FOCUS ON SCIENCE

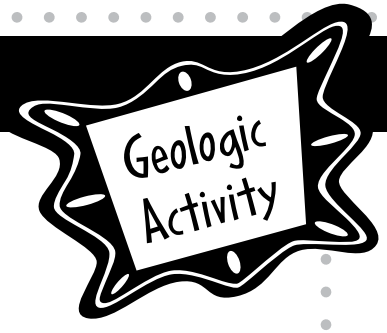
Geologic Activity

Advanced Level

Earth Science
Geology

FOCUScurriculum

866-315-7880 • www.focuscurriculum.com



Scientific Inquiry

The central purpose of scientific inquiry is to develop explanations of natural phenomena in a continuing, creative process.

Construct explanations independently for natural phenomena, especially by proposing preliminary visual models of phenomena.

Differentiate among observations, inferences, predictions, and explanations.

Represent, present, and defend their proposed explanations of everyday observations so that they can be understood and assessed by others.

The observations made while testing proposed explanations, when analyzed using conventional and invented methods, provide new insights into phenomena.

Design charts, tables, graphs, and other representations of observations in conventional and creative ways to help them address their research question or hypothesis.

Organize results, using appropriate graphs, diagrams, data tables, and other models to show relationships.

Earth Science

Many of the phenomena that we observe on Earth involve interactions among components of air, water, and land.

The interior of Earth is hot. Heat flow and movement of material within Earth cause sections of Earth's crust to move. This may result in earthquakes, volcanic eruption, and the creation of mountains and ocean basins.

Folded, tilted, faulted, and displaced rock layers suggest past crustal movement.

Plates may collide, move apart, or slide past one another. Most volcanic activity and mountain building occur at the boundaries of these plates, often resulting in earthquakes.

English Language Arts

The following is a selective listing of the literacy competencies addressed in this book.

Literacy Competencies

Word Recognition

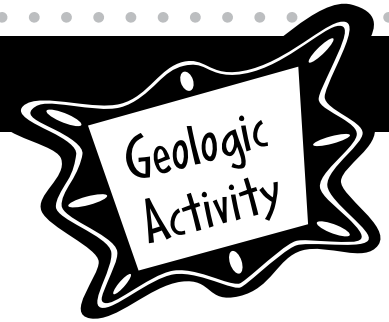
- Recognize at sight a large body of words and specialized-content vocabulary

Background Knowledge and Vocabulary

- Determine the meaning of unfamiliar vocabulary and idioms by using prior knowledge and context clues

Comprehension Strategies

- Use a variety of comprehension strategies (e.g., predicting, questioning, summarizing, visualizing, and making connections) to support understanding and response to reading



Published by FOCUScurriculum
866-315-7880
www.focuscurriculum.com

Order Number ES-51AL

Written by Michael Hill
Created by Kent Publishing Services, Inc.
Designed by Signature Design Group, Inc.

How to Help Your Students Make the Best Use of This Book

Encourage students to develop nonfiction literacy skills by completing the Active Reader activities. Also encourage them to . . .

- Underline main ideas in paragraphs.
- Circle details that support the main ideas.
- Write down questions as they read.
- Circle key words as well as unfamiliar words.

Printing Instructions

Student Book: print pages 5–28

Assessments: print pages 29–32

Answer Key: print pages 33–36

FOCUS ON SCIENCE

Geologic Activity

How do we as scientists gather and interpret evidence that Earth is continually changing?

The word *geology* means, "the study of Earth's crust." Think about the title of this book. What do you think *Geologic Activity* means? What can you conclude from the meaning of the word *geology*?

Mountains, valleys, volcanoes, and other geologic landforms dot the landscape of Earth. They are always changing. Such landforms are created through a combination of constructive and destructive geologic processes. Erosion, weathering, and tectonic plate motion all play a role in the creation of the landforms on Earth.

Read on to learn more about Earth's crust and the geologic activity that takes place there.

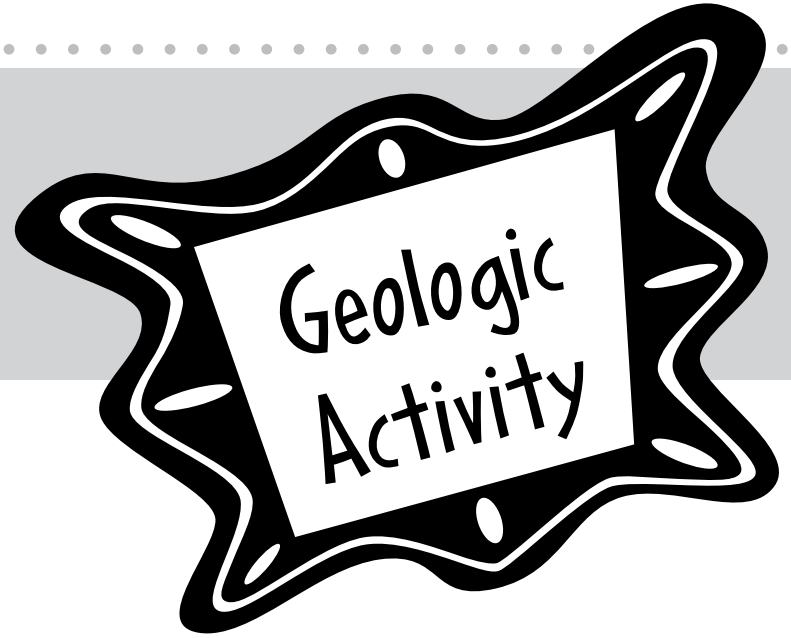


Table of Contents

Starting Points

Chapter 1 How Valleys Are Formed

Chapter 2 Mountain Building

Build Background

Predict

Constructive and destructive natural processes both contribute to the creation of various landforms. Write a sentence explaining what the terms constructive and destructive mean to you.

1. constructive: _____

2. destructive: _____

Brainstorm

What kinds of landforms are you familiar with? List as many landforms as you can on the lines below. Then, look for these words as you read this book. If you find the name of a landform you listed below, come back here and circle it. After you have completed the book, come back again and add to the list.

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

Write your own definition for the terms sedimentation and erosion. After you have read the definition of each term in the text, come back and revise your definition.

1. sedimentation: _____

2. erosion: _____

Starting Points

Key Vocabulary

Rate Your Knowledge

The words listed below have to do with geology. Each word is important, but some of them may be new. Read each word. Rate your knowledge of each by putting a check or a few words in the appropriate column. After completing this book, come back to this page and write the definitions of words you did not know.

	I don't know it.	I've seen it, and I think it means . . .	I know it well. It means . . .
erosion			
sediment			
flood plain			
alluvial fan			
delta			
uplift			
gradient			
convection current			
constructive			
destructive			
folding			
subduction			

Use Roots to Unlock Meaning

Circle the word in each sentence that contains the root.

sedi-

1. During our camping trip, we brewed coffee that contained a lot of sediment.
2. While walking along the stream, Benson noticed that the cliffs off to the side contained sedimentary rock.

3. What do you think the root *sedi-* means?

_____

sub-

4. Our father purchased a house in a new subdivision next to the expressway.
5. The term for explaining the process in which oceanic crust is pushed below continental crust is subduction.

6. What do you think the root *sub-* means?

_____

Hands On Science

Convection Tectonic plate motion is responsible for many of the geologic processes that take place on Earth. Convection currents help drive tectonic plate motion. As molten magma is heated, it begins to flow in a circular pattern. The energy created moves the plates. This results in geologic activity such as volcanoes and earthquakes. You may not realize it, but convection currents exist all around you!

1. **To examine convection currents, heat a pot of water on the stove with an adult supervising. Observe the tiny bubbles that form in the bottom of the pot as the water begins to heat up. Write a few sentences detailing the movement of these bubbles as the water reaches a boil.**

   What do you observe?

2. **How does what you observe explain the role of convection in many geologic processes, such as earthquakes and volcanoes?**

Starting Points

Key Concepts

Constructive and Destructive Processes

Two important concepts to keep in mind as you read this book are constructive and destructive geologic processes. Both processes have helped to shape the landforms on Earth and caused your surroundings to appear as they do. However, they operate in different ways. Constructive processes help to build, shape, or initiate geologic features such as mountains or volcanoes. For example, the lava that erupts from a volcano settles and cools on the surface, forming new material. Destructive processes, however, change the appearance of geologic landforms in a different manner. These processes, such as landslides or stream erosion, break down or wash away the surface of geologic features. Examine the chart to learn more about constructive and destructive processes.

Constructive Processes	Destructive Processes
Volcanic Eruption Lava erupts to surface, forming new continental crust	**Stream Erosion** Water picks up sand, gravel, and other surface material and carries it downstream
Uplift Slow, gradual uplift of Earth's surface forms mountains and plateaus	**Glaciation** Moving glaciers scrape away the surface as they advance or retreat, often carrying large rocks and other sediment
Sea Floor Spreading Occurs at a divergent plate boundary; oceanic crust is pulled apart, allowing molten magma to rise to the ocean floor and form volcanoes and mountains	**Landslide** May be caused by excess weight or extreme erosion; land gives way and slides to lower elevation, reshaping the landform
Folding: Occurs at a convergent continental plate boundary; continental crust is pushed together, folds Earth's crust, and forms mountains	Earthquake: Results from pressure within Earth; pressure is released rapidly, resulting in faulting and tearing of crust

ACTIVE READER

1 Identify *Write a C next to the processes that are constructive. Write a D next to the processes that are destructive.*

_____ uplift

_____ sedimentation

_____ earthquakes

_____ volcanic activity

_____ folding

Good to Know

Constructive and destructive processes often occur side by side. For example, erosion and deposition take place in a stream. Erosion, a destructive process, occurs on the inside bank of the stream where sediment is being washed away. Deposition, a constructive process, occurs on the outside bank where sediment settles in a new location.

Chapter 1 How Valleys Are Formed

FOCUS

In this section you will learn about one process that causes valleys to form. Look for information that will help you identify and explain this process.

Along the Appalachian Trail

Wendy and her younger brother, Charlie, have grown up in New York State and really enjoy the outdoors. During their summer break Wendy will be taking Charlie on a four-week backpacking trip along the Appalachian Trail in the eastern United States. They will hike from Roanoke, Virginia to Bear Mountain State Park in New York.

Wendy is studying geology in college and plans to teach Charlie about the geology of the trail. Her geology professor has challenged her to identify each type of landform she sees along the trail and write an explanation of how it formed. Wendy will need to think about which types of geologic activities contributed to the creation of each landform.

Charlie is very excited about the trip and has prepared all of the backpacking gear. Wendy has arranged transportation to Virginia and mapped out the daily mileage along the trail. Soon they will be hiking through the wilderness and learning about geology!

The Appalachian Trail runs from Maine to Georgia.

ACTIVE READER

1 Interpret *Look at the map. In which direction will Wendy and Charlie hike?*

2 Hypothesize *What types of landforms might Wendy and Charlie see along the trail?*

Web Quest

Charlie and Wendy will hike through varying degrees of elevation on their trip. Here is your chance to help them. Use the Internet to find a topographical map of the Appalachian Mountains. Identify the highest elevation along the Appalachian Trail, then determine if the siblings will encounter this elevation or not. Remember, they're hiking from Roanoke, VA to Bear Mountain State Park along the Hudson River.

Valleys

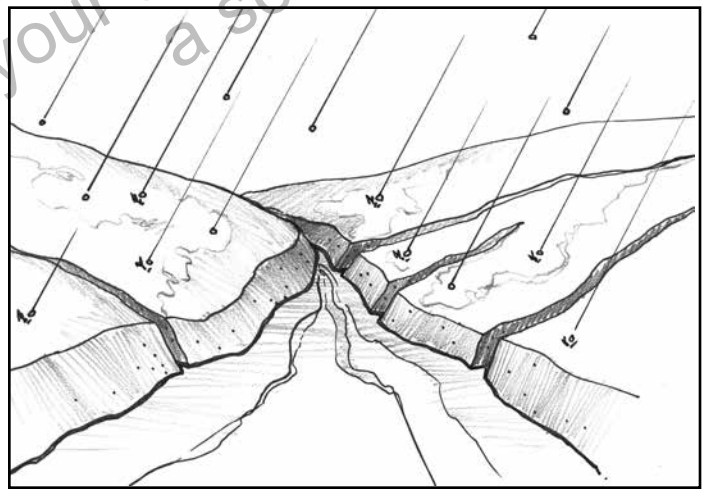
As they embark upon their journey, one of the first landforms they encounter is a large valley just north of Roanoke. As they follow the trail onto the valley floor, Charlie asks Wendy how valleys are formed. She jumps across the stream ahead of him and begins to explain that many valleys are formed by moving water such as the stream they've just crossed. Such valleys are called V-shaped valleys. Streams and rivers carry water from the hills and mountains to lower ground, often draining into a lake or ocean. **Erosion** is the driving force in the creation of a valley.

Erosion

Charlie isn't quite sure what erosion is and asks his older sister to explain. She says that erosion is a destructive natural process through which rock and soil are loosened and removed from Earth's surface. Wind, water, and ice are all erosive forces. Each of these forces can change the appearance of a landform by removing rocks, soil, and plants that form **sediment** from its surface. It is a slow process that takes place over thousands of years.

There are other natural processes that change the appearance of Earth's surface as well. Landslides can change the entire makeup of a mountainside by altering the rocks, soils, and even flora and fauna present. A landslide may even block a stream or river, causing it to alter its course.

Water is one of the most powerful erosive forces on Earth. As a river or stream flows downward from the mountains, its force erodes away the landscape. It carries sediment such as soil and rocks with it as it flows between hills and mountains.



Erosion is a destructive process. Water erodes the land by carrying away soil.

ACTIVE READER

1 Restate *Which natural process creates valleys?*

_____

2 Recall *What natural force causes rivers and streams to flow downward?*

_____

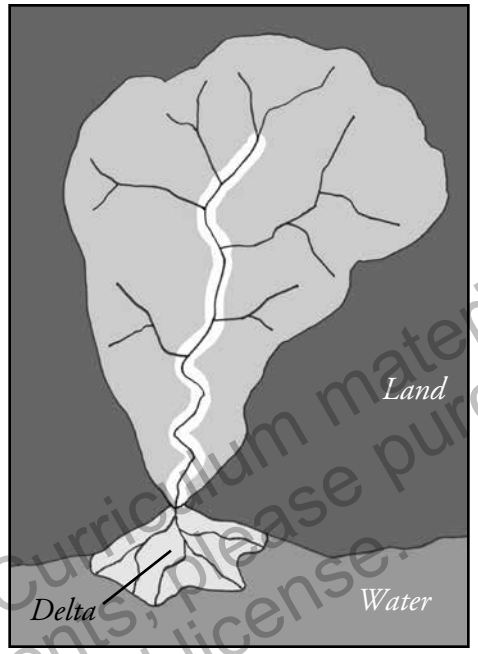
3 Connect *Circle a word in paragraph 3 that is a synonym for wildlife.*

Sedimentation

Charlie wonders where all the sediment ends up. He asks Wendy to explain.

The sediment is carried from the mountains and displaced down stream, she tells him. Unlike erosion, sedimentation, also called deposition, is a constructive natural process. Sediment often gathers in a given location until a noticeable feature is formed. Wendy points to the buildup of sediment on each side of the stream. This is the **floodplain**, or the area where sediment is deposited when the stream overflows. The floodplain includes all of the area from the edge of the stream out to the valley walls. Many times an **alluvial fan** will form where a stream or river ends and deposits sediment on land. Other times a **delta** is formed when the sediment is carried into another body of water such as an ocean, lake, or larger river.

Over the course of thousands, even millions, of years the river carves into the earth, taking away soil and rocks. Eventually, a valley such as the one they are looking at is formed.



Sediment is deposited on land until it reaches a larger body of water.

ACTIVE READER

1 Identify *Underline the sentence that defines floodplain.*

2 Explain *What is the difference between an alluvial fan and a delta?*

FOCUS QUESTIONS

1. How are erosion and sedimentation related?

2. Explain the difference between constructive and destructive natural processes.

FOCUS

This section explains two other geologic processes involved in the formation of valleys. Identify each as a constructive or destructive natural process.

Other Valley-Forming Processes

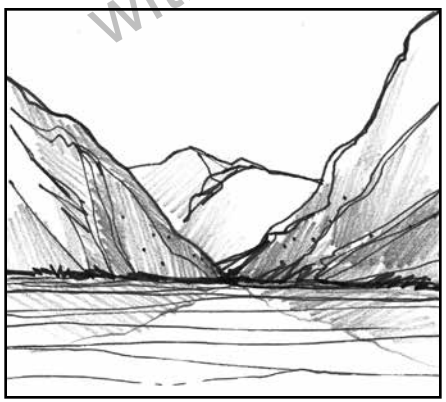
Charlie is just about to declare himself an expert in valley formation when Wendy says that other processes form valleys, too.

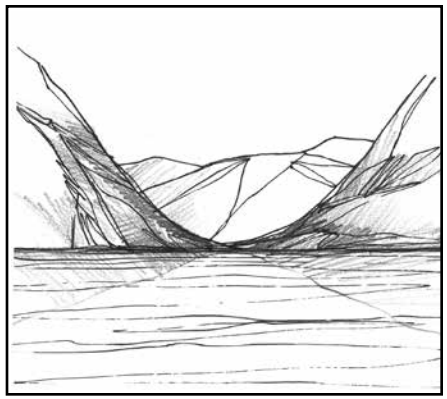
Uplift

Another constructive natural process taking place on Earth is **uplift**. An important factor in the formation of valleys, uplift is the slow, broad, upward movement of Earth's surface. As the surface of the Earth is uplifted, mountains rise and valleys deepen. A steep valley creates a steep **gradient** in a stream or river. This increase in gradient can cause a river to flow faster and increase the potential for erosion.

Glaciers

Many U-shaped valleys were formed by glaciers. As the glaciers advanced and retreated they carved out the landscape of the earth by picking up sediment and carrying it away, much like a river or stream. Moving water from the melting glaciers continued this erosive cycle. The result is a large valley where a glacier was once present.





River and stream erosion forms V-shaped valleys. Erosion from glaciers results in U-shaped valleys.

ACTIVE READER

1 Question *A question about how valleys form that I still need to answer is . . .*

_____

_____

_____

_____

_____

_____

_____

Good to Know

The last glacial period affecting New York ended approximately 11,000 years ago, as the Canadian Ice Shield moved over the land. During its peak, the ice may have measured up to one mile thick!

Charlie asks his sister if there are glaciers in New York, where their grandparents live. She tells him that there are not currently any glaciers in New York, but there most certainly were in the past. She reminds him of the trip their family took to the Finger Lakes last summer. They were all quite impressed with the beautiful lakes and valleys.

The Finger Lakes were formed during a series of "Ice Ages" when glaciers advanced and receded across the land. Wendy explains that deep valleys were cut out of riverbeds by the giant glaciers as they scraped away the landscape of New York. They produced some of the most dramatic lakes, valleys, and gorges in the United States. They also deposited a lot of sand and soil, making New York a good farming environment.

Charlie is impressed with his sister's knowledge. He's excited to see the next landform so he can learn more!

a present-day glacier

FOCUS QUESTIONS

1. **How does uplift contribute to the creation of valleys?**

2. **Explain the origin of V-shaped valleys and U-shaped valleys.**

ACTIVE READER

1 Research *Where do glaciers exist today?*

2 Monitor *Circle two forms of evidence that glaciers once moved through New York.*

3 Recall *Glacial movement is one type of what destructive natural process?*

Stop and Think

This page will help summarize what you have read so far.

1. Why is erosion considered to be a destructive natural process?

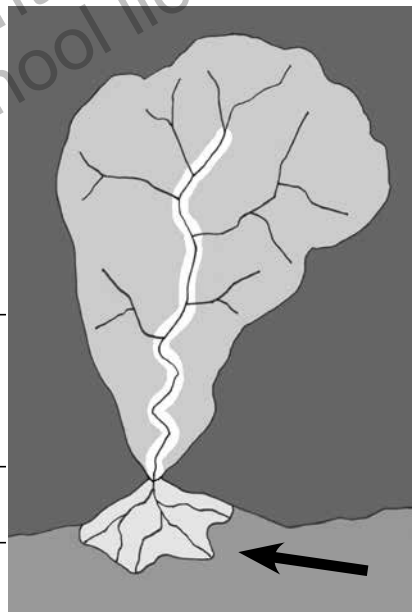
(1) It removes rocks, soil, and sediment.
(2) It changes the appearance of Earth's surface.
(3) It is responsible for the creation of landforms.
(4) It occurs through the forces of water, wind, or ice.

Tip:
To answer question 1, look back through the text to find the definition of "destructive."

2. Which statement describes uplift?

(1) the increase in gradient of valley walls
(2) the upward flow of water in streams and rivers
(3) the slow, upward movement of the Earth's surface
(4) the rapid gathering of rocks and soil in a given location

Base your answers to questions 3 and 4 on the picture at the right and on your knowledge of science.



3. Identify the geologic feature indicated in the picture.

_____

4. Describe the natural process that created it.

_____

_____

_____

Dear Ms. Understanding,

I thought I'd be able to see mountains being formed while on vacation in Colorado. Has mountain building ended?

Disappointed in Delmar

Dear Disappointed,

Mountain building is definitely still taking place today! While it's a difficult concept to grasp, it is important to understand that geologic processes occur over thousands, even millions of years. To understand the concept of geologic time, consider that Earth is approximately 4.5 billion years old.

Ms. Understanding

Hands On Science

Demonstrate Erosion

As you have read, erosion is a powerful, destructive process. To better understand how erosional forces act to alter the landscape, complete the following project.

Procedure:

Gather a handful of sand, soil, or loose gravel from outside your home. Pile the loose sediment onto a flat surface such as a sheet of aluminum foil, cardboard, or plastic. Next, pour a glass of water over the top of your sediment pile. What happens? Record your observations in the chart below. Be sure to explain in detail what took place as you poured the water. Describe the size of the sediment pile, the movement of the sediment, and the direction of the moving water. Be sure to record the end result.

Appearance of Sediment at Onset of Project	Observations on Movement of Sediment	Observations on Path of Water	Final Observations

1. Make a prediction about what would happen if you did the same experiment using half a glass of water.

_____

2. Draw a conclusion about how water levels affect erosion in the natural world.

_____

_____

Chapter 2 Mountain Building

FOCUS

The underlined sentences state important ideas about how geologic processes are connected to plate motion. As you read, think about how what we see above Earth's surface is a direct result of what happens below.

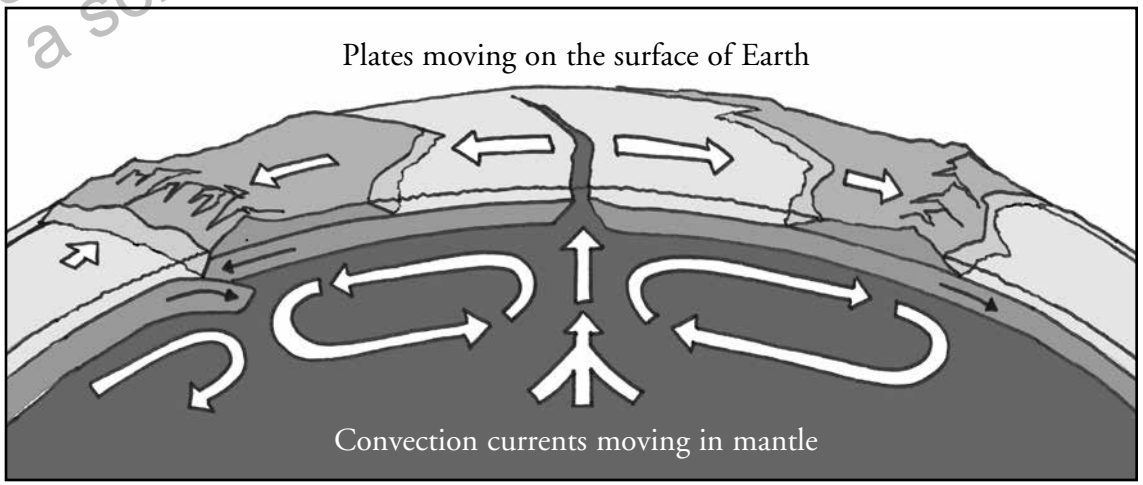
Natural Forces Combined

After camping on the valley floor for two nights, Wendy and Charlie continue their trip northward. As they ascend out of the valley they begin to climb into the mountains. Charlie is first to notice the majestic Mt. Rogers. At 5,729 feet above sea level, it is very impressive. Charlie begins snapping pictures right away and wonders out loud how a mountain that large was formed. Encouraged by her brother's excitement, Wendy pulls out her notebook to refresh her memory about mountain building processes.

Mountains may result from several different geologic processes, she explains to Charlie. They may be formed by volcanic eruptions, erosion, and activity within Earth's crust. The Appalachian Mountains were formed by a series of tectonic plate collisions, erosion, and further plate collisions.

Wendy explains that within the interior of Earth lie rigid tectonic plates. They rest upon the hot, molten mantle. **Convection currents** within the mantle cause the plates to move very slowly. Each plate can move up to 10 cm per year. Charlie is amazed to learn that parts of Earth are actually moving. He asks his sister to explain further.

As convection currents move within the mantle, the tectonic plates shift as well. This can result in volcanic activity, earthquakes, and the creation of mountains.



ACTIVE READER

1 Recall *What causes tectonic plates to move?*

_____

2 Hypothesize *How do you think scientists measure plate movement?*

_____

_____

_____

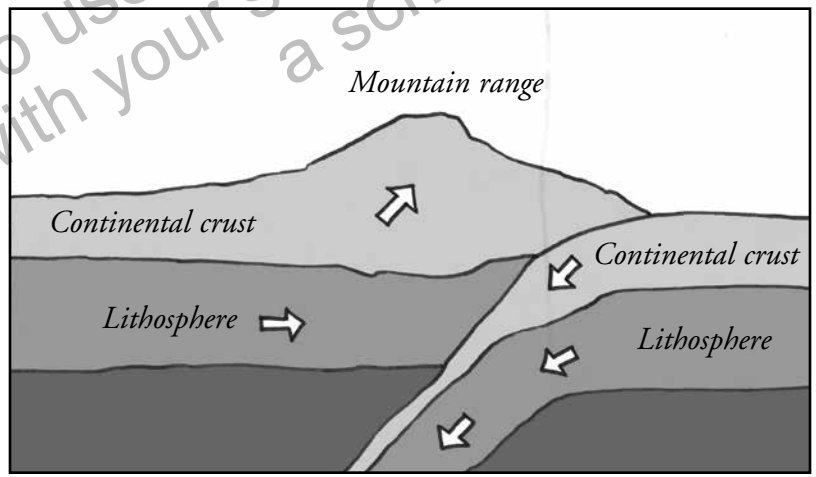
Plate Motion

Wendy goes on to explain that as tectonic plates drift, they often push into one another. This is called a **convergent** plate boundary. **Crustal deformation** results from this type of plate interaction.

There are two types of convergent plate boundaries. When two continental plates converge, **folding** and uplifting take place. The plates press into each other, causing the crust to fold over onto itself, kind of like an accordion. The crust is deformed and pushed up, creating a mountain.

When an oceanic plate converges with a continental plate, volcanic activity results. This, too, is a constructive process, as lava erupts at the surface and furthers the mountain building process. Because oceanic crust is more dense than continental crust, it is **subducted**, or sucked into Earth at a convergent plate boundary. There it can be heated, melted, and forced to the surface of Earth in the form of a volcano. Magma rises through Earth and erupts as lava. It cools on the surface, forming new rock layers.

Both uplifting and volcanic activity are examples of crustal deformation. And, Wendy explains, both constructive processes took place in the formation of the Appalachian Mountains. This geologic activity occurred over the course of millions of years. Then, destructive, erosive forces such as wind, water, and ice wore down the mountains over time, giving them their present day appearance.



Crustal deformation occurs when two plates push into one another.

ACTIVE READER

1 Monitor *Circle two examples of constructive processes.*

2 Define *Explain subduction.*

_____

_____

_____

3 Extend *What will the Appalachian Mountains look like in another million years?*

_____

_____

_____

Good to Know

The continents have been drifting for hundreds of millions of years. The rate of movement has been measured at 2 to 12 cm per year. At one time all of the continents were connected as one super-continent called Pangaea.

The Rock Cycle at Work

Charlie is beginning to realize that Earth is much more complex than he realized. For the first time he can comprehend that the geologic activity that creates the landforms on Earth is an ongoing process. He compares the tectonic activity that he has just learned about to a conveyor belt that constantly recycles the rocks of Earth.

First, igneous rocks are formed as magma erupts in the form of a volcano and cools on the surface of Earth, creating rock layers. Over time these rock layers are covered by a thin layer of loose sediment. This sediment is compacted and cemented together, forming sedimentary rocks. Erosion can wear these rocks down to smaller pieces of rock, sand, and soil. Rivers and streams can then carry this sediment away from the mountains and deposit it into the ocean. There it can settle onto the ocean floor and be subducted into Earth. Heat and pressure within Earth change the chemical makeup of the rocks. This is known as the metamorphic process. Metamorphic rocks are pre-existing rocks such as igneous or sedimentary rocks that have undergone chemical changes. Charlie is really beginning to like geology!

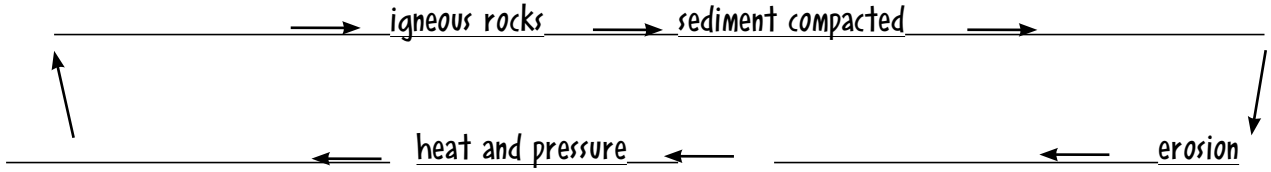
FOCUS QUESTIONS

1. **Explain crustal deformation and its role in creating landforms.**

_____

_____

2. **Add labels to the diagram to show the rock cycle.**



ACTIVE READER

1 Analyze *What is a synonym for cycle? Why is this a fitting term for the process that rocks undergo?*

_____

_____

_____

_____

2 List *What are the three main types of rocks?*

a. _____

b. _____

c. _____

Now that you understand the rock cycle a little better, you should have a firm grasp on the three types of rocks. Use the Internet to research igneous, sedimentary, and metamorphic rocks. Make a list of a few types of each rock and give some characteristics of each.

FOCUS

This section is about other geologic activities that create landforms. As you read, find out how pressure within the Earth displaces rock layers.

Rock Layers

As they continue along the Appalachian Trail, Wendy and Charlie have the opportunity to see many more landforms. They continue on through Virginia, Maryland, Pennsylvania and eventually enter into New York State for the last few days of their trip.

Anticlines and Synclines

Wendy is pleased with the notes she has taken along the way. She is also happy about being able to teach Charlie about how various geologic features are formed. If her memory of the trail serves her well, they will be approaching an **anticline** sometime in the late afternoon. She's sure Charlie will be curious as to how this feature was formed.

Just as Wendy expected, Charlie almost immediately questions her upon seeing the anticline; he's never seen anything like it. Wendy asks Charlie to think back to when she was explaining mountain building processes, namely folding and uplifting. Wendy tells him to observe the rock layers in the anticline. Usually the newest rock layers are deposited closer to the surface, or above the oldest rock layers. But in an anticline, the rocks are displaced so that the youngest rock layers are not always on top. There is a curvature in the mountainside, which has rearranged the rock. Instead of horizontal layers, these rocks form a large curve, much like an arch. Charlie is really confused about how the rock layers can be shaped this way, so Wendy explains further.

Instead of horizontal layers, the rocks in an anticline form a large curve.

ACTIVE READER

1 Connect *Anticline and syncline contain the same root. In Greek, "klei" means "to lean." Identify another word that contains this root and define it.*

_____

_____

_____

_____

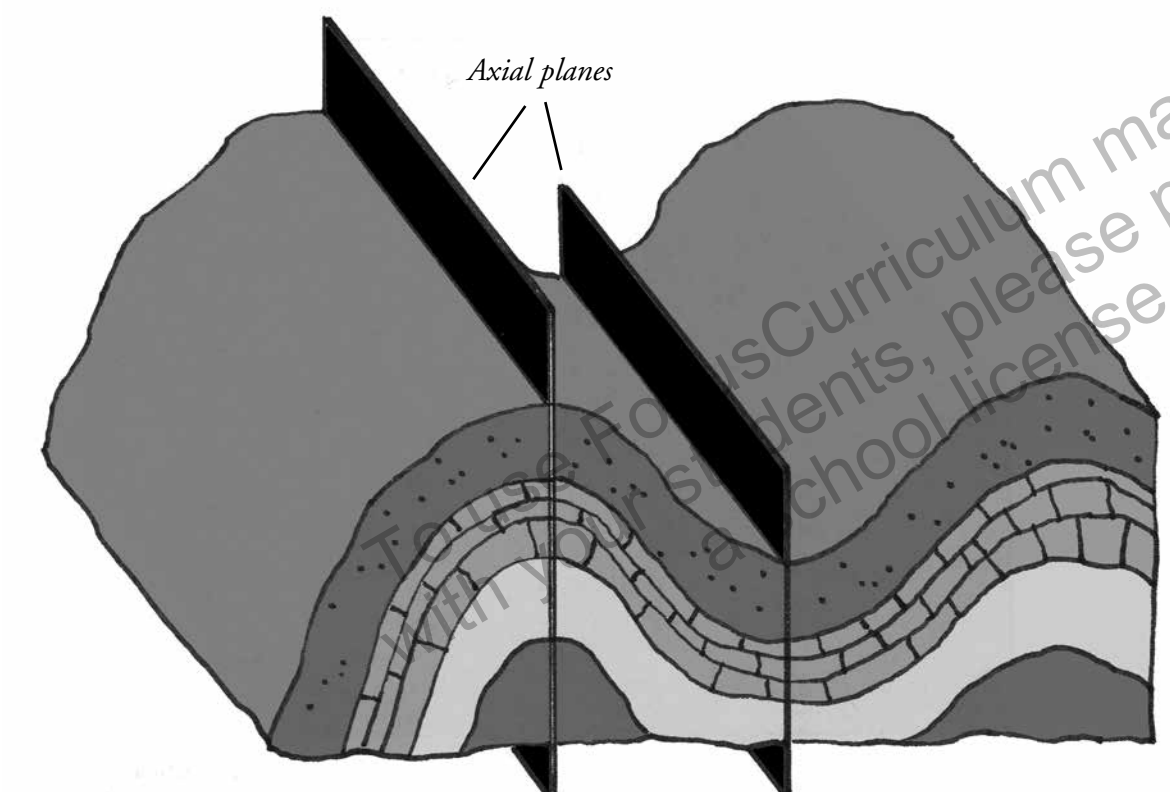
_____

Good to Know

Geologists and archaeologists study rock layers to determine the age of rocks and fossils. Often times an archaeologist will use a scientific dating method such as radiocarbon dating. The dates of the rock and the fossil can be compared to gain an accurate calculation.

An anticline is caused by pressure within Earth. As increased pressure is put on the rock layers, they might fold and either curve up or down. If the rocks fold upward, the result is an anticline. If the rocks fold downward, the result is a **syncline**.

Wendy tells Charlie to think of a rug on the floor. Pushing on the sides of the rug would cause it to fold and form small curves. The process within the interior of Earth is similar. Pressure has caused the rock layers to fold, pushing the middle upward and forming the anticline.



Increased pressure can cause rock layers to fold upward (anticline) or downward (syncline).

ACTIVE READER

1 Compare *What is the difference between an anticline and a syncline?*

An anticline _____

_____

_____

A syncline _____

_____

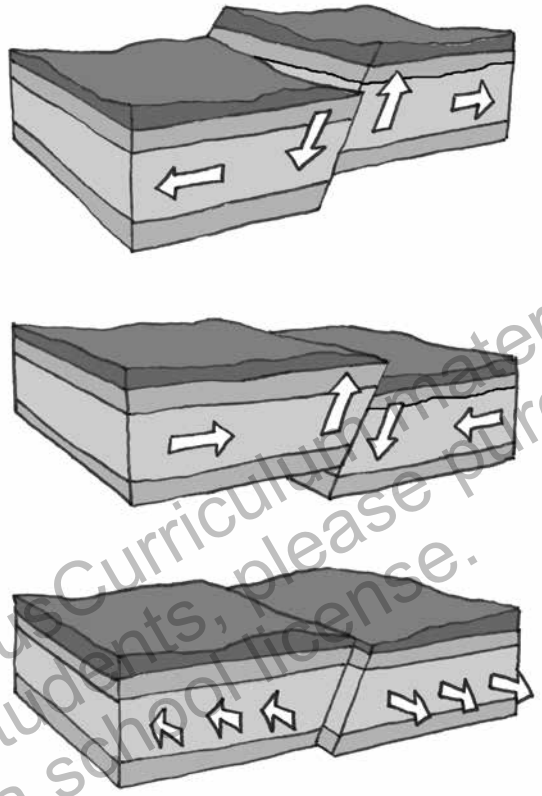
_____

2 Identify *Underline the sentences that give a metaphor for how anticlines and synclines form.*

Faulting

Similarly, Wendy explains, **faulting** can displace rock layers. A fault is a crack in Earth's surface caused by pressure. The surfaces on either side of the fault may push against one another, or they may slide up or down in relation to the other side. When the pressure becomes too great, it is released, resulting in an earthquake. The surfaces on each side of the fault are shifted and moved several inches or feet from their original location. The rock layers that were once deposited together are now displaced.

Once again Charlie is very impressed with his sister's knowledge. The two will be finishing their trip soon. He is anxious to tell all of his friends about the amazing landforms he saw along the Appalachian Trail!



The surfaces on either side of the fault may slide up or down or they may push against one another.

ACTIVE READER

1 Infer *Is faulting a constructive process or a destructive process? Why?*

_____

_____

_____

_____

2 Restate *Use context clues to write a definition of the word displaced found in paragraph 1.*

_____

_____

_____

FOCUS QUESTIONS

1. How are the geologic activities of uplifting, folding, and faulting similar?

_____

_____

2. Explain how pressure within Earth can cause an earthquake.

_____

_____

Stop and Think

This page will help summarize what you have read so far.

1. What causes rock layers to be displaced?

(1) the rock cycle
(2) chemical changes
(3) pressure within Earth
(4) erosion by wind, water, and ice

Tip:
Cross out the answer choices that you know are incorrect. Then go back and look for key words in the text.

2. What occurs when an oceanic plate converges with a continental plate?

(1) synclines
(2) anticlines
(3) earthquakes
(4) volcanic activity

3. Which explains the relationship between the rock cycle and plate motion?

(1) Crustal deformation is a result of plate movement. When the plates press into each other, the crust is deformed and pushed up, creating a mountain.

(2) Folding, faulting, and uplifting are a result of plate movement. When plates collide, the rock layers shift so that the youngest rocks are not necessarily on top.

(3) Destructive natural causes such as erosion break down rocks. When the rocks are subducted, heat and pressure in the Earth change their chemical makeup, forming metamorphic rocks.

(4) Convection currents in the mantle cause the plates to move. When plates collide, rocks are heated, melted, and forced to the surface, erupting as lava and cooling into new rock layers.

Dear Ms. Understanding,

I thought that once a layer of rock was deposited, it stayed put. My friend claims that rock layers can become displaced by other rock layers. Can you help clear this up?

At Odds in Olean

Dear At Odds,

Rock layers are deposited horizontally. They will remain intact unless pressures from within Earth cause faulting or folding. This can separate and interrupt rock layers. This displacement can be seen in an anticline or syncline. Furthermore, magma can push through an existing rock layer and change the chemical makeup of a layer of rock in one location, leaving other parts of the existing layer as is.

Ms. Understanding

Satellite Images Geologists and other Earth scientists use satellite images to aid their research. You can study satellite images for certain geologic features, too. Access the internet and visit the link below.

http://geology.com/satellite/landsat-images-alluvial-fans-deltas.shtml

You will see five satellite images of alluvial fans and deltas. Print the photos in your computer lab at school or from your printer at home. Observe each picture carefully. Circle the alluvial fan or delta in each picture. Use the chart below to note observations about each image, including whether the image shows an alluvial fan or a delta. Use the scale to measure the width of each alluvial fan or delta (in both kilometers and miles) at its widest point. Write these measurements in the chart.

U.S.A.	
China	
Egypt	
Russia/Kazakhstan	
Bangladesh/India	

Glossary

alluvial fan – the feature that forms where a stream or river ends and deposits sediment on land

anticline – a landform that results when increased pressure is put on rock layers, causing them to fold upward

constructive processes – processes that help to build, shape, or initiate geologic features such as mountains or volcanoes

convection currents – circular movement of molten magma that causes tectonic plates to shift

convergent – a plate boundary where two tectonic plates collide

crustal deformation – any change to the Earth's crust that results from two tectonic plates converging

delta – the feature that forms when sediment is carried from a stream or river into another body of water such as an ocean, lake, or larger river

destructive processes – processes such as landslides or stream erosion that break down or wash away the surface of geologic features

erosion – a destructive natural process through which rock and soil are loosened and removed from the Earth's surface

faulting – a process that displaces rock layers when surfaces on either side of a crack in the Earth's surface shift

floodplain – the area extending from a stream to its valley walls, where sediment is deposited when the stream overflows

folding – the process that occurs when two plates converge, causing the crust to fold over onto itself

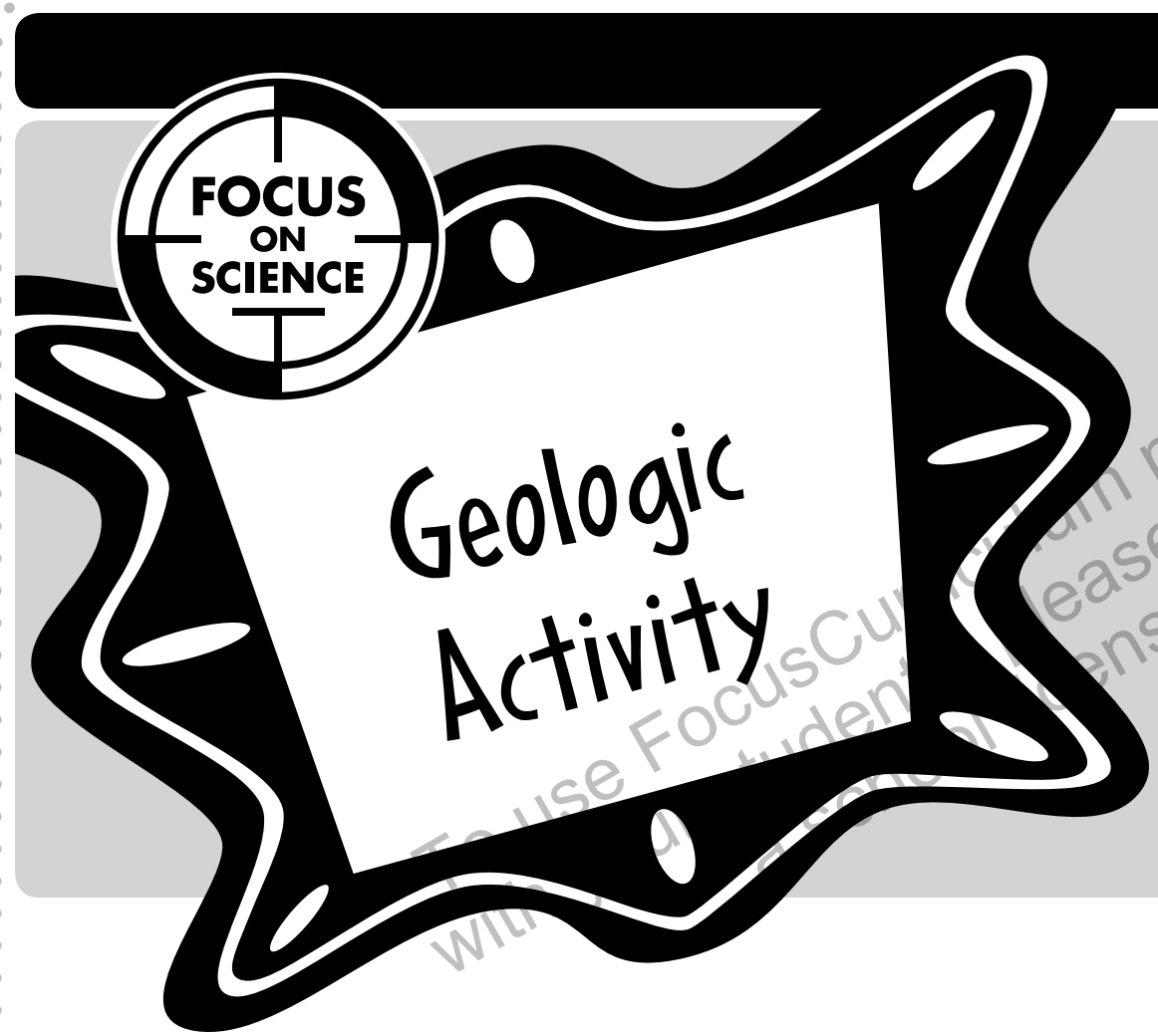
gradient – the slope of a river or stream

sediment – particles of sand, stone, or dirt that are removed from Earth's surface and deposited elsewhere

subducted – pulled under the other tectonic plate at a convergent plate boundary

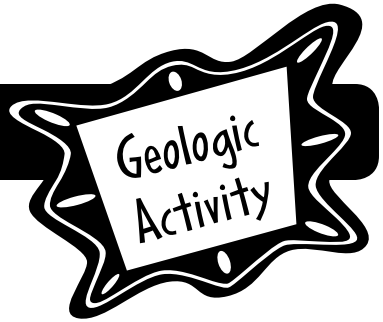
syncline – a landform that results when increased pressure is put on rock layers, causing them to fold downward

uplift – the slow, broad, upward movement of the Earth's surface



Assessments

Check Understanding



In the Answer Document on this page, mark your answer in the row of circles for each question by filling in the circle that has the same number as the answer you have chosen.

1. A student takes a picture of a valley near her grandparents' house. When she looks at the picture, she observes that it looks like the letter "V".

   How did this valley form?

   (1) a glacier eroded it
   (2) a river or stream eroded it
   (3) a landslide blocked the river
   (4) an earthquake pulled the two sides apart

2. Sediment is bits of rock, sand, and soil.

   Which statement best describes sedimentation?

   (1) the erosion of rock into smaller pieces
   (2) the rapid movement of rocks down a mountainside
   (3) the area where sediment is deposited when a stream overflows
   (4) the gathering of sediment in a given location until a noticeable feature is formed

3. You are on a hike when you notice a section of rock unlike the other rocks you've seen. The rock layers form a curve instead of a straight line. In fact, it looks like a large arch.

   What kind of geologic activity occurred to create this unusual rock pattern?

   (1) folding
   (2) subduction
   (3) sedimentation
   (4) volcanic activity

4. Which of the following is a destructive process?

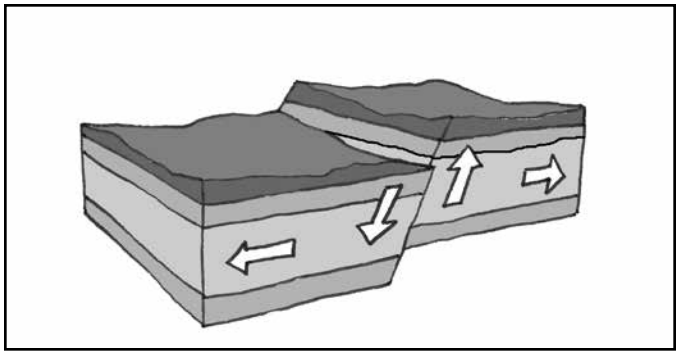
   (1) erosion
   (2) folding
   (3) uplifting
   (4) faulting

Answer Document

1.	①	②	③	④		3.	①	②	③	④
2.	①	②	③	④		4.	①	②	③	④

Check Understanding

Base your answers to questions 5 and 6 on the diagram below and on your knowledge of science.



5. What geologic process is shown in the diagram?.

_____

_____

6. What caused the movement shown in the diagram to occur?

_____

_____

_____

_____

_____

Base your answers to questions 7 and 8 on the information below and on your knowledge of science.

The Earth's surface is constantly changing. Landforms are created by constructive and destructive processes.

7. Identify a landform.

_____

_____

8. Explain which constructive and destructive processes created it.

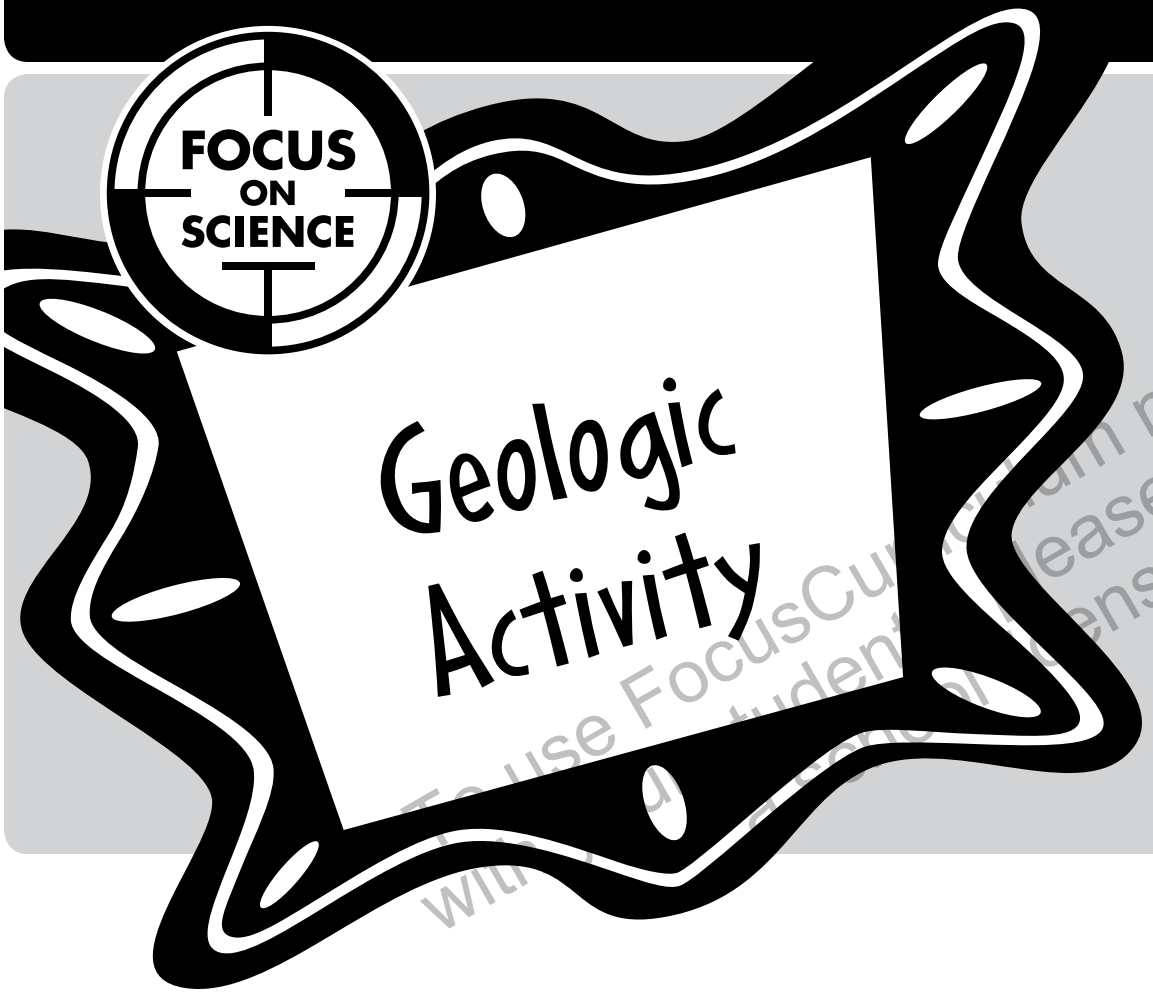
_____

_____

_____

_____

_____



Answer Key

Answer Key

Page 8: Starting Points
Build Background
Predict: Answers will vary.
Brainstorm: Answers will vary.
Define: 1. Sedimentation: a constructive natural process that occurs when sediment gathers in a given location until a noticeable feature is formed. 2. Erosion: a destructive natural process through which rock and soil are loosened and removed from the Earth's surface.

Page 9: Starting Points
Key Vocabulary
Rate Your Knowledge: Answers will vary according to the student's prior knowledge. Use Roots to Unlock Meaning: 1. sediment; 2. sedimentary; 3. to sit; 4. subdivision; 5. subduction; 6. beneath, below

Page 10: Hands On Science
Convection: 1. Sample answer: Small bubbles form on the bottom of the pot. They rise to the top center of the water, then drift to the outer edges of the pot. The bubbles are pushed down at the outer edges and are heated again. 2. Sample answer: Convection causes heated material to rise and cooler material to fall. The rising heated material can shift tectonic plates or force molten rock up through a volcano.

Page 11: Starting Points
Key Concepts
Active Reader: 1. C, C, D, C, C

Page 12: Chapter 1
Active Reader: 1. Northeast; 2. Answers will vary.

Page 13: Chapter 1
Active Reader: 1. erosion; 2. gravity; 3. Circle: fauna

Page 14: Chapter 1
Active Reader: 1. Underline: This is the floodplain, or the area where sediment is deposited when the stream overflows. 2. An alluvial fan is formed when sediment is deposited on land. A delta is formed when sediment is deposited in another body of water.
Focus Questions: 1. Sedimentation is the buildup of sediment that has been carried away due to erosion. 2. Constructive natural processes build up, while destructive natural processes break down.

Page 15: Chapter 1
Active Reader: 1. Answers will vary.

Page 16: Chapter 1
Active Reader: 1. Sample answers: Alaska, Pakistan, Antarctica, Greenland; 2. Circle: lakes and valleys, sands and soils; 3. Erosion
Focus Questions: 1. Uplift is the upward movement of Earth's surface. As uplift occurs, valleys deepen. 2. V-shaped valleys are formed by river and stream erosion. U-shaped valleys are formed by glacier erosion.

Page 17: Chapter 1
Stop and Think
1. (1); 2. (3); 3. Delta; A delta is formed at the place where sediment carried by a river or stream is deposited into a larger body of water.

Page 18: Hands On Science
Demonstrate Erosion: Sample answers: Appearance of Sediment at Onset of Project: Sediment piled closely, neatly together in the shape of a mound; Observations on Movement of Sediment: Sediment was pushed away as the water was poured; some sediment was carried with the water; sediment was separated, leaving groupings; some remained grouped together, other portions of sediment were spread thinly over surface; Observations on Path of Water: Water cut several channels through the sediment, running in various directions; Final Observations: Water acted as a destructive force to alter the appearance of the sediment pile; now remaining are several smaller sediment piles. 1. Sample answer: Not as much sediment will move. 2. The more water there is, the more erosion will occur.

Answer Key

Page 19: Chapter 2
Active Reader: 1. convection currents; 2. Answers will vary.

Page 20: Chapter 2
Active Reader: 1. Circle: volcanic activity, uplifting; 2. Subduction occurs when one plate is sucked under another plate at a convergent plate boundary. 3. Sample answer: The mountains will be much lower due to erosion.

Page 21: Chapter 2
Active Reader: 1. Sample answers: round, rotation, pattern; The rocks follow a pattern of change over time. 2. igneous, sedimentary, metamorphic
Focus Questions: 1. Crustal deformation occurs when plates interact and the crust folds over onto itself. The crust can be pushed up to form a mountain. 2. magma cools, sedimentary rocks, sediment subducted, metamorphic rocks

Page 22: Chapter 2
Active Reader: 1. Sample answer: incline; a sloping surface

Page 23: Chapter 2
Active Reader: 1. An anticline results when pressure within the Earth causes the rock layers to fold upward. A syncline results when pressure within the Earth causes the rock layers to fold downward. 2. Underline: Wendy tells Charlie to think of a rug on the floor. Pushing on the sides of the rug would cause it to fold and form small curves.

Page 24: Chapter 2
Active Reader: 1. Constructive; The crust is being built up, not worn away. 2. Moved to a different location
Focus Questions: 1. They all rearrange rock layers. 2. Pressure can cause a fault to form. When the pressure becomes too great, it causes the surfaces on either side of the fault to move significantly.

Page 25: Chapter 2
Stop and Think
1. (3); 2. (4); 3. (4)

Page 26: Think Like a Scientist
Satellite Images: Observations will vary.
U.S.A.: alluvial fan; China: alluvial fan; Egypt: delta; Russia/Kazakhstan: delta; Bangladesh/China: delta

Page 31: Check Understanding
1. (2); 2. (4); 3. (1); 4. (1)

Page 32: Check Understanding
5. Faulting; 6. A fault is caused by pressure in the Earth. 7. Sample answer: Mountain; 8. Sample answer: A mountain is formed when two plates collide. Sometimes, this results in a volcanic eruption, which rapidly adds new layers of rock to Earth's surface. These are constructive natural processes. Then, erosion occurs over time and wind, water, and ice can wear away the mountain.