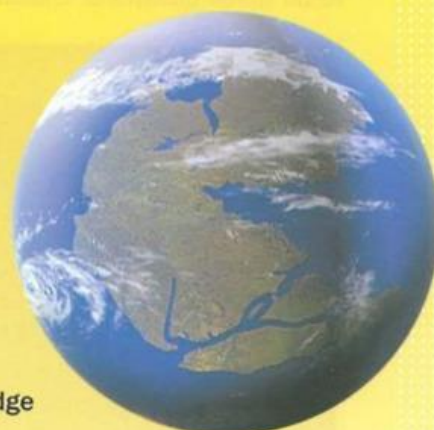


UNIT

7

GEOLOGY

Roving Continents



In this unit, you will

- > learn how scientific discovery led to our current knowledge of the movement of Earth's outer layer, the crust.
- > read about exciting changes in the earth's crust in one part of the world.
- > increase your understanding of the target academic words for this unit.

READING SKILLS Making Inferences

Self-Assessment

Think about how well you know each target word, and check (✓) the appropriate column. I have...

TARGET WORDS

AWL

accommodate

aid

community

comprehensive

displace

evolve

fluctuate

integrate

intermediate

nuclear

random

restrain

reverse

rigid

transform

never seen
the word
before

seen the word
but am not sure
what it means

seen the word
and understand
what it means

used the word,
but am not sure
if correctly

used the word
confidently in
either speaking
or writing

used the word
confidently in
both speaking
and writing



Outside the Reading What do you know about geology?
Watch the video on the student website to find out more.

Oxford 3000™ keywords

READING 1

Before You Read

Read these questions. Discuss your answers in a small group.



1. What continent do you live on now? Is it connected to other continents? Have you ever lived on (or visited) another continent?
2. Have scientists discovered any evidence that the climate on your continent was once very different from what it is now? What caused the change(s)?
3. Name two parts of the world that experience a lot of volcanic eruptions or earthquakes. What do you think causes these events?

MORE WORDS YOU'LL NEED

continent: a large landmass; the seven continents are Africa, Antarctica, Asia, Australia, Europe, North America, and South America

theory: a systematic explanation of how something works

Read

This introduction to a chapter in a geology textbook explains the basic ideas behind the theory of a long-ago supercontinent on Earth.

Pieces of a Puzzle: The Evidence for Pangaea

In geology, a *plate* is a large, **rigid** area of solid rock. The earth's surface is built of about 40 plates, called *tectonic plates*—some as large as continents and others only a few hundred miles across. Modern geology has shown that these tectonic plates move in relation to each other. Such movement is possible because the plates float on top of the *mantle*, the layer of molten¹ rock between the planet's outer crust and its dense **nucleus**, called the *core*. Even before this theory of *plate tectonics* became accepted, many in the geological **community** believed Earth's continents had moved during the history of the planet. They were right, but their ideas faced great opposition.

SUDDEN EVENTS

Until the 1700s, most Europeans explained the origins of Earth's bodies of water and landmasses in terms of "catastrophism." According to this explanation, a few sudden, violent events (catastrophes) periodically **transformed** Earth's surface. Then, a revival of science in Europe **restrained** the imaginations of geographers. Catastrophism was **displaced** by "uniformitarianism," a term derived from the word *uniform*. According to this explanation, the forces we see shaping the earth now are the same forces that shaped it in the past. Since most of the processes we see are slow and gradual, we assume that, for the most part, Earth's surface was shaped slowly and gradually.

The belief that continents have not always been in their present positions was common long before the 20th century. In 1596, the Dutch mapmaker Abraham Ortelius suggested that the

Americas were "torn away from Europe and Africa . . . by earthquakes and floods." As evidence, he pointed out that, if you imagine putting Africa and South America together, they would fit almost like two puzzle pieces. The big opening along Africa's western coast would easily **accommodate** the "hump" in South America's eastern coastline.



Pangaea splitting into Laurasia and Gondwanaland

WEGENER'S THEORY

More geologists began to think that the arrangement of today's continents gradually **evolved**. In 1912, a scientific explanation, called the *theory of continental drift*, was proposed by a German meteorologist named Alfred Lothar Wegener. He argued that all of Earth's landmasses were once joined in a single supercontinent, which he called *Pangaea* (from the Greek *pan-*, meaning "all" or "complete," and *Gaea*, meaning "Earth"). According to Wegener's theory, about 200 million years ago, Pangaea began to split apart. One of Wegener's biggest supporters, Alexander Du Toit, proposed an **intermediate** stage. He said that

¹ molten: liquified due to heat; usually used to describe rock, such as volcanic lava

Evidence that Continents Were Once Joined		
Evidence	Countries or Regions	Continents
coal	Britain and the northeastern United States	Europe and North America
<i>Glossopteris</i>	throughout the Southern Hemisphere	Africa, Antarctica, Australia, South America
mountains	southern Africa and eastern Brazil	Africa and South America
red sandstone	northeastern Europe, Greenland, and Canada	Europe and North America
the shapes of continents	western Africa and eastern Brazil	Africa and South America

Pangaea first broke into two large continental landmasses: *Laurasia* in the northern hemisphere and *Gondwanaland* in the south. Laurasia and Gondwanaland then continued to break apart into the various smaller continents that exist today.

Wegener's theory was based partly on the remarkable fit of the South American and African continents noticed by Ortelius three centuries earlier. He and his supporters also offered other pieces of evidence. For example, fossils² of an ancient plant called *Glossopteris* were found throughout the southern continents—Africa, Australia, Antarctica, and South America—and in India. If all these continents had not once been joined, *Glossopteris* would probably not have spread so far. And if Antarctica had not once been closer to the equator, the plant would not have grown there at all.

Geological structures on today's separated continents also offered evidence. Some mountains in South Africa are structurally similar to mountains in eastern Brazil. The coal deposits of Britain match deposits in the Appalachian Mountains of eastern North America. A band of red sandstone stretches from northeastern Europe, through Greenland, and into Canada. These similarities seemed too numerous to be **random** coincidences.

BUT HOW?

Wegener's theory, especially his ideas about

Pangaea, took things too far for most of the scientific **community**. They could accept uniform processes and a slow Africa/South America split, but not split after split and then long-distance travel by the continents. Their strongest objections centered on the question, "How?" Some scientists tried to show that it was physically impossible for continental rock to move across the ocean floor. Such objections were entirely reasonable, and Wegener's theory had no good answer.

Finally, in the late 20th century, the theory of plate tectonics came to the **aid** of the theory of continental drift. It offered the **comprehensive** explanation of landmass movement that Wegener had been unable to provide. New evidence made it hard to believe that the continents were *not* moving. The floor of the Atlantic Ocean was found to be spreading apart. New discoveries showed that the planet's magnetic field is not constant. It **fluctuates** over very long time periods, and has clearly shifted several times. The theory's system of plates moving on molten rock offered a believable answer to the question, "How?" It **integrated** pieces of evidence ranging from volcanic activity to the formation of mountains to the distribution of fossil plants. It shows that Pangaea not only could exist, but probably did. It also states that the trend toward separation will eventually **reverse**. The continents will drift together again and form a new supercontinent. ■

² fossils: evidence, such as a piece of bone or a mark in a rock, left by an animal or plant that lived long ago

Reading Comprehension

Mark each sentence as *T* (true) or *F* (false) according to the information in Reading 1. Use the dictionary to help you understand new words.

- ___ 1. Earth's large landmasses continually move around the globe.
- ___ 2. Earth's crust is solid, but the other parts of the planet are liquid.
- ___ 3. Maps in the 1600s showed that Africa and South America might once have fit together.
- ___ 4. Alfred Wegener's theory was essentially the same as Ortelius's theory.
- ___ 5. *Glossopteris* fossils are widespread because the continents were once all at the equator.
- ___ 6. Some bands of rock appear on several separate continents.
- ___ 7. The biggest criticism of Wegener's theory was that it failed to explain the advantages of continental movement.
- ___ 8. The theory of plate tectonics solved the biggest problems posed by the theory of continental drift.
- ___ 9. Continents on either side of the Atlantic are moving away from each other.
- ___ 10. Someday, the continents might all be joined together again.

READING SKILL

Making Inferences

LEARN

When you make an inference, you use clues in a reading to understand something the author has not directly stated. The reading implies it, and you infer it. An inference is a conclusion that you draw from the information presented in the reading.

APPLY

Read the paragraph indicated again. Then select the one or two statements that can be most strongly inferred from each paragraph. Compare selections with a partner and explain your choices.

1. Paragraph 1:
 - a. There are more small tectonic plates than large ones.
 - b. The top layer of the mantle is liquid.
 - c. The continents were formed from material in the mantle.
2. Paragraph 2:
 - a. Catastrophists believed the earth should not change.
 - b. Catastrophists believed that science was a bad thing.
 - c. Catastrophists believed that forces observable today were not enough to shape the earth.

3. Paragraphs 4 and 5:
 - a. Wegener formulated a theory about meteorology that also worked for geology.
 - b. Wegener was not the only scientist of his time who thought Pangaea once existed.
 - c. Wegener went on expeditions to explore the continents in the Southern Hemisphere.
4. Paragraph 7:
 - a. Wegener's theory was weak in some respects.
 - b. Wegener's opponents were all catastrophists.
 - c. Wegener's opponents could not accept that a landmass might break into two.

Vocabulary Activities STEP 1: Word Level

- A.** Read these excerpts from an article on tectonic plates. For each excerpt, cross out the one word or phrase in parentheses with a different meaning from the other three choices. Compare answers with a partner.
1. *Geodesy* is the study of the size and shape of the earth. Over thousands of years, the tools of the field have (*fluctuated* / *developed* / *evolved* / *progressed*) so that now we can use geodetic measurements to track the movement of tectonic plates.
 2. Because plate movements happen all over the globe at the same time, only satellite-based methods can give a truly (*all-inclusive* / *comprehensive* / *accurate* / *thorough*) view of them.
 3. In the late 1970s, these space-based techniques completely (*improved* / *changed* / *altered* / *transformed*) the field of geodesy.
 4. Of the space-based techniques, the Global Positioning System (GPS) has provided the most (*aid* / *assistance* / *truth* / *help*) to scientists studying the movements of Earth's crust.
 5. By repeatedly measuring distances between specific points, geologists can determine if there has been significant (*displacement* / *restraint* / *movement* / *repositioning*) among the plates.
 6. For example, scientists now know that earthquakes and volcanic eruptions along the lines between plates do not occur (*rigidly* / *by chance* / *randomly* / *haphazardly*).
 7. Space-geodetic data have already confirmed that the present-day rates and directions of plate movement (*fit in* / *integrate* / *harmonize* / *evolve*) well with the geologists' estimates.

The word *integrate* means "to join things so that they become one thing or fit together." Often, sentences with *integrate* mention the individual things (or people) and the larger thing that eventually includes them.

His theory **integrated** the work of several scientists in different fields of study.

The new students slowly **integrated** into the social groups on campus.



B. What smaller parts might integrate into each of these larger units? Compare answers with a partner.

1. an army
2. a public park
3. the European Union
4. a transportation network
5. an all-star soccer team
6. a neighborhood

C. Which of these things do you think should be rigid? Which are less rigid or can fluctuate depending on the situation? Write *R* for those that you think should be rigid and *F* for those that can fluctuate. Discuss your answers in a small group.

- 1. bedtime for small children
- 2. financial agreements between friends
- 3. financial agreements between family members
- 4. transport schedules (bus, train, plane)
- 5. a teacher's grading system
- 6. beliefs about what's good for the environment
- 7. political views

Vocabulary Activities STEP II: Sentence Level

Word Form Chart

Noun	Verb	Adjective	Adverb
transformation	transform	transformative	_____

D. Answer these questions in your notebook. Use each form of *transform* at least once in your answers. Refer to Reading 1 for information. Compare sentences with a partner.

1. What is the most significant way Earth's landmasses have changed since the days of Pangaea?
2. As scientific thinking became more advanced in Europe, how did explanations of Earth's geology change?
3. How did continental drift affect Antarctica?
4. What role did the theory of plate tectonics play in the debate about continental movement?
5. What big change is likely in the arrangement of Earth's continents?

Word Form Chart			
Noun	Verb	Adjective	Adverb
accommodation	accommodate	accommodating	accommodatingly
displacement	displace	displaced	_____
evolution	evolve	evolved evolving evolutionary	_____
restraint	restrain	restrained restraining	_____
reverse reversal	reverse	reverse	(in reverse)

E. Read another excerpt related to plate tectonics. Then restate the information in your notebook, using the word(s) in parentheses. Concentrate on main ideas and leave out the less important details. Be prepared to read aloud or discuss your sentences in class.

- Continental drift is a powerful, ongoing process. Many geologists let their thoughts roam a few hundred million years in the future without letting Earth's present appearance distract them from what it will eventually look like. (*restrain*)

*The minds of many geologists are not **restrained** by the Earth's present form.*

- Using the principles of plate tectonics, they try to guess how the arrangement of the Earth's continents will change between now and 250 million years from now. (*evolve*)
- Dr. Christopher R. Scotese, of the University of Texas at Arlington, predicts that the current continents will slowly join again, creating a new supercontinent, *Pangaea Ultima*. (*evolution*)
- He and other geologists agree about other likely changes. As Africa moves north toward Europe, it will squeeze the Mediterranean Sea out of its location. A rugged range of "Mediterranean Mountains" will take its place. (*displace*)
- An immense new landmass containing present-day Africa, Europe, and Asia—*Afrasia*—will form. Australia and Antarctica will run into it. Only a small basin will be left for a much smaller Indian Ocean. (*accommodate*)
- South America will move north, pushing aside the islands of the Caribbean, until northern Venezuela crashes into southern Florida. The two Americas will together head west toward eastern Afrasia. (*displace*)
- Scotese predicts that, about 200 million years from now, the westward-moving Americas will change direction and head east toward the other side of Afrasia. The Atlantic Ocean will disappear. (*reverse*)
- Other geologists believe nothing will keep the Americas from moving west, as they are now. Dr. Sergei Pisarevsky of the University of Western Australia predicts that the Pacific Ocean will disappear. (*restraint*)
- Many geologists agree that Pangaea Ultima will eventually form, and there are many different scenarios for how it might happen. When you're guessing about the next 250 million years, you have to be prepared for surprises. (*accommodation* or *accommodate*)

READING 2

Before You Read

Read these questions. Discuss your answers in a small group.

1. Find the African countries of Eritrea, Ethiopia, and Djibouti on a map. What do you know about these countries or this area of the world?
2. On the map of Africa, what geological features indicate where a tear might be located on Earth's crust?
3. How do you think oceans form?

Read

This online news article examines a major geological event occurring in East Africa.

An Ocean Waiting to Happen

The nomads¹ were terrified. For a week in September of 2005, the ground shook violently. Cracks opened up in the soil, swallowing
5 goats and camels. Smoke rose out of the dark splits in the ground. After retreating to the hills, the nomads saw pieces of glassy rock burst **randomly**
10 through Earth's crust "like huge black birds" and fly almost 100 feet (30.5 meters) into the air. A cloud of ash dimmed the sun for three days. At night
15 the new crater² breathed flashes of fire.



Afar's desert with smoke or fire visible in the rift

"They had experienced earthquakes before but never anything like this," said Atalay Ayele, a scientist at Addis Ababa University, who
20 interviewed the Afar tribespeople in this isolated corner of northeastern Ethiopia. The Afar people did not know why the land was shaking and exploding.

Dr. Ayele and his colleagues knew the area
25 was geologically unstable, but the number of strong earthquakes was exceptional. There were 162 quakes measuring more than 4 on the Richter scale³ in just two weeks—a quake measuring 5 on the scale releases as much
30 energy as the **nuclear** explosion that destroyed Hiroshima in World War II. All this

¹ nomads: members of a **community** that moves seasonally and has no permanent home

² crater: a large hole in the ground formed by natural processes

³ Richter scale: the system for showing the strength of an earthquake

made Ayele's team suspect that something extraordinary had happened deep underground.

SPLITTING APART

When satellite data for the region became

35 available, they showed that huge forces had just **transformed** East Africa. Here in the Afar desert, one of the hottest and driest places on Earth, a new ocean was **evolving**. For the first time, observation of an event of this sort was possible, 40 **aided** by a satellite. Images from the European Space Agency's Envisat satellite showed that a huge rift, or crack, 40 miles (64 kilometers) long and up to 26 feet (8 meters) wide, had opened deep in Earth's crust. The tear was created by a 45 violent upsurge of molten rock. This magma pushed in along a break where two plates of Earth's crust meet. The magma **displaced** both plates, pushing them aside and apart.

Tim Wright, a geologist at the University of Leeds 50 who interpreted the satellite results, was astonished by the images and what they pointed to. "The process happening here is identical to that which created the Atlantic Ocean," he said. "If this continues we believe parts of Eritrea, 55 Ethiopia, and Djibouti will sink low enough to allow water to flow in from the Red Sea."

LAND OF DEATH

Teams from the United Kingdom, France, Italy, and the United States have gone on expeditions to Afar. This is the region described by the 60 explorer Wilfred Thesiger in the early 20th century as a "land of death." Satellites now give **comprehensive** views of what he meant. From above, you can see vast, **rigid**, black tongues of cooled lava reaching out into the 65 desert sands. Rust-colored volcanoes stand open and gaping, their lids blown off. There are so many fissures⁴ and faults⁵ where the ground has opened and slipped that Earth's "skin" looks like elephant skin.

70 The moon-like geography reflects what lies beneath. Afar stands at the junction of three tectonic plates, which meet at unstable fault lines. The Nubian and Somali plates run along the Great Rift Valley. The Arabian plate branches out

75 to the north. The boundaries of these plates continually **fluctuate** as the magma underneath pushes them around.

COLLISION AND DIVISION

Earth's tectonic plates are constantly shifting—usually by only a few centimeters a year.

80 Adjacent plates can slide past one another, as occurs along the San Andreas Fault in California. The plates can also collide. India's collision with the landmass to the north started its **integration** with the Eurasian continent. This 85 process forces the crust upward and creates mountain ranges, such as the Himalayas.



Movement of the India land mass over the past 71 million years

Or the **reverse** could happen. Plates can also pull apart, causing continents to break up and

⁴ fissures: small cracks, as in a rock or Earth's crust

⁵ faults: large, deep cracks in Earth's crust

oceans to form. Early in this process, as the
90 distance between plates increases, the earth's
crust stretches and thins out. Magma rises up,
eventually cracking the thinned crust, and the
plates drift apart. Between the fault lines, the
crust, now heavy with cooled magma, sinks to form
95 a deep valley, often below sea level. The formation
of this depression is an **intermediate** stage in the
birth of an ocean. A bowl now sits ready to
accommodate water that rushes in from a nearby
sea as soon as there is an open channel.

100 This is how the Atlantic was formed, separating
Africa and Eurasia from the Americas. And this is
what scientists believe is happening in Afar as
the Arabian, Nubian, and Somali plates pull apart.

Parts of the region have already sunk to more
105 than 328 feet (100 meters) below sea level.
Only the highlands east and north of the
Danakil Depression **restrain** the Red Sea
from rushing in. Eventually, erosion or
quakes will create a break in the highlands,
110 and the depression will quickly become an
ocean floor. The new sea is predicted to be
formed within about a million years. The
complete separation of the Nubian and
Somali plates along the Great Rift Valley
115 could take ten times as long. At that time,
Africa will lose its distinctive horn as the
Somali Plate heads east.

Reading Comprehension

Mark each sentence as *T* (true) or *F* (false) according to the information in Reading 2.
Use the dictionary to help you understand new words.

- ___ 1. During the 2005 earthquakes, pieces of rock flew up randomly out of the ground.
- ___ 2. Water from the Red Sea has rushed into the Afar region.
- ___ 3. A rift is a kind of opening.
- ___ 4. Three tectonic plates come together in the Afar region.
- ___ 5. Before the 2005 earthquakes, the Afar region could accommodate farms.
- ___ 6. Despite the region's remoteness, the effects of the 2005 quakes have been extensively studied.
- ___ 7. Satellite photos of the Afar region show that a hole many miles long opened up in 2005.
- ___ 8. Scientists believe magma will rise up between the tectonic plates and displace them, pushing them farther apart.
- ___ 9. The Atlantic Ocean is the only thing restraining the new ocean from forming.
- ___ 10. Residents of Afar hope the new ocean will soon help relieve the extreme heat in the region.

APPLY

An author's choice of language can imply feelings or attitudes. Read these excerpts from Reading 2 and complete each implication that follows. Infer the adjective that best describes what the author means. Four of the adjectives will not be used. Check your dictionary for the meanings of new words. Compare answers with a partner.

accurate
avoidable
difficult

incompetent
inevitable

misleading
perceptive

uninformed
useful

1. The Afar community did not know why the land was shaking and exploding.

Implication: The Afar community was _____.

2. All this made Ayele's team suspect that something extraordinary had happened deep underground.

Implication: Ayele's team is _____.

3. This is the region described by the explorer Wilfred Thesiger in the early 20th century as a "land of death." Satellites now give comprehensive views of what he meant.

Implication: Thesiger's description was _____.

4. Images from the European Space Agency's Envisat satellite showed that a huge rift, 40 miles (64 kilometers) long and up to 26 feet (8 meters) wide, had opened deep in Earth's crust.

Implication: Envisat was _____.

5. Eventually, erosion or quakes will create a break in the highlands, and the depression will quickly become an ocean floor.

Implication: The formation of an ocean is _____.

Vocabulary Activities STEP I: Word Level

- A.** Complete the sentences about Africa's Rift Valley with the target vocabulary in the box. The synonyms in parentheses can help you. (Note: The sentences are not yet in order.)

accommodated	community	evolving	an intermediate
aided	displacement	fluctuated	restrain

- a. "We are incredibly fortunate to have the Rift Valley," Leakey says, because that system has been _____ over the last 20 million years."
(forming)
- b. During the course of its formation, the rift's new basins _____
(made room for) water from rivers and seas, water that carried lots of sediment with it.
- c. Leakey has had the good fortune to live in _____ period of
(middle) the Rift Valley's history. The Eritrean and Ethiopian portions of the rift, in particular, are between an opening-up phase and a flooding phase.
- d. Leakey says the continuing _____ of land along the rift
(moving aside) makes erosion possible in previously buried sediments, exposing new fossils.
- e. Maeve Leakey, of East Africa's most famous family of fossil-hunters, considers herself lucky to have worked in the Rift Valley. She cannot easily _____ herself as she describes the importance of the rift.
(control)
- f. She also points out that "many of the rift sites, like Turkana, are badlands, which cannot be cultivated and are not threatened with buildings and concrete." Members of the scientific _____ are the only
(group with shared interests) humans with a reason to spend much time there.
- g. The Great Rift Valley runs from southern Lebanon to southern Africa's Zambezi Valley. Its dramatic geology has _____ anthropologists hunting for remains of distant human ancestors, especially
(made things easier for) in Eritrea, Ethiopia, Kenya, and Tanzania.
- h. The sediments buried the bodies of dead of animals in the area, fossilizing bodies and animal bones. As water levels _____ with changes
(went up and down) in the landscape, the process repeated itself several times.

- B.** Put the sentences in activity A into a logical account of Maeve Leakey's observations. (More than one order may be possible.) Read your sequence to a partner.

- C.** Read each of these pairs. What are some intermediate stages between the members of the pair? Write as many as you can in your notebook. Compare lists in a small group and discuss your ideas.

1. cold / hot

cold...chilly...cool...mild...warm...hot

2. child / adult
3. college graduate / professor
4. office assistant / company president
5. blueprint for a house / a livable residence
6. running one mile a day / running a marathon
7. not knowing about something / becoming an expert at it
8. buying a camera / showing your movie to an audience
9. reading a recipe / serving dinner to family or friends

- D.** Read the sample sentences that feature forms of the word *accommodate*. Then answer the questions below in your notebook, using a dictionary as suggested. Compare answers with a partner.

- a. As our family grew, my parents had to keep building additions onto the house to **accommodate** us all.
b. Making **accommodation** for Jim's disability was not hard, involving only a ramp at the front door and some new bathroom fixtures.
c. The proposal is quite **accommodating** to the opposing party's demands.
d. He **accommodated** the press a great deal, giving interviews and posing for pictures.

1. Check (✓) the word closest in meaning to *accommodate*. Consult your dictionary before you answer.

___ suit ___ access ___ compose ___ embrace

2. Each of the sentences in the box above indicates that something was accommodated. What was it?

- a. _____
b. _____
c. _____
d. _____

3. Look at the sample sentences in your dictionary for *accommodate* and its forms. What is being accommodated in each of those samples?
4. Does *accommodate* have any forms that are not used in the sample sentences in the box above? If so, what are they? Consult your dictionary.

Vocabulary Activities STEP II: Sentence Level

Some of the changes the earth has undergone have been enormous. Some of them have been beneficial, some harmful, and some both, depending on which people you consider. For example, the Medieval Warm Period was certainly beneficial to the Vikings, who were able to explore farther than ever before. It was not so great, however, for the people the Vikings conquered during this period.

- E.** Each of these situations describes a big event or change on Earth. How might the change be beneficial? How might it be harmful? Who does (or did) it affect and how? Write a few sentences for each item in your notebook, using at least two of the target words in parentheses, in any form, in your answers. Be prepared to read aloud or discuss your ideas in class.
1. The ten hottest years, as measured by worldwide average temperatures, have occurred since 1998. There is no longer much serious doubt that the climate of the planet is getting warmer. (*fluctuate, reverse, random, transform*)
 2. In 1991, a huge volcanic eruption at Mt. Pinatubo in the Philippines threw massive amounts of ash into the air. This hung in the atmosphere worldwide for most of the following 12 months and prevented sunlight from reaching Earth's surface. The planet's average temperature in 1991 was almost one degree Celsius lower than normal. Worldwide, 1991 was the third-wettest year on record and had the third-coolest summer. (*aid, community, nuclear, transform*)
 3. From 1963 to 1967, a new volcanic island, named Surtsey, formed off the southwest coast of Iceland. (*accommodate, community, displace, evolve*)
 4. In human history, Africa's climate has become significantly drier. The Sahara Desert has expanded many times over, making it almost impossible for people to live, grow crops, or raise animals there. (*aid, displace, restrain, reverse*)
 5. In 1908, a gigantic explosion occurred over the forests of Siberia in Russia. About 80 million trees were instantly flattened. People more than 100 miles away were knocked down by the shock wave from the explosion. It was probably caused by an asteroid vaporizing as it streaked through Earth's atmosphere. (*nuclear, random, rigid, transform*)
 6. Until about 7000 years ago, a land bridge existed across the Bering Strait. It connected northeast Asia and what is now Alaska. It formed because a series of ice ages locked a great deal of water into glaciers, lowering sea levels. (*accommodate, evolve, integrate, intermediate*)