FOCUS ON SCIENCE

Rocks, Minerals, and Fossils

Advanced Level

Earth Science
Geology

FOCUScurriculum

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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.

Beyond the use of reasoning and consensus, scientific inquiry involves the testing of proposed explanations involving the use of conventional techniques and procedures and usually requiring considerable ingenuity.

Use conventional techniques and those of their own design to make further observations and refine their explanations, guided by a need for more information.

Use appropriate tools and conventional techniques to solve problems about the natural world, including: measuring, observing, describing, classifying, sequencing.

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

Interpret the organized data to answer the research question or hypothesis and to gain insight into the problem.

Use and interpret graphs and data tables

Earth Science

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

Rocks are composed of minerals. Only a few rock-forming minerals make up most of the rocks of Earth. Minerals are identified on the basis of physical properties such as streak, hardness, and reaction to acid.

Fossils are usually found in sedimentary rocks. Fossils can be used to study past climates and environments.

The dynamic processes that wear away Earth's surface include weathering and erosion.

The process of weathering breaks down rocks to form sediment. Soil consists of sediment, organic material, water, and air.

Erosion is the transport of sediment. Gravity is the driving force behind erosion. Gravity can act directly or through agents such as moving water, wind, and glaciers.

Rocks are classified according to their method of formation. The three classes of rocks are sedimentary, metamorphic, and igneous. Most rocks show characteristics that give clues to their formation conditions.

The rock cycle model shows how types of rock or rock material may be transformed from one type of rock to another.

Life Science

Individual organisms and species change over time.

Extinction of a species occurs when the environment changes and the adaptive characteristics of a species are insufficient to permit its survival. Extinction of species is common. Fossils are evidence that a great variety of species existed in the past.

Many thousands of layers of sedimentary rock provide evidence for the long history of Earth and for the long history of changing lifeforms whose remains are found in the rocks. Recently deposited rock layers are more likely to contain fossils resembling existing species.

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

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

Encourage students to develop nonfiction literacy skills by using the Active Reader questions and activities. Also suggest that they . . .

- 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 5–32

Assessments: print pages 23–36

Answer Key: print pages 37–40

FOCUS ON SCIENCE

Rocks, Minerals, and Fossils

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

Continents clash together. These sometimes violent occurrences melt rocks and minerals creating magma. Magma flows through volcanic vents spewing lava to Earth's surface, both on land and under the ocean. Pressure on Earth compacts and binds materials together. Living organisms eventually die and become buried.

What do these events have in common? The result of these activities is the formation of rocks, minerals, and fossils.

Trilobite fossils like the one shown here are commonly found in the soils of southeastern Pennsylvania.

Table of Contents

Build Background

Predict

Is there a difference between rocks and minerals? Do they share anything in common? Write a few words explaining what you think the similarities and differences are between rocks and rocks and minerals.

_____

_____

Brainstorm

What kinds of rocks and minerals are you already familiar with? (Hint: Gems, such as diamonds, are minerals.) List as many rocks and minerals as you can on the lines below. Then, look for these words as you read this book. If you find the name of a rock or mineral you listed below, come back here and circle it. After you have completed the book, come back again and add to the list.

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

Define

Based on the list above, write your own definition for the terms rocks and minerals. Use some of the examples listed above in your definitions.

1. rocks: _____

2. minerals: _____

Starting Points

Key Vocabulary

Rate Your Knowledge

The words listed below have to do with rocks and minerals. Each word is important, but some of them may be new to you. Rate your knowledge of each one 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 . . .
biogenic			
cleavage			
crystal			
fossil			
geology			
igneous			
lava			
magma			
metamorphic			
sedimentary			

Circle the word in each sentence that contains the root.

sedi-

1. When I finished my tea, I noticed that sediment had settled on the bottom of the cup.
2. We have sedimentary rocks around here, even though there are no more rivers or lakes.

-morph

3. Animated TV characters can metamorphose from one person into another on-screen.
4. Metamorphic rocks must be mined from under Earth's surface.

ign-

5. The driver turned the ignition on the car, and it fired right up.
6. Mom lit a match to ignite the campfire.
7. We found the igneous rock close to the volcano.

Starting Points

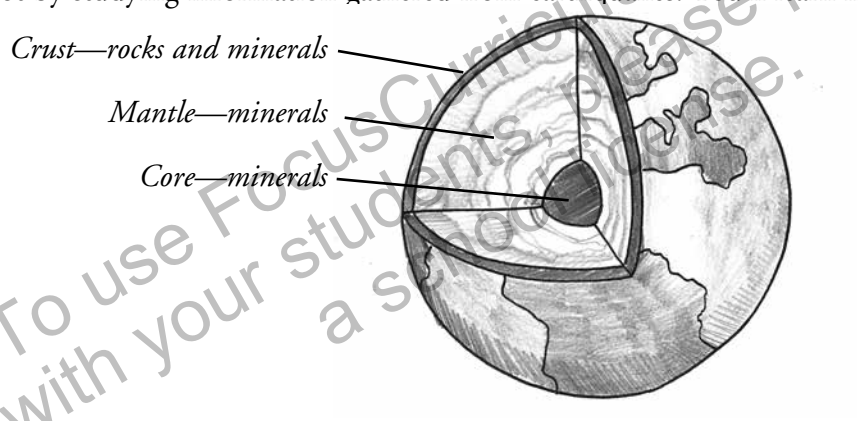
Key Concepts

Studying the Earth

Geology is the study of Earth. This includes Earth's crust and what it is made of. The planet has three main parts: the crust, the mantle, and the core. Although the crust is generally only about twenty-five miles thick, and about six miles thick under the ocean, all mining and drilling happen at the crust.

As difficult as it is for us to drill through all the rock in the crust, the mantle is even more dense. Scientists believe that the core, in the center of Earth, is hot molten lava around a solid metal ball.

Where do scientists get their ideas about the structure of Earth if no one has ever been to the mantle or core? Geologists can learn a lot by studying information gathered from earthquakes. You'll learn how as you read this book.



Geologists and Rockhounds

Geologists work in a variety of fields. Some study the history of the planet. Others work with engineers to ensure new buildings and other construction projects are safely built on Earth's surface. Others monitor activity around the globe to predict disasters such as earthquakes, floods, landslides, and volcanic eruptions.

Some people study Earth's surface for fun. Many people like to find, collect, and classify rocks and minerals as a hobby. These people are called **rockhounds**. They often have clubs. Some people polish rocks and minerals as a hobby, others do it as a career. A person who likes to polishes, cuts, and engraves precious rocks and minerals is called a **lapidary**.

ACTIVE READER

1 Extend *The word geologist, one who studies the Earth, is applied to scientists working in a variety of careers. Read the list below. Write G beside the people who would need to know something about geology.*

_____ *volcanologist (studies volcanoes)*

_____ *mineralogist (studies minerals)*

_____ *biologist (studies life sciences)*

_____ *paleontologist (studies fossils)*

_____ *novelist (writes novels)*

_____ *hydrologist (studies water underground)*

What does the suffix -ist *mean?*

_____

Hands On Science

The Difference

Although many people use the word rocks to describe both rocks and minerals, the two are not the same.

1. **To examine the differences, get a rock from outside. Look for something bigger than a pebble. Then, borrow a gem such as an opal necklace or onyx tie tack from an adult. A gem is a type of mineral.**
2. **Use the chart below to compare the rock and the mineral. In the space next to the word Rock, write where you found the rock. Next to Mineral, identify the type of gem it is.**

Rock _____	Mineral _____

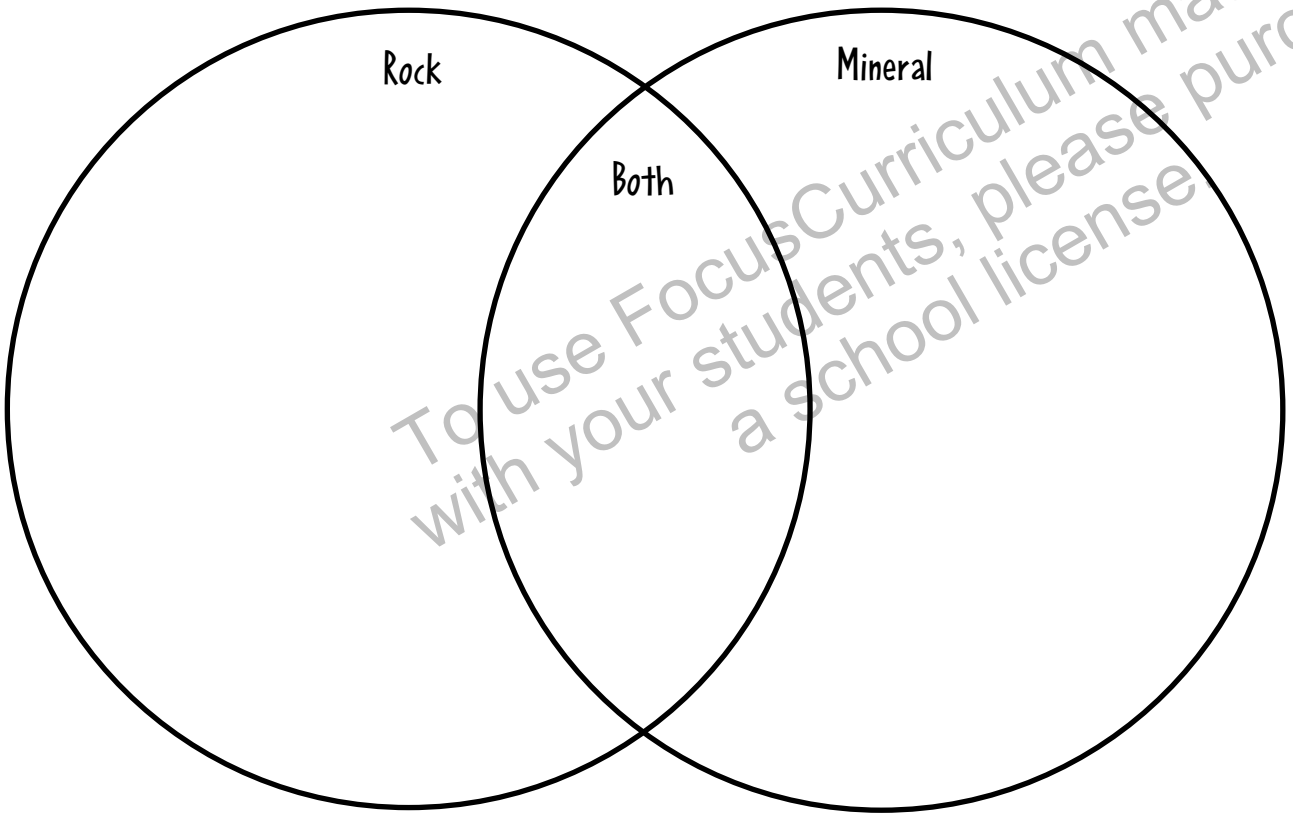
3. **Now look at the rock. Hold it up to the light. Look at it in a place with no light, such as a closet. Examine it upside down and from the back and front. Write as much as you can in the box to describe your rock. Then do the same with your mineral. Use your own words as well as words from the list below.**

Geologist's Adjectives

Hard	Soft	Light	Heavy	Dark	Bumpy	Smooth
Rounded	Jagged	Layered	Shiny	Sparkly	Glowing	Dull
Green	Red	Yellow	Blue	Black	Tan	Speckled

The Difference *(continued)*

4. Think about the differences between your rock and your mineral. What traits did you notice? Create a Venn diagram to record your comparison. List characteristics they share in the middle section. Then list the characteristics that are unique to each stone in the circle under its own label.



Good to Know

Earth's crust is made of rocks and minerals. Even dirt and sand are just worn down rocks, minerals, and organic material. Geologists think that Earth's core is super-heated liquid iron and nickel, two minerals we see every day.

Most people don't bother to distinguish between rocks and minerals, but there is a difference between the two. Rocks and minerals are found in different places on Earth. They are also made up of different substances.

Chapter 1 Rocks Versus Minerals

FOCUS

The underlined sentences state important ideas about the differences between minerals and rocks. As you read, find out how rocks and minerals are different, looking for specific features that set each apart from the other.

Similarities and Differences

Minerals are found in nature and have a **crystalline** structure. The atoms or molecules in a crystal are arranged in a pattern that is repeated over and over. Salt, for example, is a mineral with crystals shaped like a cube. Minerals can be found throughout Earth and its various layers and are composed of all the same material.

Rocks, on the other hand, are only found on Earth's crust and are made of different combinations of various minerals. One rock may contain the same minerals as another, but the two rocks will look and act completely different. This is because the rocks contain different amounts of the same minerals or were formed under different Earth processes.

Various Earth processes, such as blowing wind, flowing rivers, and erupting volcanoes, break up and recombine minerals to create rocks. For example, a mineral can form if a gas condenses to a liquid and then freezes to a solid. Minerals also may be transformed into different rocks due to extreme pressure or heat beneath Earth's surface.

Gypsum is a mineral that can grow in a crystalline shape.

Rocks are made up of pieces of various minerals and other substances.

ACTIVE READER

1 Differentiate *What is the difference between rocks and minerals?*

_____

_____

_____

2 Relate *What familiar cold-climate substance is crystalline?*

_____

Web Quest

Some minerals are elements. Elements are the basic building blocks of all matter around us. They will not change their basic features under any circumstances, even extreme heat or pressure. You know many of these elements, such as iron and gold. Use the Internet to find out more about elements, especially minerals that are elements. You may be surprised to find that you know more about elements than you thought.

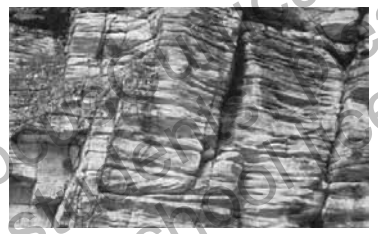
Igneous Rocks

All rocks on Earth begin as **igneous** rocks. Igneous rocks come from volcanoes. Volcanoes sometimes erupt, and **lava** may flow from a vent. As ash and lava cool and harden, rocks, such as basalt, granite, or pumice, form. You can tell how fast a rock cooled down by looking at the crystals of the minerals that form the rock. When a rock cooled quickly, like many types of pumice, you can not only see crystals, but also air pockets.

Pumice is an igneous rock.

Sedimentary Rocks

Wind, ice, and water erode rocks and minerals. Eventually they end up at the bottom of a lake, glacier, or the ocean as sediment. Water or ice presses down on the mixture of pieces, cementing them together to form **sedimentary** rocks. Because they form in thin sheets, these rocks often look layered. Sandstone and shale are two types of sedimentary rock that geologists studied to figure out when glaciers covered most of New York.



Sandstone is a sedimentary rock found in layers.

Because organic material can also weather, sedimentary rocks can be biogenic. This means that minerals could be compressed with plant materials, shells, bones, coral, and even animal bodies. Coal, which is mined in nearby Pennsylvania, is formed by pressurizing plant material. Fossils are created when a plant or animal part becomes preserved in rock.

coal

fossil

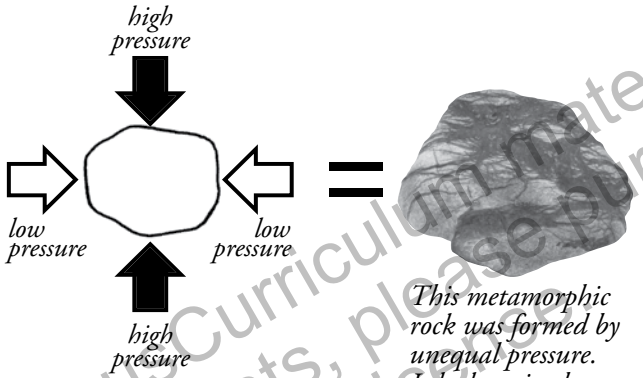
ACTIVE READER

1 Interview *Talk to a parent or another adult about rocks and minerals in your city or county. List the types of rocks or minerals found in your area.*

Metamorphic Rocks

Finally, igneous and sedimentary rock can eventually be changed into **metamorphic** rock. Metamorphism occurs when any previously existing rock is buried under layers of other rock. The deeper the rock is buried the higher the pressure becomes and the hotter it gets. Eventually, the rock must adjust to the new conditions, whether it is baked, or squeezed, or both, and in the process becomes a metamorphic rock.

Many types of metamorphic rocks appear to be striped, or banded. This is caused by uneven pressure as the rock was formed. Marble, which is not banded, comes from overheated limestone.



This metamorphic rock was formed by unequal pressure. It looks striped.

FOCUS QUESTIONS

1. What sets minerals and rocks apart from each other?

2. How are rocks and minerals alike?

ACTIVE READER

1 Summarize *What are the three types of rocks. How are they formed?*

Good to Know

When examining a rock or mineral to learn what it is, geologists look at much more than just color and size. They compare it against a rating scale for hardness. They study what happens when breaking the substance apart. They test to see if it is magnetic.

FOCUS

This section discusses how rocks are changed from one form to another. As you read, look for a pattern of steps. What are the steps in the process? Is the process random, or can you predict what will happen first, next, and last?

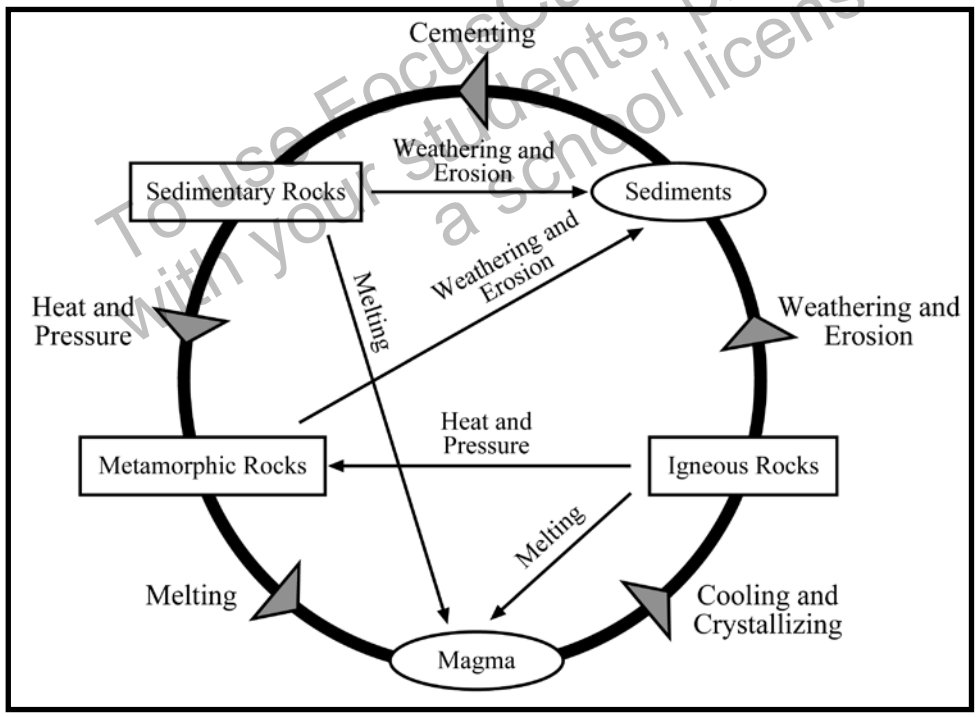
The Rock Cycle

The rock cycle is the sequence of events that causes rocks to form throughout Earth. It is used to explain how the three rock types are related to each other and how Earth processes change a rock from one type to another through time. The movement of plates beneath Earth's crust is responsible for the recycling of rock materials and is the driving force of the rock cycle.

Rocks are "born" as volcanic eruptions eject large amounts of **magma** onto Earth's surface, or the magma is trapped beneath the surface. All rocks start as magma and become igneous rock as they cool and harden. These rocks may include basalt, granite, and obsidian.

Many Earth processes may happen at this point. Wind and water may move the rock, breaking it into pieces, or sediment. Sediment collects and is pressed together over time. Eventually, it becomes sedimentary rock. Sedimentary rock include slate, sandstone, and limestone.

Then water and newer sedimentary rock bury and pressurize the sedimentary rock. Heat and pressure transform it into metamorphic rock.



ACTIVE READER

1 Explain *What is the difference between magma and lava?*

_____

_____

_____

_____

_____

_____

Web Quest

When playing "Twenty Questions" someone may begin by asking if a subject is "animal, vegetable, or mineral." But not everything in the universe fits into these three classifications. Glass, fungus, energy, and oxygen are all examples of things that do not fit any of these categories. Use the Internet to find other classifications. Then find and list items that fit in each one.

As metamorphic rock is pressed deep under the surface, it might again be melted as magma. Ultimately, all rock is covered over and is eventually spewed up again as lava from a volcano. The cycle starts all over.

The rock cycle is an ongoing process. It takes millions of years to complete a cycle. Like other cycles in nature, such as the water cycle, the rock cycle ensures a steady recycling of geological materials, and it explains the origins of various rock types.

Geologists use their knowledge of the rock cycle to gather information about the age of Earth, and to learn about specific formations on Earth.

Magma from deep in Earth erupts from a volcano as lava. This is the start of the rock cycle.

FOCUS QUESTIONS

1. What is likely to happen to an igneous rock on the Earth's surface?

_____

_____

2. Complete the diagram below.

igneous ⟶ sedimentary ⟶ metamorphic ⟶ magma ⟶ _____

ACTIVE READER

1 Describe *Name a weather event that is likely to affect rocks and describe what might happen to the rocks as a result of this weather.*

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Stop and Think

This page will help summarize what you have read so far. Use the tip to helpyou answer the questions.

Tip:
An effect is the result of a cause. Reread page 14 to recall the effect of water and ice compressing rock together.

Base your answer to questions 1 and 2 on your knowledge of science.

1. Complete the chart below to show a cause and effect relationship.

Cause	Effect
Water and ice press down on bits of rock, cementing them together.	

2. Write a sentence about the type of rock that results from this process and give examples.

_____

_____

3. Which statement best describes the relationship between rocks and minerals?

(1) Rocks and minerals are the same thing.
(2) Rocks are compounds; minerals are elements.
(3) Rocks are made up of combinations of minerals.
(4) Rocks are formed by erosion; minerals are formed by pressure.

Dear Ms. Understanding,

I thought salt was the stuff I put on food. Now I hear that a salt is anything that ends in *–ide, –ite,* or *–ate*. Should I be calling my salt "saltite"?

Muddled in Manhattan

Dear Muddled,

Actually both are correct—although there's no such thing as "saltite." The condiment you sprinkle over your food, which we call table salt, is actually the mineral known to scientists as sodium chloride. But any mineral that makes an acid less acidic is considered a salt. You may use some of these salts, such as Epsom salts (bath salts) or baking soda (sodium bicarbonate), at home.

Ms. Understanding

Chapter 2 Properties of Rocks and Minerals

FOCUS

The underlined sentences state important ideas about the properties of rocks and minerals. Read on to learn about the different properties that set rocks and minerals apart from each other.

Properties

When you analyze a character in a book, you list his or her character traits. When you analyze a rock or mineral, you examine its **properties**. A property is a quality or characteristic. A property may refer to the rock or mineral's ability to conduct electricity or how it smells. You will be examining properties of rocks and minerals in the next activity.

Some properties are easier and safer to test for than others. Often a geologist can tell what a mineral is by performing one or two simple tests. Other times, more than twenty tests may be needed to figure out what it is.

Not all tests apply to each rock or mineral. For example, gems sometimes exhibit a quality called **asterism**, which is the ability to reflect light in a certain way. This quality applies only to gems. If you have a gem handy, hold it up to the light. Your gem has asterism if you see stars of light on the surface of the gem.

Hands On Science

Test a Rock's Properties Get a rock from outside—something bigger than a pebble. It may be the same rock you used for the first Hands On Science feature, but make sure it is not something you wish to keep. You will be examining the rock's properties like a geologist. Use the chart on the next page to document your findings. Be as thorough as possible in your descriptions.

ACTIVE READER

1 Predict *List different properties that you think may set minerals and rocks apart from each other.*

_____

_____

_____

_____

_____

_____

_____

2 Relate *Other words containing the root astr- include asteroid and astronaut. What do you think the root means?*

_____

_____

_____

_____

Location	Color	Luster	Transparency
Streak	Odor	Feel	Magnetism

1. **Location** – Describe where you got your rock.
2. **Color** – Look at your rock from several angles. It may change color in different kinds of light, such as sunlight or filtered light. Examine it dry, then wet. Be sure to describe all the colors you see.
3. **Luster** – How does your rock look in the light? Dull, earthy, greasy, pearly, waxy, metallic, or glassy?
4. **Transparency** – Hold your rock up to the light again. If you can see through it, it is transparent. If light comes through it, it is translucent. If light does not go through it at all, it is opaque. Write one of these three words in the box.
5. **Streak** – Rub your rock across a light-colored cutting board. Write down the color of the powder left behind. It may be quite different from the color of the rock itself. Hematite, a gray mineral, has a blood-red streak. Gold has a yellow streak, while pyrite (fool's gold) has a black streak! Remember to clean the cutting board when you finish.
6. **Odor** – Smell your rock after rubbing, crushing, or striking it. Not all rocks will smell, but many minerals do! Common smells include sulfur, earth, garlic, or clay.
7. **Feel** – It might be obvious how your rock feels in your hand. But close your eyes and see if you notice even more than you did before. Is it soft, hard, oily, jagged, smooth, greasy, or something else altogether?
8. **Magnetism** – Use a compass or the strongest magnet you have. To fill in this box, you may write *weak, attracted, strong,* or *none.*
9. If you have observed anything else about your rock, use the extra boxes to label and describe these properties. See the next page for examples of other properties and descriptions you might use.

Other Properties

Cleavage

Cleavage is the way a mineral breaks. Some rocks break cleanly along even surfaces. They are said to have good cleavage. Others break in jagged surfaces. This quality can only be tested by breaking a rock or mineral. If a rock or mineral has good cleavage, it will break smoothly every time. If you already know how your rock breaks, add that information to your chart. Words like jagged, uneven, splintery, or crumbly may apply.

This calcite specimen shows good cleavage. It breaks evenly.

Hardness

One very soft rock is talc, which can be ground up as talcum powder. This rock is so soft that it is used as an example of a 1 on a hardness scale called the Moh's Scale of Hardness. This scale goes from softest to hardest —1 being softest, 10 being hardest. The hardest mineral, 10 on the scale, is a diamond. In between is copper, 3.5; quartz is harder at 7.

To test a rock for hardness, geologists often employ the scratch test, using quartz to try to scratch their rock. If quartz can scratch the specimen, then it is lower than 7 on the hardness scale. If quartz can't scratch the specimen, then it is higher than 7.

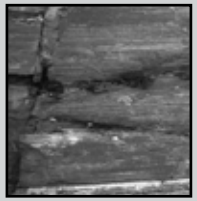
Moh's Scale of Hardness

1—Talc
2—Gypsum
3—Calcite
4—Fluorite
5—Apatite
6—Orthoclase
7—Quartz
8—Topaz
9—Corundum
10—Diamond

Good to Know

The rock you used in the Hands On Science activity on pages 19 and 20 may have come from your yard or a park, but did it come from New York originally? Or, was it transported here?

Rocks from certain places have much in common, which helps identify them. For example, a rock from Hawaii will most likely be igneous. Hawaii is a volcano. A rock from New York will most likely be sedimentary.

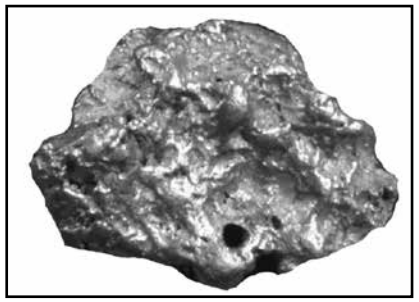


Bluestone is a sedimentary rock commonly found in New York State.

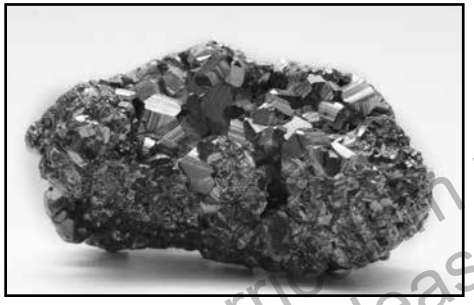
Obsidian is an igneous rock commonly found in Hawaii.

Specific Gravity

The **specific gravity** of a rock sample is a comparison of the density of a rock or mineral to the density of water. In some cases, the rock or mineral may be much less dense than water. For example, pumice is less dense than water, so it floats in water. Specific gravity can help rockhounds tell gold from pyrite, or fool's gold. Gold has a higher specific gravity than pyrite.



gold



pyrite

Other properties to test for include solubility (how quickly a rock dissolves), reactivity to other types of light, fusibility (how easily it blends with another rock), taste (don't try tasting—some minerals are poisonous), crystalline structure, and conductivity with heat and electricity. Some minerals are even tested for radioactivity!

FOCUS QUESTIONS

1. What is a geologic property?

2. Choose one geologic property and describe it in your own words.

ACTIVE READER

1 Evaluate *Choose one property mentioned on this page and tell why it was not included on the chart of properties to test.*

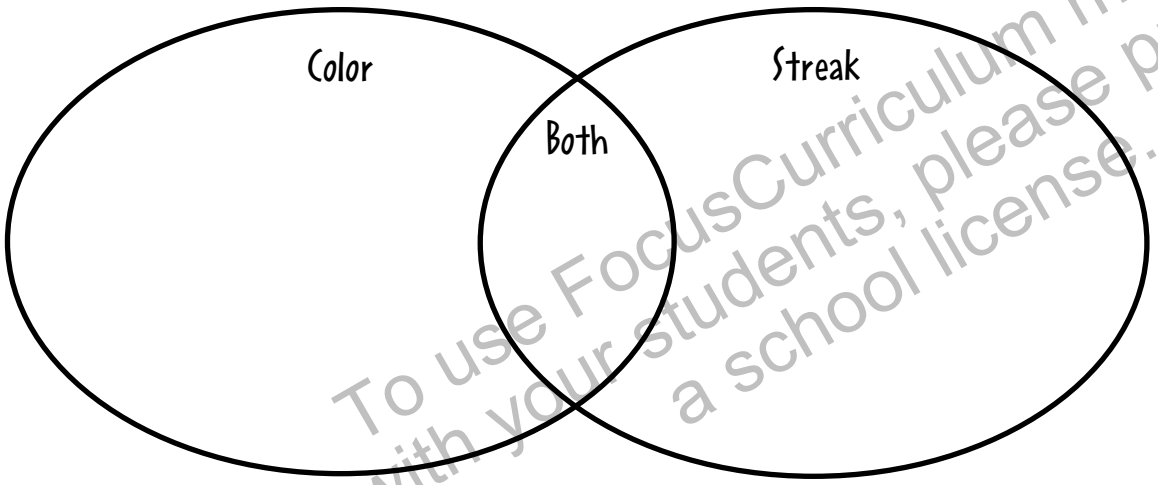
Stop and Think

This page will help summarize what you have read so far. Use the tip to helpyou answer the questions.

Tip:
To compare two things, list their similarities. To contrast them, list their differences.

Base your answers to questions 1 and 2 on your knowledge of science.

1. Complete the Venn diagram comparing color and streak as properties.



2. Write a sentence to explain the diagram.

_____

_____

3. Which is not a property used to determine a mineral's identity?

(1) odor (3) taste
(2) color (4) weight

Dear Ms. Understanding,

I have a rock that attracts the needle of a compass. Does that mean that my rock is the mineral iron, or does it just have some iron in it?

Wondering in Williamsbridge

Dear Wondering,

Good question! Iron is magnetic and your rock may be iron or contain iron. But several other rocks and minerals are magnetic as well. Even salt is slightly magnetic. So, do some other tests and try to figure out what you've got.

Ms. Understanding

Chapter 3 Natural Processes at Work

FOCUS

As you read this section, look for information about how rocks become part of the soil.

Weathering is the process of breaking rocks down into smaller and smaller pieces. There aretwo types of weathering: mechanical and chemical. Mechanical weathering occurs when changes in temperature cause rocks to crack. Mechanical weathering can also occur when wind or water cause rocks to rub against each other and break apart. The ice expands as it forms from water, pushing sections of rock apart. Mechanical weathering results in solid fragments of rock that are moved by wind and water. These fragments collect and form sediment.

Erosion is the transportation of sediment. Water and wind are important ways in which sediments, larger particles, and rocks are moved from one place to another. Gravity is also important in the process of erosion. For example, gravity is at work when landslides move mountains of snow or huge boulders.

Chemical weathering occurs when the materials in the rock are changed through chemical reactions. This often causes the rock to break apart. For example, limestone is made of a chemical called calcium carbonate. Calcium carbonate can dissolve in water that is slightly acidic. Limestone caves are geologic examples of this process. Over time the water dissolves the limestone and carries it away leaving a space inside the Earth. A cave is formed. Then, stalactites and stalagmites build up over time as dripping water redeposits calcium carbonate.

When calcium carbonate dissolved in water ends up in a still, shallow pool, chalk can be deposited at the bottom of the pool as the water evaporates. Chalk and limestone are different forms of the same chemical, calcium carbonate, with a few other things mixed in.

As materials that have undergone weathering and erosion build up over thousands of years, the buried layers beneath become compacted and more dense. Sedimentary rock is formed. The soil layers on top are not as dense and may consist of sand, clay, and organic matter.

ACTIVE READER

1 Identify *Write M on the line if the process described is mechanical. Write C on the line if the process described is chemical.*

_____ *the scarring of a rock face during a windstorm*

_____ *the formation of stalactites and stalagmites in a cave*

_____ *the rusting of metal*

This cave was formed by the chemical weathering of limestone.

Metamorphism

Limestone and chalk are both sedimentary rocks. But if they are buried deeply enough, they may changed by pressure and heat into marble, a metamorphic rock. Marble is another form of calcium carbonate. When sedimentary or igneous rock is subjected to intense heat and pressure, its crystalline structure changes and metamorphic rock is created.

FOCUS QUESTIONS

1. **Which type of rock results, in part, from the process of weathering?**

_____

_____

ACTIVE READER

1 Recall *How are marble and chalk alike and different?*

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

FOCUS

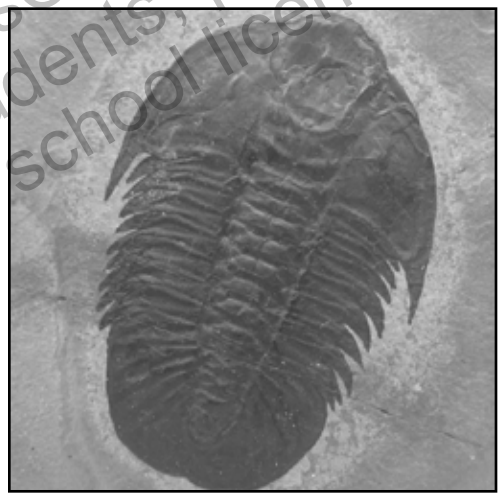
In the previous section, you learned that weathering of rock happens because of forces such as wind and water and results in the formation of sediment and sedimentary rock. Read this section to find out about how living things have led to the creation of soil.

The Interaction of Living and Nonliving Things

Living things play a role in forming sediment and rock as well as wind and water. Imagine the Earth millions of years ago when plants first appeared on land. Tiny mosses and ferns probably grew at the edges of a lake or sea. Soon they gained a foothold on a nearby rock. These early plants adapted to life on land and began to cover the rocky shoreline. Eventually, roots and stems grew in the pores and cracks of rocks and began to split them into smaller pieces, just as water does when it turns to ice.

Like all living things, plants die, and the organic material that makes up the plant falls to the ground and **decomposes**. This decaying matter becomes intermingled with dust, sand, silt and small rocks and over time forms soil. Larger life forms such as leaves with rigid parts and small animals with shells or bones die and become buried. Soil covers them, builds up over time, and forms layers.

As water trickles down through the layers, the minerals it carries with it, such as calcium carbonate, can replace the decaying tissue of the leaf or small animal. Eventually, an impression of the organism is preserved in the rock that forms over time. Today, we find some of these preserved organisms as **fossils** in places where the rock is close to the surface.



Trilobites lived over 250 million years ago. Their fossils are plentiful in the soils of New York. Photo by Bryan Kemp.

ACTIVE READER

1 Analyze *Which word on this page is a synonym for decomposing?*

_____

_____

2 Infer *Where would be a good place to hunt for fossils?*

_____

_____

_____

_____

_____

_____

_____

Good to Know

The state fossil of New York is Eurypterus Remipes, a prehistoric sea scorpion. Eurypterus preyed on trilobites and other creatures of the sea.

The Fossil Record

Analyzing fossils found in one place and comparing them with fossils found in other places gives scientists a fascinating picture of life on Earth in the distant past. For example, the same plant and animal fossils have been discovered in eastern South America and western Africa. In this way, the fossil record provides evidence that the continents were once together as one large land mass.

Fossils represent the remains of once-living organisms. Most of the organisms represented inthe fossil record are now extinct. The fossils found in rocks of different ages are different because life on Earth has changed so much over time. The fossil record has shown us that older species are the ancestors of younger ones. In this way, the fossil record provides evidence that species have evolved and changed over time.

Studying the fossil record can take us back to a time when there were no humans. It can take us farther back to a time when there were no mammals, and even farther to a time when there were no living organisms on our planet. By studying the fossil record, we can plot the formation of continents by the movement of tectonic plates. We can also learn about how the climate on Earth has changed over millions of years.

FOCUS QUESTIONS

1. **What are two things scientists have learned from studying the fossil record?**

ACTIVE READER

1 Infer *Why are so many of the species represented in the fossil record extinct?*

Stop and Think

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

1. Which term best describes sediment?

(1) chemical weathering
(2) acidic water
(3) limestone rock
(4) fragmentary rock

2. Limestone, chalk, and marble are different forms of

(1) weathering and erosion
(2) calcium carbonate
(3) metamorphic rock
(4) sedimentary rock

3. The fossil record provides evidence for several scientific ideas. Identify one such idea and explain the evidence that the fossil record provides.

Dear Ms. Understanding,

If fossils are the remains of dead organisms and dead organisms are part of the soil, does that mean that all those dead bugs and leaves I see in the soil are fossils?

Buggy in The Bronx

Dear Buggy,

You are correct that there are many dead bugs and plants in soil, but remember that fossils are not just the remains of dead animals. Fossils are made of minerals deposited from the soils above the animal and plant remains. Over millions of years those remains change until they actually become a type of rock. So, in the end, the organic material you see in the soil is not old enough to be called fossils.

Ms. Understanding

Hands On Science

Rocks Lab Do different rocks change in the same way over time? In this book you learned that rocks break down over time to make the sands, clays, and gravel in different soils. In this activity, go deeper and gather data from three types of rocks to understand how different soils are formed over time.

Materials:

4 plastic containers to hold rock samples

2 rock samples: 1 sedimentary, 1 igneous or metamorphic

1 refrigerator with a freezer

goggles

hammer

gloves

water

Procedure:

1. Mark the plastic containers "freeze/thaw." Label them "Sedimentary, Sample A," "Sedimentary, Sample B," and similarly for the igneous or metamorphic samples.
2. Wearing goggles and gloves, use the hammer to break the rocks into at least 2 separate pieces.
3. Place each rock in a plastic container. Fill the container with water until the rock is barely submerged.
4. Observe the state of the rocks.
5. Place the rocks in the freezer for 3 hours, or until the water is completely frozen.
6. Take the rocks out of the freezer and observe their state. Note any changes in color, texture, or size.
7. Allow the water around the rocks to melt. Note any changes in color, texture, or size.
8. Repeat steps 4–7 at least 10 times. Remember: Each time the rock is covered with ice the rock experiences conditions similar to winter; each time it thaws the conditions are similar to summer.

Hands On Science

Rocks Lab *continued*

Data Table

Use the table below, or one like it that you create on you own, to track the freeze/thaw cycles.

Freeze/Thaw Cycle	Sedimentary Sample A	Sedimentary Sample B	Igneous or Metamorphic Sample A	Igneous or Metamorphic Sample B
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

Questions to Ponder:

1. Do the rocks change at the same rate?
2. If both these rocks were present in a soil, how would that soil change over time?_

Glossary

asterism – a starlike image produced in some minerals when light hits the surface

biogenic – organic; produced by living things

cleavage – the tendency of some rocks and minerals to break along smooth-surfaced planes

crystalline – made of crystals

crystals – solid parts of a rock in which the atoms or molecules are arranged in a regular, repeated pattern

decompose – the process of organic matter breaking down into the basic elements

fossils – the preserved remains of dead organisms from the remote past

geologists – scientists who study the Earth and how it was formed

geology – the study of the Earth and how it was formed

igneous – volcanic; rock formed by lava

lapidary – people who polish rocks and minerals

lava – liquid or molten rock that has reached the surface of the Earth

magma – liquid or molten rock deep in the Earth

metamorphic – rock that has been changed by the heat or pressure of the Earth

minerals – substances made of one material and found in nature

properties – qualities or characteristics

rockhounds – people who like to find, collect, and classify rocks as a hobby

rocks – substances found in nature and made of a combination of minerals and sometimes biogenic material

scale – a measure or rating

sedimentary – weathered rock that has been cemented together by the pressure of water or ice

specific gravity – the ratio of the density of a solid material to the density of an equal volume of water

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. Pumice is usually found above ground. It is less dense than water, so it floats.

   Pumice is produced by what rock-forming process?

   (1) eruption of volcanic ash

   (2) crystalization from melted rock

   (3) cementing of sediment from erosion

   (4) compressed plant and animal material

2. When rocks are forced deep within Earth, the heat and pressure change their structure.

   Which type of rock results from this process?

   (1) biogenic

   (2) igneous

   (3) sedimentary

   (4) metamorphic

3. Which is not something a geologist might do to examine a rock's properties?

   (1) Check its magnetism.

   (2) Check its conductivity.

   (3) Test to see if it reacts to light.

   (4) Find another rock to compare the two.

4. If you live in New York State, why are you more likely to find limestone than pumice in your backyard?

   (1) Because limestone is the official rock of New York State.

   (2) Because limestone is more common than pumice.

   (3) Because limestone is found closer to the Earth's surface.

   (4) Because sedimentary rocks are more common in New York than igneous rocks.

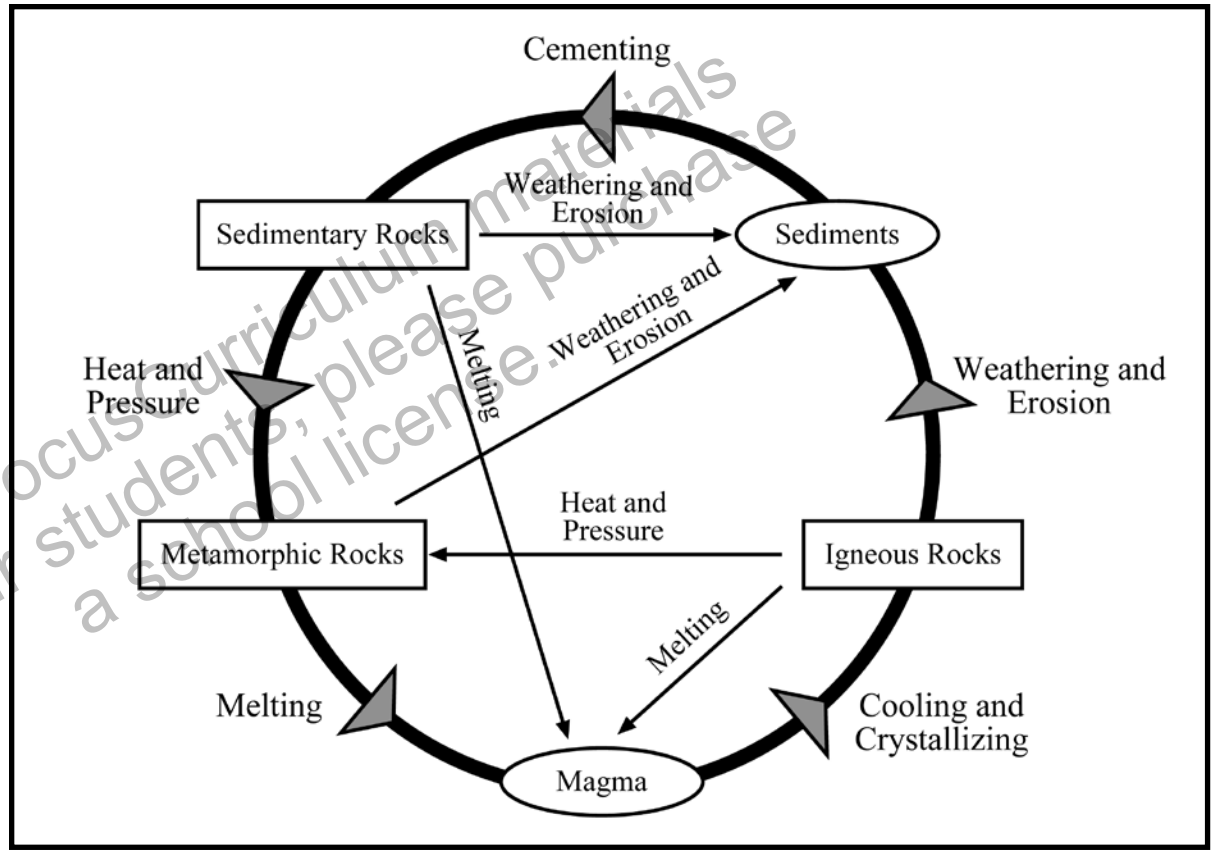
Answer Document

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

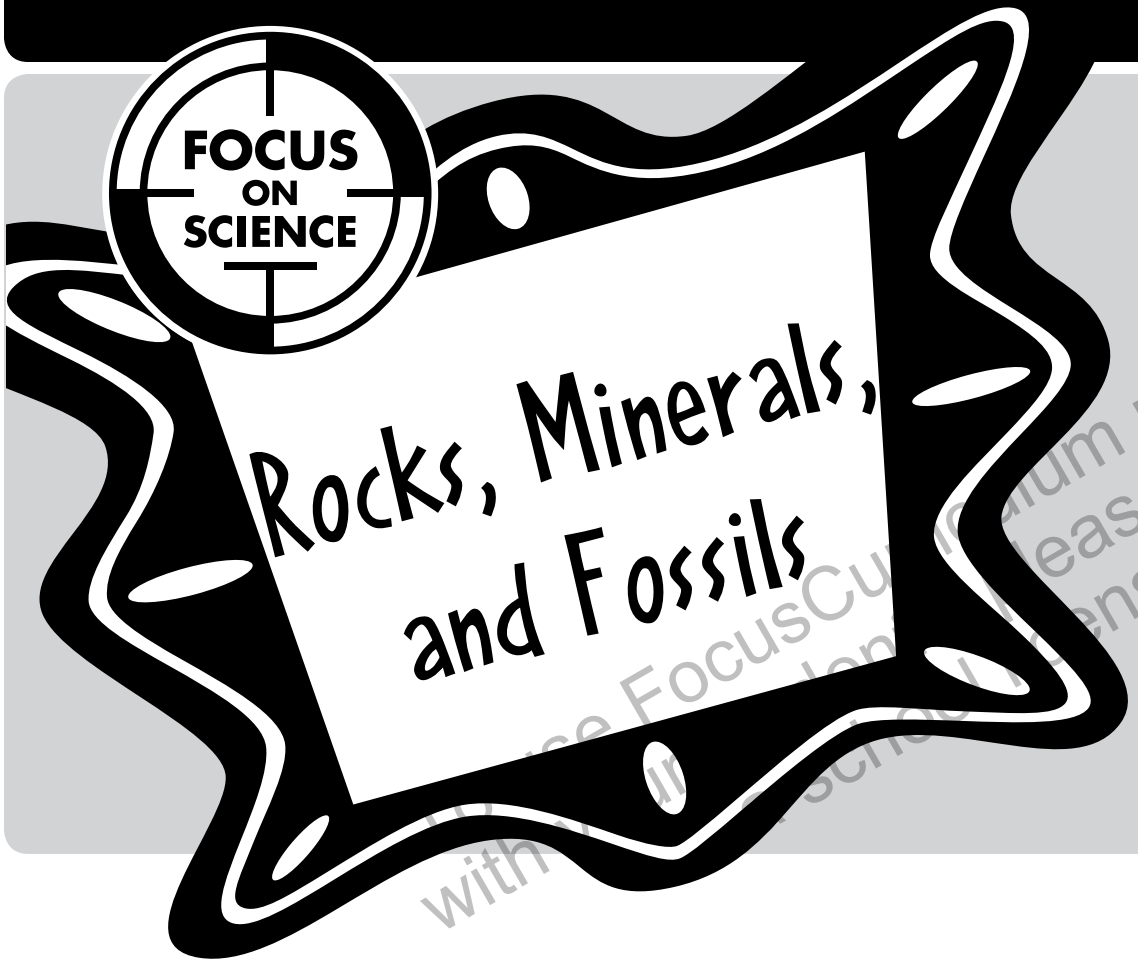
Check Understanding

Base your answers to questions 5 and 6 on the diagram below. It shows the Rock Cycle.

5. Choose one type of rock shown in the diagram. How is this type of rock formed?



6. What is one example of a rock formed from this process?



Answer Key

Answer Key

Page 8: Starting Points
Build Background
Predict: Answers will vary according to the student's prior knowledge.
Brainstorm: Answers will vary.
Define: Answers will vary.

Page 9: Starting Points
Key Vocabulary
Roots: 1. sediment; 2. sedimentary; 3. metamorphose; 4. metamorphic; 5. ignition; 6. ignite; 7. igneous

Page 10: Starting Points
Key Concepts
Active Reader: 1. Write G beside the following careers: volcanologist, mineralogist, paleontologist, hydrologist; -ist means "one who practices"

Page 11: Hands On Science
The Difference: Results will vary depending on the rock and mineral being compared.

Page 13: Chapter 1
Active Reader: 1. Minerals are composed of the same material. Rocks are composed of minerals and other substances held together.; 2. snow

Page 14: Chapter 1
Active Reader: 1. Answers will vary.

Page 15: Chapter 1
Active Reader: 1. Igneous rocks are formed from cooling lava, Sedimentary rocks are formed when eroded pieces are cemented together under pressure. Metamorphic rocks are formed by pressure and heat deep in Earth.
Focus Questions: 1. Minerals are crystalline and all made of the same thing. Rocks are made of different combinations of minerals. 2. Both are found in nature.

Page 16: Chapter 1
Active Reader: 1. Magma is molten rock found inside the Earth. When magma erupts from a volcano, it is called lava.

Page 17: Chapter 1
Active Reader: 1. Sample answer: A flood may occur, moving rock and breaking it down further. Where the rock settles, more rock may settle on top, crushing it further.
Focus Questions: 1. It is likely to be subjected to weathering and its fragments will become part of rock. 2. igneous

Page 18: Chapter 1
Stop and Think: 1. A sedimentary rock results. 2. It could be layered like sandstone or shale and may contain fossils or other biogenic material; 3. (3)

Page 19: Chapter 2
Active Reader: 1. Answers will vary but may include asterism, which is a property of some minerals, and rough texture, which suggests that a specimen is a rock. 2. star

Page 20: Chapter 2
Hands On Science: Test a Rock's Properties: Results will vary depending on the rock used.

Page 22: Chapter 2
Active Reader: 1. Properties and reasons will vary, but may include that the process is dangerous or difficult to do. Sample answer: Taste was not included because some minerals are poisonous.
Focus Questions: 1. A geologic property is a trait that helps describe a rock. 2. Sample answer: Streak is the color of a rock's powder. It can set apart one type of rock from another.

Answer Key

Page 23: Chapter 2
Stop and Think: 1. Diagrams will vary.; 2. Color and streak both have to do with the color of a rock or mineral and can help identify it. Color is the color of the actual rock, while streak is the color of its powder (which may or may not be the same). 3. (4)

Page 24: Chapter 3
Active Reader: 1. M, C, C

Page 25: Chapter 3
Active Reader: 1. Marble and chalk are both forms of calcium carbonate. Marble is metamorphic and much harder and more dense. Chalk is a sedimentary rock.
Focus Questions: 1. Sedimentary rock results from a process involving weathering, erosion, deposition, and compaction.

Page 26: Chapter 3
Active Reader: 1. decaying; 2. Sample answer: Anywhere that sedimentary rock can be found.

Page 27: Chapter 3
Active Reader: 1. Most species that have inhabited Earth are already extinct. That is because life forms are constantly changing.
Focus Questions: 1. Continents, such as South America and Africa, once formed a single land mass. Older, now extinct species of plants and animals are related to species found on Earth today.

Page 28: Chapter 3
Stop and Think: 1. (4); 2. (2); 3. Sample answer: Fossils of similar animals found on two different continents is evidence that the continents were once a single land mass.

Page 30: Chapter 3
Hands On Science: Responses will vary.

Page 25: Check Understanding
1. (1); 2. (4); 3. (4); 4. (4)

Page 36: Check Understanding
5. Sample answer: Igneous rock occurs after a volcanic eruption: the lava cools, forming the rock.; 6. Pumice and obsidian are examples of igneous rock.