly in various directions. Some plates slowly pull away from each other, some plates push toward each other, and some plates slide past each other. **According to the theory of plate tectonics, Earth's landmasses have changed position over time because they are part of plates that are slowly moving.**

Why Do Earth's Plates Move? Have you ever heated a pot of water and watched what happens? The liquid at the bottom gets hotter faster. The hotter liquid rises upward. At the surface it cools, and then hotter water moving upward pushes it aside. The same type of churning motion drives the movement of Earth's plates.

Underneath Earth's rigid plates is somewhat softer rock that moves similarly to boiling water. Scientists think that heat deep inside Earth causes material there to slowly rise upward. As more heated material rises, it pushes aside cooler material at the top of the layer. Eventually the cooler material sinks downward. The rising and sinking of material creates a slow-moving current beneath Earth's outer layer. It is this current that causes Earth's plates to move.

FIGURE 7
Earth's Plates
The black outlines show the boundaries of some of Earth's plates.
Interpreting Maps Which plates border the Nazca plate?



What causes Earth's plates to move?

225 Million Years Ago



180-200 Million Years Ago



135 Million Years Ago



Present Day



FIGURE 8

Motion of the Continents

The shapes and positions of Earth's continents have changed greatly over time and will continue to change in the future.

Interpreting Maps Locate Australia on the map. How does its position change over time?

Go  online
active art 

For: Continental Drift activity
Visit: PHSchool.com
Web Code: cfp-1015

Scientists have found that South America is moving 10 cm west per year. You can use this speed to predict how far the continent will move in 500 years.

Distance = Speed \times Time

$$\text{Distance} = \frac{10 \text{ cm}}{1 \text{ year}} \times 500 \text{ years} = 5,000 \text{ cm}$$

South America will move 5,000 cm, or 50 m, in the next 500 years.

Plate Movement

Unless you have experienced an earthquake, you have probably never felt Earth's plates moving. Why not? After all, you live on one of Earth's plates. One reason may be that they move so slowly. **Some plates move at a rate of several centimeters each year. Others move only a few millimeters per year.**

Knowing the average speed of Earth's plates allows scientists to explain how Earth's surface has changed over time. It also helps them predict future changes. Figure 8 shows how scientists think the continents may have looked in the past.

Suppose you study the motion of a plate. You find that the plate moved a distance of 5 centimeters in one year. So, the speed of the plate is 5 cm/yr. You can use this speed to predict how far the plate will move in 1,000 years. Start by rearranging the speed formula to find the distance. Then calculate distance.

$$\text{Distance} = \text{Speed} \times \text{Time}$$

$$\text{Distance} = \frac{5 \text{ cm}}{1 \text{ yr}} \times 1,000 \text{ yr} = 5,000 \text{ cm}$$

In 1,000 years, the plate will move 5,000 centimeters. You could probably walk the same distance in 30 seconds!



Why are scientists interested in the average speed of Earth's plates?

Section 2 Assessment

Target Reading Strategy **Previewing Visuals**

Refer to your questions and answers about Figure 8 to help you answer Question 1 below.

Reviewing Key Concepts

1. a. **Defining** What theory explains the movement of pieces of Earth's surface?
b. **Explaining** Why do Earth's plates move?
c. **Interpreting Maps** Use the map in Figure 7 to determine which plate contains most of the United States.
2. a. **Reviewing** In general, at what speed do Earth's plates move?
b. **Calculating** A plate moves at a speed of 45 mm/yr. How far will the plate move in 100 years?
c. **Predicting** Figure 8 shows that North America and Europe are moving apart from each other. In your lifetime, how will this affect the time it takes to travel between the two continents?



Lab zone

At Home Activity

Fingernail Growth Have a family member measure in millimeters the length of the white part of one fingernail. Record the result and which finger you used. In exactly three weeks, again measure the white part of the same fingernail. Then calculate the speed, in millimeters per day, at which the fingernail grew. Discuss with your family member how your results compare with the typical speed of Earth's plates.