17.4 Theory of Plate Tectonics

Over time, more evidence was gathered, and support grew for the idea of continental drift. But the theory that emerged said the continents weren't the only part of Earth's lithosphere that moves.

Plates that Make Up Earth

The **theory of plate tectonics** states that the lithosphere is divided into 12 large sections (plates) and about 20 smaller ones (Figure 1). These tectonic plates "float" on the more dense, fluid-like asthenosphere. Each plate moves in a different direction, so that some plates are moving away from each other, and others are moving toward each other. Some are moving past each other in opposite directions. Tectonic plates meet at three types of plate boundaries, defined by the movement there: divergent, convergent, or transform.

Did You KNOW?

Planetary Architecture

The word "tectonics" comes from the Greek word *tektonikós*, which means "relating to construction." You might think of plate tectonics as the construction of Earth's features.

To see an animation of the movement at plate tectonic boundaries, go to **www.science.nelson.com**

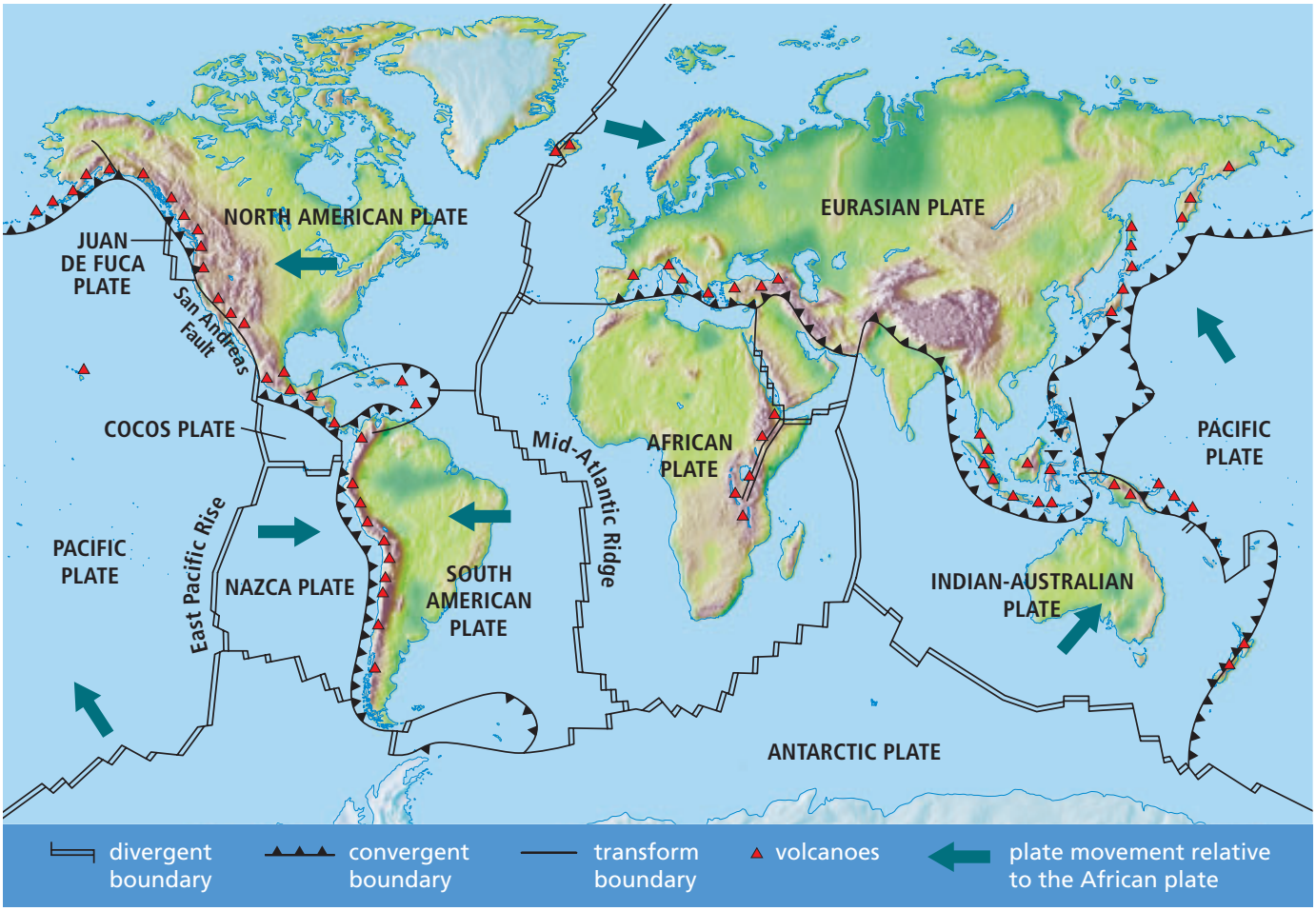
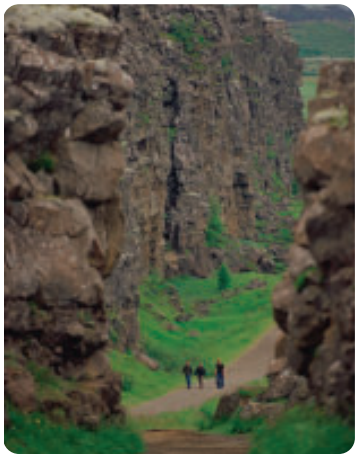


Figure 1 The symbols on this tectonic map tell us a lot about the movement of the tectonic plates. Since all the plates are in motion, their direction is given relative to the African plate, as if that plate were standing still. At a convergent boundary, the triangles point to the plate that is riding up and over the other. That means that the Juan de Fuca Plate is being pushed beneath the North American Plate.

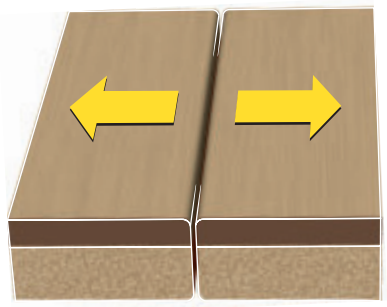
Divergent Boundaries

The point where two plates move away from each other is called a **divergent boundary** (Figure 2). This creates shallow valleys or rifts. Most rifts are under the ocean (at mid-ocean ridges) and cover Earth like seams on a baseball. When a divergent boundary cuts across land, as it does in Iceland, it is called a **rift valley**. Small volcanoes and shallow earthquakes occur along these boundaries.

If you would like to learn more about rift valleys, go to **www.science.nelson.com**



(a)



(b)

Figure 2 Iceland lies on the divergent boundary between the Eurasian Plate and the North American Plate. (a) The road in this picture lies on the flat bottom of the rift. Elsewhere along the rift there are volcanoes. (b) At a divergent boundary, the plates are moving away from each other.

Convergent Boundaries

Plates moving toward each other collide at a **convergent boundary**. In some cases, the surface of one plate is scraped up, creating mountains (Figure 3). In other cases, one plate is pushed beneath the others, creating a deep ocean trench at the boundary and a **subduction zone** where the two plates overlap. What happens at a convergent boundary depends on the types of plates involved:

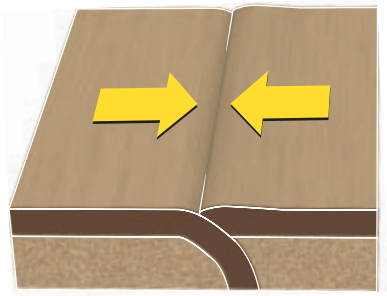
- **oceanic–oceanic convergent boundaries** create islands such as the Philippines
- **oceanic–continental convergent boundaries** create deep ocean trenches and parallel mountain chains such as that along the coast of B.C.
- **continental–continental convergent boundaries** create inland mountain ranges such as the Himalayas

STUDY TIP

There is a lot of new vocabulary in this section. As you read, write unfamiliar words on study cards. Then read the section again and write a definition for each word on the back of the card.

How high could a mountain get before it sinks into the ground? To find out, listen to the audio clip at **www.science.nelson.com**

(a)



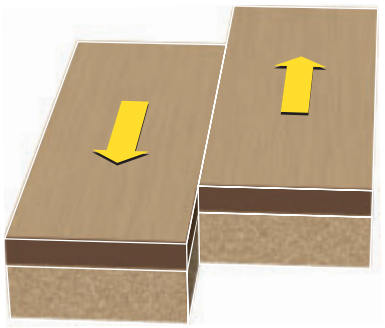
(b)

Figure 3 (a) Vancouver Island is an ancient layer of Earth's crust scraped up by the collision of the Juan de Fuca Plate with the North American Plate along a convergent boundary. (b) At a convergent boundary, tectonic plates are moving toward each other, and one plate will subduct beneath the other.

Transform Boundaries

At a **transform boundary**, plates move past each other in opposite directions (Figure 4). These are seen as **strike–slip faults**, where the land on either side of the fault line is moving in opposite directions parallel to the fault. Neither plate rides over the other, but the slip is not smooth; earthquakes often result.

(a)



(b)

Figure 4 (a) The tectonic plates beneath this farm moved after the field was ploughed, so the rows are now offset. (b) This farm lies above a transform boundary, where the plates are sliding past one another.

Note that each of these boundary types is related to the other. When one side of a plate is converging, the other side is diverging. Other areas of the plate may form a transform boundary with part of another plate. In Chapter 18, you will learn more about the effects of these tectonic movements. 17A *Investigation*

LEARNING TIP

Active readers know when they have learned something new. After reading this section, ask yourself, "What have I learned about the theory of plate tectonics that I didn't know before?"

17A *Investigation*

Clocking Tectonic Plates

To perform this investigation, turn to page 510.

In this investigation, you will analyze evidence in the Hawaiian Islands to calculate the speed and direction of the Pacific plate over the past 300 million years.

TRY THIS: Simulate Plate Tectonics

Skills Focus: communicating, creating models, evaluating

You can use household materials to demonstrate your understanding of what happens at plate boundaries.

Possible Materials: pieces of paper, foam rubber, jelly-filled layer cake, lasagna

1. Using common materials, build a model of convergent boundaries.

A. Present your demonstration to a family member or classmate. Can they see how mountains and trenches are formed when tectonic plates collide?

B. Evaluate your model, identifying how it is like and how it is not like plate tectonics.

17.4 CHECK YOUR Understanding

1. Outline the theory of plate tectonics.
2. If all the tectonic plates are moving, why doesn't the African plate in Figure 5 have an arrow on it?

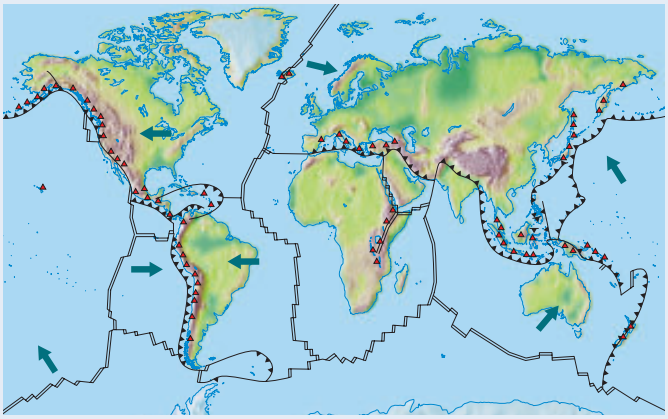


Figure 5

3. Describe where on Earth there is a
   (a) transform boundary
   (b) divergent boundary
   (c) convergent boundary
4. Draw diagrams to illustrate the type of movement that occurs between tectonic plates at a
   (a) divergent boundary
   (b) convergent boundary
   (c) transform boundary
5. What geological feature do you expect to find at a divergent boundary?
6. What kind of plate boundary is related to the formation of a mountain range?
7. Based on the theory of plate tectonics, how are mountains built?
8. Do tectonic plates slip smoothly by each other? Describe what you might experience at a transform boundary.
9. (a) What is a strike–slip fault?
   (b) At what kind of plate boundary would you find one?
10. Consider what happens at a convergent boundary, where the sea floor subducts beneath the crust of the continent. Which type of crust do you think is denser? Explain.
11. How is a subduction zone associated with a convergent boundary?
12. (a) Figure 6 shows the Cocos Plate. In which direction is the plate moving?
    (b) At the convergent boundary, is the Cocos Plate sinking beneath the continent or rising over the top? How do you know?

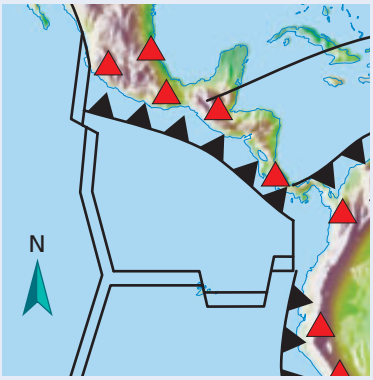


Figure 6

13. Draw the tectonic map symbol you would see at a
    (a) mid-ocean ridge
    (b) strike-slip fault
    (c) subduction zone