FOCUS ON SCIENCE

Earth Cycles

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.

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.

Conduct an experiment designed by others.

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

Earth Science

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

Nearly all the atmosphere is confined to a thin shell surrounding Earth. The atmosphere is a mixture of gases, including nitrogen and oxygen with small amounts of water vapor, carbon dioxide, and other trace gases. The atmosphere is stratified into layers, each having distinct properties. Nearly all weather occurs in the lowest layer of the atmosphere.

The rock at Earth's surface forms a nearly continuous shell around Earth called the lithosphere.

The majority of the lithosphere is covered by a relatively thin layer of water called the hydrosphere.

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 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 5–32

Assessments: print pages 32–36

Answer Key: print pages 37–40

FOCUS ON SCIENCE

Earth Cycles

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

From the most remote mountain glacier, to the deepest ocean life forms, to the clouds in the sky, to the people we see everyday, all matter on the planet is connected by Earth's cycles. These cycles include three cycles you are familiar with: the rock cycle, the water cycle, and the atmospheric cycle

Did you know Earth's cycles interact with each other? Here's an example: Precipitation and runoff of water results in erosion, sedimentation, and the creation of sedimentary rocks. In this way, Earth cycles help move and reuse the essential chemicals that make up all matter on Earth. Land, air, water, and the living organisms within each are connected to each other by Earth's cycles.

Table of Contents

Build Background

Predict

One of Earth's cycles is the water cycle. We experience this cycle every day. Write a few sentences describing some everyday events that you think are part of the water cycle.

Brainstorm

Matter can either be a liquid, a gas, or a solid. Make a list of three different liquids, solids, and gases.

Liquids	Solids	Gases

Define

What is a cycle? Write a definition for the word and describe two different cycles that you are familiar with.

Starting Points

Key Vocabulary

Rate Your Knowledge

The words listed below have to do with earth cycles and systems. Each word is important, but some of them may be new to you. Rate your knowledge of each one by checking the appropriate column. Give the definition, if you know the word. 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, but I'm not sure what it means.	I know it well, it means...
cycle			
matter			
replenish			
finite			
atmosphere			
lithosphere			
hydrosphere			
abiotic			
evaporate			
condense			
precipitation			
photosynthesis			

Starting Points

Key Vocabulary

Use Roots to Unlock Meaning

Many science words come from Greek or Latin. Knowing Greek and Latin roots can help you unlock the meaning of many science terms. Circle the word in each sentence that contains the root. Think about what each word means in context. Then explain what you think the root means.

***bio-* means** _____

1. **I just finished reading a biography of my favorite movie star.**
2. **I want my family to help the environment by using only biodegradable shopping bags.**
3. **When I go to college, I want to study chemistry, biology, and physics.**

***hydro-* means** _____

4. **It's important to drink lots of water and to stay well hydrated.**
5. **I saw a show about an amazing boat called a hydrofoil that travels on top of water.**

Multiple Meanings

Sometimes a word can have several meanings. These can be very different meanings depending how the word is used and what context it is referring to. Look up the following word in a dictionary. Note the number of different definitions there are listed for this word and write down the definition you think best applies to the context of Earth cycles. Explain your choice.

1. ***system***

_____

_____

_____

Starting Points

Key Concepts

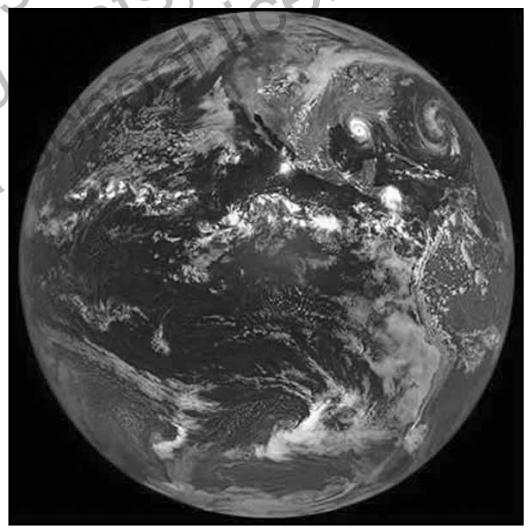
The Ever-changing Earth

By now you've learned that Earth is a place of constant change. From the cycles of night and day caused by the rotation of Earth, to changing weather patterns around the globe, to plate tectonics and mountain building. Almost every thing on Earth is connected in one big system that links the air, the water, the land, and the living organisms in each. All of Earth's cycles interact with each other in one way or another. Together, they create the life-sustaining environment that makes our planet unique.

This connectedness has been explained with the story of the "butterfly effect." The story is a metaphor that suggests that the flapping wings of a butterfly in Africa can set off a chain of events that result in a hurricane in the Atlantic. While this may not be literally true, it makes the point that small events can affect big events in ways that are difficult to predict.

There are three important Earth cycles that you know something about: rock, atmospheric, and water. Each cycle serves an important role in helping life exist on Earth by moving matter through Earth's systems.

So next time you take a walk outside and see a butterfly land on a flower, feel a breeze on your face, see a stream washing over polished rocks, or see the moon rise over the horizon, remember you are looking at Earth's dynamic cycles at work. And don't forget that you—eating, sleeping, living, breathing you—are also part of this incredible planet we call Earth.



Earth is always changing. Earth's changing cycles work together to maintain life on Earth.

ACTIVE READER

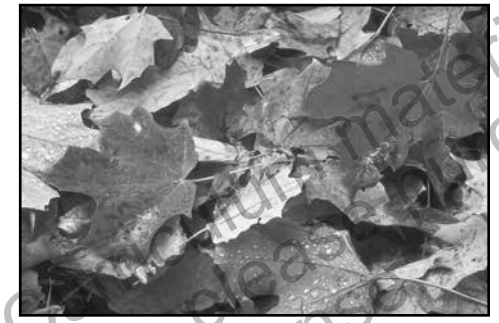
1 Analyze *Think of two Earth processes that are related to each other. Explain how.*

Chapter 1 Cycles Sustain Life

FOCUS

This section is about understanding Earth's cycles. As you read, find out what defines a cycle. Pay attention to the different ways energy and matter are supplied to the Earth.

Understanding Earth Cycles



Seasonal change is an example of an Earth cycle.

What Is a Cycle?

Every year when you head back to school, what do you notice? The leaves start to change color, the days get shorter, and the temperature gets colder. This is a sign that summer is ending and autumn is beginning. But this change of season is not an isolated event. It is part of a cycle.

A cycle is a series of related events that repeat over a certain period of time. The seasons change at roughly the same time every year. In the same way, the events in any cycle happen in the same order and in roughly the same amount of time during each cycle. The change of seasons is only one example of the many cycles that make Earth a **dynamic** place.

Earth's Most Important Cycles

Earth is the only planet in our solar system capable of supporting life as we know it. This is possible because of a series of Earth cycles called **biogeochemical cycles**. Biogeochemical cycles recycle matter throughout both living (animals and plants) and non-living (rocks) things on Earth. There are three main biogeochemical cycles on Earth: the rock cycle, the atmospheric cycle, and the water cycle.

The word biogeochemical is formed from parts of three words: biology, geology, and chemistry. Biology refers to life, geology to Earth, and chemistry to physical matter. By putting these word parts together, the word suggests how biogeochemical cycles connect all aspects of our planet.

ACTIVE READER

1 Illustrate *Draw a picture of an Earth cycle you often see.*

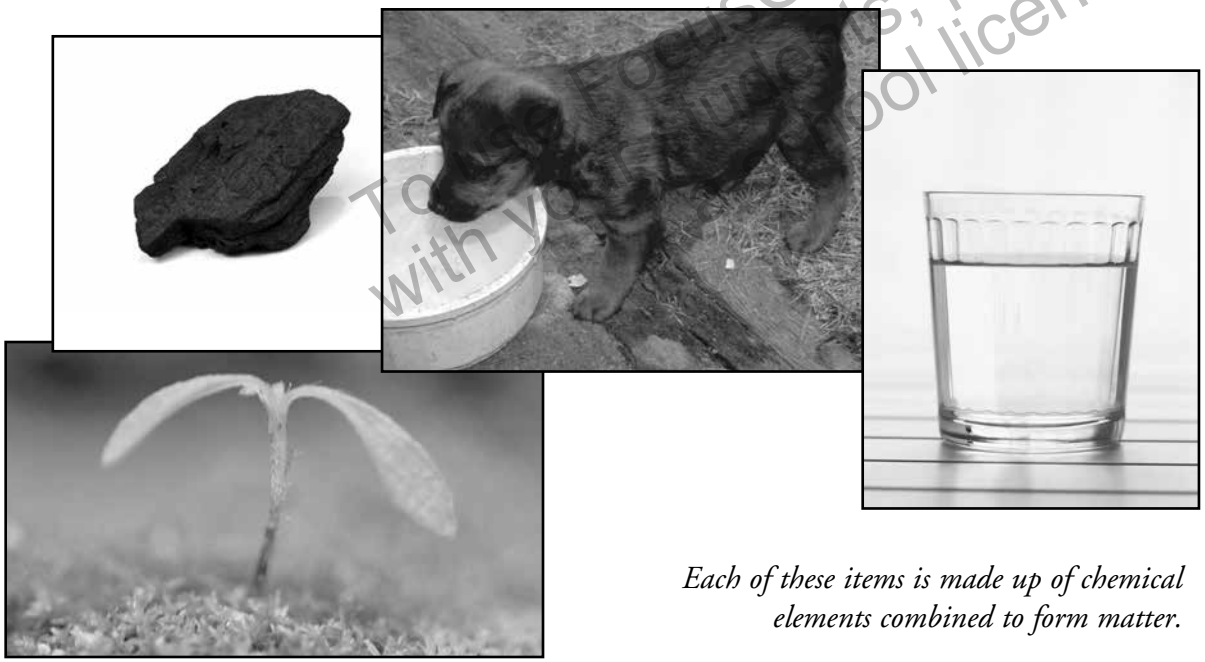
2 Interview *Talk to a parent or caregiver about this or another Earth cycle you often see in your area.*

What Do Biogeochemical Cycles Do?

Biogeochemical cycles move matter and energy through Earth's living and nonliving systems. For example, we get most of our energy from the sun. This energy moves in an **open system** where energy is constantly fed into Earth. In other words, the energy used is constantly **replenished** from outside. This happens day after day when the sun shines on the different parts of Earth.

Replenishing Earth's **matter** is not as simple. Matter is made up of a combination of chemical **elements**. Even though there are 94 chemical elements that occur naturally on Earth, only six of them make up 95 percent of the mass of all things on the planet. That's six elements combining to form just about everything on the planet! These elements are hydrogen, carbon, nitrogen, oxygen, phosphorous, and sulfur. These six essential elements make up the water we drink, the air we breathe, the food we eat, and the plants, animals, and the people all around us.

The challenge is that the planet is made up of a **finite** amount of matter. No new matter is ever added to the system from outside. In other words, Earth's matter moves in a **closed system**. Because of this, all of the planet's essential chemicals need to be used over and over again to sustain life on Earth. This is where biogeochemical cycles come in.



Each of these items is made up of chemical elements combined to form matter.

ACTIVE READER

1 Recall *Look closely at the word biogeochemical. Break it down into three parts and explain the meaning of each part. How do they help you understand the definition of the word?*

Unlike energy, Earth does not get any new matter from outside of Earth's system. For life to continue on Earth, we need to recycle the matter we have. Biogeochemical cycles transform and transport matter around the planet so that important chemical elements can continuously be reused. Without this constant recycling of matter, plants and animals could not get the nutrients they need to grow and reproduce. In fact, without cycles, life on Earth could not exist.

FOCUS QUESTIONS

1. What has to happen for a series of events to be considered a cycle?

2. How many key elements make up almost all matter on Earth?

3. What is the difference between how energy is supplied to Earth's system and how matter is supplied?

ACTIVE READER

1 Recall *What do the biogeochemical cycles do?*

2 Explain *Why are biogeochemical cycles important?*

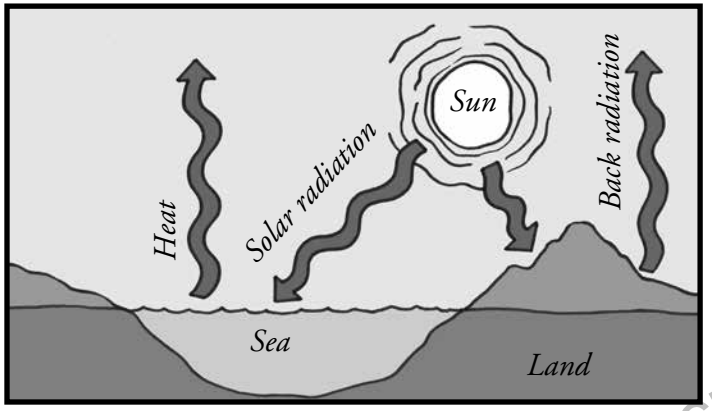
Good to Know

The law of conservation of matter states that matter cannot be created or destroyed, only transformed.

Stop and Think

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

Use the diagram below and your knowledge of science to answer the questions.



Tip:
Look back through the chapter to find the key terms in the questions. Reread the sentences that contain those key terms.

1. Does the diagram show an open or closed system?

_____

2. Explain the flow of energy in this system.

_____

_____

_____

3. What might happen to Earth if the energy it received from the sun remained in a closed system?

(1) Earth would not change.
(2) Earth would quickly cool down.
(3) Earth would slowly darken.
(4) Earth would quickly warm up.

Dear Ms. Understanding,

If Earth's matter is always recycled, then all the matter that's on the planet now has always been here. So does that mean that I'm drinking the same water as the dinosaurs once did?

Tense in Tonawanda

Dear Tense,

Yes, you could be. The water the dinosaurs were drinking is made up of the same molecules as the water on Earth today. This is because all the water on Earth has been cycled through the system since the planet's earliest days.

Ms. Understanding

Chapter 2 Earth Systems

FOCUS

The underlined sentence names four different Earth systems through which matter is moved. Read on to learn the different forms of matter that are found in these systems.

What are Earth Systems?

Imagine you are walking on the beach. The wind is blowing fresh air in your face. The waves are crashing against the shore sending wet spray into the air. The sand is hot under your feet and seagulls are flying past.

This may seem like a simple walk outside, but what you are actually doing is moving through four of the most important systems on the planet. They are the **lithosphere** (land), the **atmosphere** (air), the **hydrosphere** (water), and the **biosphere** (organisms living on Earth).

Each of these Earth systems is made up of combnations of matter in the form of liquid, gas, or solid. Together they create the environments that sustain life on Earth.

At the seashore, you can see an example of many of Earth's systems in one place.

FOCUS QUESTIONS

1. **What are the four most important systems on Earth?**

_____

_____

ACTIVE READER

1 List *Think of common substances that you can find in your own home. Write the name of the substance and what state of matter it is: solid, liquid, or gas.*

_____

_____

_____

_____

_____

_____

_____

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_____

_____

FOCUS

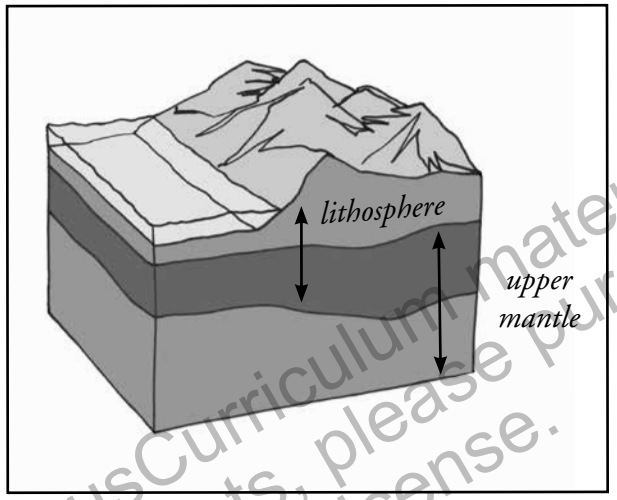
In this section you will find out the difference between abiotic and biotic systems. Pay attention to how they interact with each other.

Earth's Abiotic and Biotic Systems

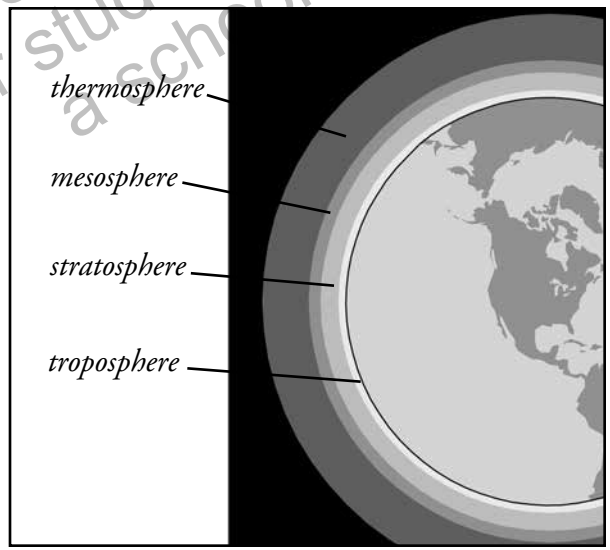
There are three abiotic or non-living Earth systems. They are the lithosphere, atmosphere, and hydrosphere. The **lithosphere** is made up of Earth's **crust** and **upper mantle**. In other words it's the ground we walk on and the layers of sand, soil, solid rock, and moveable molten rock beneath our feet.

The **atmosphere** is the air we breathe. It is the layer of gases that surround the planet and are held in place by gravity. Our atmosphere extends from the surface of Earth to more than 75 miles into space. It is what **insulates** Earth from the sun's extreme heat during the day and outer space's freezing cold at night. The atmosphere is where all of the world's weather occurs. Most weather happens in the troposphere, the lowest part of the atmosphere because most of the water vapor in the atmosphere is contained there.

The **hydrosphere** is all the water found in and on the planet. The hydrosphere overlaps with both the lithosphere and the atmosphere. It includes ground water, or water that flows underneath the ground, and water found on Earth's surface in lakes, streams, oceans, and glaciers. The hydrosphere also includes water in the atmosphere in the form of clouds, rain, and snow.



Earth's lithospheric system



Earth's atmospheric system

ACTIVE READER

1 Identify *Think of a setting where the lithosphere, atmosphere, biosphere, and hydrosphere overlap. List it here.*

2 Describe *Detail how these different systems overlap in this setting.*

However, not all Earth systems are abiotic. The life forms that eat, drink, breathe, reproduce, and die on the planet are also part of our complex planet. This aspect of Earth's system is called the biosphere. This system encompasses not only all living beings on Earth, but also all the areas of the planet capable of sustaining life. The biosphere is a **biotic**, or living system.

How Do They Work Together?

These systems are not just stacked on top of each other like building blocks. They are very closely tied together. They constantly overlap and interact in a series of natural processes that use energy from the sun to take stored matter, use it, and as a result, transform it into new forms of matter that can be passed between systems.

These processes transform and move matter through each system until it reaches the point where it started. Then the process repeats. These repeated series of processes moving matter make up the biogeochemical cycles. You will learn more about how these cycles work in Chapter 3.

FOCUS QUESTIONS

1. **What is the difference between a biotic and abiotic system?**

2. **How do biotic and abiotic systems overlap?**

ACTIVE READER

1 Paraphrase *Explain how Earth's systems interact with each other to move matter.*

Web Quest

Go online and search for illustrations of Earth's different systems. What can you learn from these images?

Stop and Think

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

1. Which of the following is a living system on Earth?

(1) hydrosphere
(2) atmosphere
(3) lithosphere
(4) biosphere

Tip:
Read the answer choices in a multiple-choice question first. That way you'll be ready when you read the question.

2. Identify one of Earth's systems and describe a characteristic of it.

Identify: _____

Describe: _____

_____

_____

3. What makes up the hydrosphere?

(1) molten rock
(2) water
(3) soil
(4) gas

4. Which system are plants a part of?

(1) biosphere
(2) lithosphere
(3) atmosphere
(4) hydrosphere

Dear Ms. Understanding,

I know the biosphere overlaps with the other systems on Earth because plants and animals live there. But what about the atmosphere? Nothing really lives there.

Perplexed in Poughkeepsie

Dear Perplexed,

The biosphere doesn't just mean the areas of Earth where plants and animals live. It also covers the places on Earth that support life. Plants, animals, and people could not live without air to breath or protection from extreme temperatures. That's why the atmosphere also overlaps with the biosphere.

Ms. Understanding

Hands On Science

Document Biotic and Abiotic Systems Biotic and abiotic systems can overlap. Collect evidence to demonstrate how. Visit two abiotic systems, the hydrosphere and the lithosphere. In each system collect a sample of anabiotic element and a biotic element. Record your findings in the table below.

Hydrosphere

	Location	Sample	Abiotic or Biotic Characteristic
Abiotic Sample			
Biotic Sample			

Lithosphere

	Location	Sample	Abiotic or Biotic Characteristic
Abiotic Sample			
Biotic Sample			

Chapter 3 The Cycles at Work

FOCUS

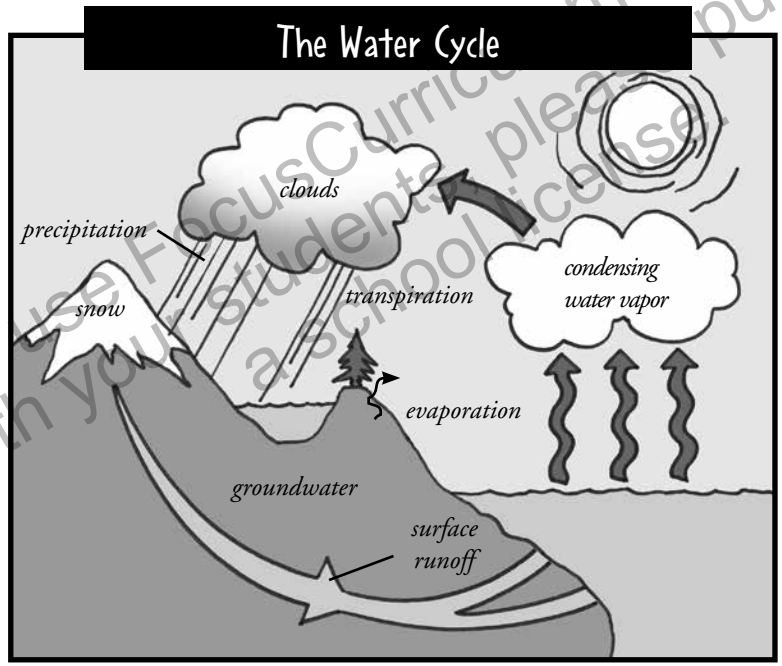
This section illustrates a specific biogeochemical cycle at work, the water cycle. As you read, understand how water from the hydrosphere moves through the lithosphere, the atmosphere, and back again.

The atmosphere is a mixture of gases including oxygen, carbon dioxide, nitrogen, and water vapor. Each of these components flows through Earth's systems in a cycle. You are probably most familiar with the water cycle.

The Water Cycle

Every time you see a cloud in the sky, a stream running down a hill, snow falling, or steam rising off of a hot pavement after a cool rain, you are seeing the water cycle at work. The water cycle, also called the **hydrologic cycle**, is how water moves through Earth's four systems.

Energy from the sun heats up water in the hydrosphere from oceans, lakes, rivers, and streams. The heat causes the water molecules to **evaporate** or change into vapor. Water vapor is also produced in the biosphere as plants convert the energy of sunlight to food. Water vapor is released and rises up into the atmosphere in a process called **transpiration**.



The water cycle depends on at least four different natural processes to work.

ACTIVE READER

1 Illustrate *Draw a simple diagram of a water source near you. Add labels of each of the parts in your diagram.*

2 Explain *Explain where this water source fits in the water cycle.*

Once in the atmosphere, the vapor condenses to form clouds. The clouds build until finally they reach a point where they become full of water, or saturated, and the water is released into the atmosphere as precipitation. This rain or snow falls back to Earth, providing drinking water for plants, animals, and people in the biosphere.

Water also collects as groundwater in aquifers. The groundwater eventually cycles back into such places as glaciers, oceans, and lakes. From here the water cycle starts again.

Evaporation and transpiration are two processes that transform water from a liquid into a gas.

ACTIVE READER

1 Summarize *List the places where water collects as it goes through the water cycle.*

FOCUS QUESTIONS

1. Name four natural processes that help move water through the hydrologic cycle.

2. Does the water cycle have a natural beginning or end? Why or why not?

Web Quest

Water is a finite resource. As the population grows, we will need more and more drinking water. There is no way to add more water to a closed system. The best solution is to conserve it. Search online using the term water conservation. Come up with five tips for how you can help save water.

FOCUS

This section will look at some other examples of biogeochemical cycles. As you read, pay attention to the different ways that carbon and nitrogen are released and absorbed.

Other Important Cycles

There are equally important cycles in place for essential elements such as carbon, nitrogen, phosphorus, and sulfur. Let's look at two biogeochemical cycles: carbon and nitrogen.

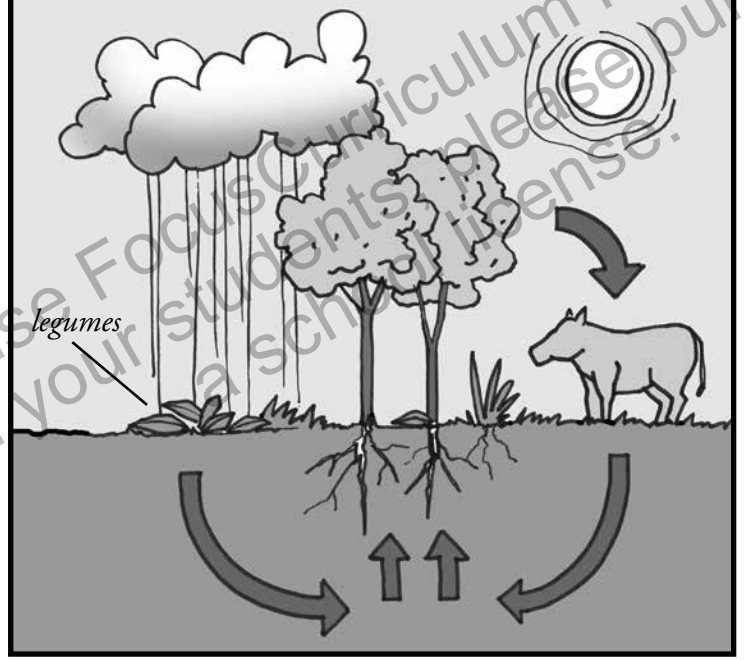
The Carbon Cycle

Carbon is found in all living things. In our oceans, soil, and in air as carbon dioxide. It is released when we burn fossil fuels and when living things die and **decompose. Photosynthesizing** plants and vegetation absorb carbon from the soil. Plants also give off carbon dioxide.

The Nitrogen Cycle

Our atmosphere is 79 percent nitrogen gas. Nitrogen is an important natural fertilizer for growing plants and vegetation. It is absorbed into soil from decaying animal waste. It is also put into the soil by nitrogen processing plants called legumes. Nitrogen is released back into the atmosphere when nitrogen-containing plants **decay**.

The Nitrogen Cycle



In the Nitrogen Cycle, nitrogen in the soil is absorbed by plants. Animals eat the plants. They release nitrogen back into the soil when they die and decompose. Legumes also process nitrogen and release it back into the soil. Soy beans, peanuts, and peas are common legumes.

ACTIVE READER

1 Recognize *Briefly explain the role of photosynthesis in the carbon cycle.*

Web Quest

One of the ways nitrogen is transformed from inert gas in the atmosphere to a form that plants can use to grow is through lighting. This is called nitrogen fixation. Research to find out how lighting is able to fix nitrogen in the atmosphere.

What Do the Cycles Have in Common?

Even though different natural processes drive each cycle, they share some common features. All the matter in a system is stored in the system in two ways: in a **reservoir** or in an **exchange pool**. A reservoir is a place where matter is stored for a long time before being used, like water in the ocean, or carbon in an underground coal seam.

An exchange pool is where matter is held for a short period of time before being cycled through a system, for example water in a cloud or the nitrogen in a growing plant. The amount of time that matter stays in storage is called its **residence time.**

FOCUS QUESTIONS

1. Name a process that releases carbon and a process that absorbs carbon.

_____

_____

_____

2. Name a process that releases nitrogen and a process that absorbs nitrogen.

_____

_____

_____

ACTIVE READER

1 Differentiate *Explain the difference between a reservoir and an exchange pool.*

_____

_____

_____

_____

_____

_____

_____

_____

Right now we get most of our energy from fossil fuels. Fossil fuels are often found in reservoirs like coal seams and oil fields deep in Earth. Research and list the places in the world known for their reservoirs of oil or coal. Hint: Three of Ohio's neighboring states are known for their coal production.

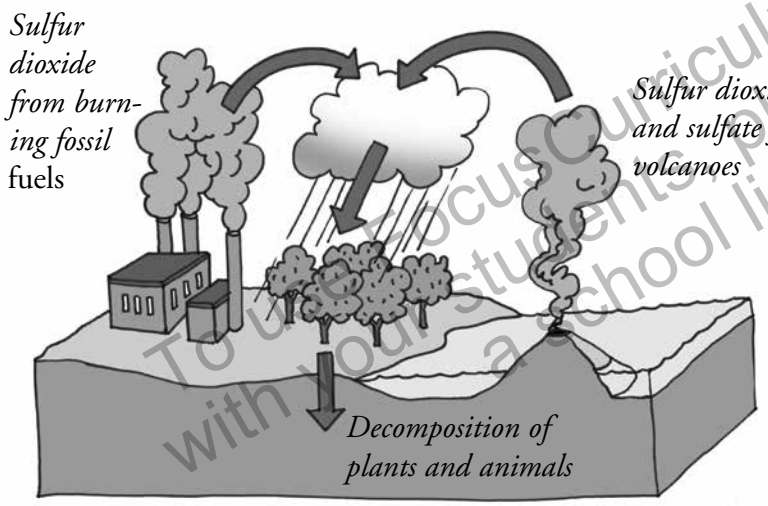
Stop and Think

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

1. Which is an example of matter that is moved through the hydrosphere?

(1) animals
(2) soil
(3) water
(4) gas

Use the diagram of Earth's sulfur cycle below and your knowledge of science to answer question 2.



2. Like carbon and nitrogen, sulfur is one of Earth's essential elements. According to the diagram, identify two ways that sulfur is released into the sulfur cycle.

_____

_____

_____

Dear Ms. Understanding,

I've read that carbon and nitrogen are released into soil when living things die and decay. Does that mean dying is part of the biogeochemical cycles? And does that include us when we die?

Curious in Canandaigua

Dear Curious,

Yes, dying is part of the biogeochemical cycle. When we die all the nutrients in our bodies will return to the lithosphere if we are buried and decompose naturally. Don't forget we are made of matter just like everything else in the biosphere. And that matter needs to be recycled. So when we die we actually help other living things grow.

Ms. Understanding

Chapter 4 Humans and Biogeochemical Cycles

FOCUS

In this chapter we will find out how Earth cycles can help deal with human-made pollution. Read on to find out more about how humans impact Earth cycles.

Benefits and Problems

Biogeochemical cycles are an effective way to share resources between Earth systems. But they have an added benefit to humans. Because they are responsible for changing matter between its different forms, these cycles can also act as filters to clean up a certain amount of human made pollution.

For example, nitrogen is found in biological waste like animal manure and sewage. If too much of this waste is released into the environment, it can pollute our water reservoirs and make the water undrinkable. But, because the nitrogen cycle overlaps with the water cycle, plants that use nitrogen to grow can absorb some of this excess nitrogen. This process filters the excess nitrogen out of our water, making it safe to drink.

Human Impact

The problem is that the biogeochemical cycles can only handle so much pollution. Each of these cycles rely on a balance between the amount of matter released into the cycle and the time takes for it to be processed through the cycle. If too much matter enters any of the cycles at one time, it will overload the system and cause a build up of matter in one or more of Earth's four systems.

Carbon is released into the atmosphere when we burn fossil fuels for energy.

How Does a Cycle Get Overloaded?

Remember matter in a cycle is stored in two places, a reservoir and an exchange pool. Matter in a reservoir has a much longer residence time than water in an exchange pool. Normally it would take a very long time for the matter in a reservoir to get out of storage and start actively moving through the cycle. But human actions are taking matter out of its different reservoirs and sending it into the cycle faster than Earth can process it.

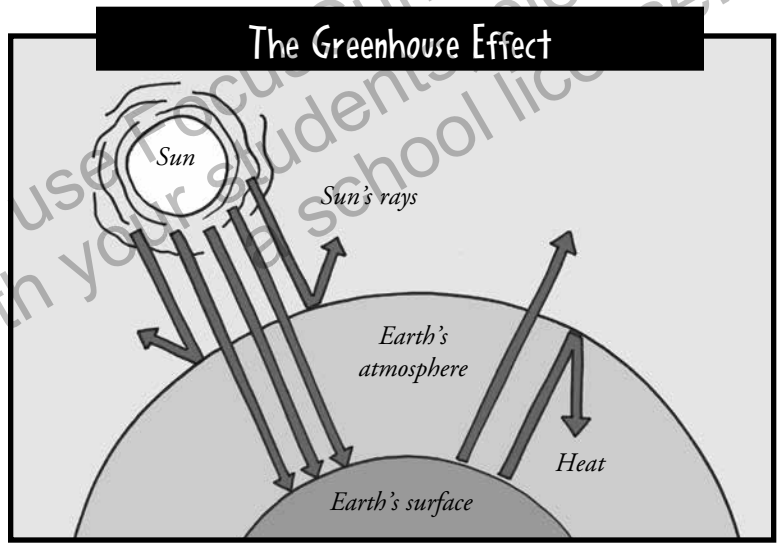
ACTIVE READER

1 Recall *Where do plants get the nitrogen they need to grow?*

One of the most important examples is our release of excess amounts of carbon into the atmosphere. One of the biggest reservoirs of carbon is in fossil fuels like coal and oil. We burn these fuels to create electricity and power everything from our cars, to our factories, to homes. Burning these fuels releases large amounts of carbon into the atmosphere as smoke and smog. Normally green plants that use the carbon to grow would absorb this carbon. But at the same time as we are releasing more carbon into the air we are also cutting down more and more trees and forests to make room for cities and industry. This takes away the trees that could be helping to regulate the amount of carbon in the cycle. As a result the cycle gets overloaded and stops working.

Long-Term Effects

So what does that mean for all the living beings that depend on these cycles to keep Earth habitable? Scientists are starting to realize that one of the effects of too much carbon in our atmosphere is a rise of global temperatures. This change in climate has the potential to further upset the biogeochemical cycles and make it harder for life to exist on Earth.



Carbon dioxide is what's called a greenhouse gas. It has the ability to trap heat radiating from Earth inside the atmosphere. This causes Earth's climate to warm.

ACTIVE READER

1 Demonstrate *How might a rise in global temperature have a negative affect on the biogeochemical cycles? Give an example.*

Web Quest

A warming of the global climate has the potential to upset several of Earth's systems. Research changes that could occur or are occurring because of global climate change. Identify things you can do help prevent those changes.

Rising temperatures are causing Earth's glaciers to melt more rapidly. These glaciers are actually reservoirs of frozen water. Their release adds excess matter to the water cycle, causing things like flooding and irregular weather patterns. These irregular patterns can affect plant and animal habitats, and affect their food supply and their survival. As you can see, if one cycle becomes unbalanced, it affects all the other cycles and eventually all of Earth's systems.

What Can We Do?

Scientists, world leaders, and citizens all over the world are only just beginning to understand the impact we are having on Earth's biogeochemical cycles and in turn on Earth's systems. In the future, we need to come up with ways to reduce our excess use of Earth's matter to help the biogeochemical cycles restore balance to Earth's systems. This may mean changing what we use for fuel, conserving our water, and reducing the amount of waste we put into the system. If we can all commit to living more sustainably, we can insure that Earth's biogeochemical cycles will continue to provide enough matter to support life for all.

FOCUS QUESTIONS

1. **Give one example of how Earth cycles can help regulate human-made pollution.**

2. **What is one effect of the excess release of carbon into the atmosphere?**

ACTIVE READER

1 Argue *Should we be concerned that humans are impacting Earth cycles? Why or why not? Defend your answer.*

Web Quest

Burning fossil fuels is releasing excess carbon into Earth's atmosphere and contributing to a rise in global temperatures. One solution is to find alternate fuel sources. Use the search term fossil fuel alternative. to find out more about cleaner sources of energy.

Hands On Science

Observe Transpiration

This simple experiment will illustrate transpiration at work in plants. Transpiration is the act of water evaporating thorough pores in a plant's petals or leaves.

1. **Take a white flower with petals. A white carnation works best. Cut the stem until it is about 3 inches long. Place the flower stem in a vase or glass of water. Add a few drops of brightly colored water-soluble food coloring to the water in the vase. Green, blue, or red will work well. Add enough food coloring to deeply tint the water in the vase.**

2. **Let the flower stand in the colored water. Check on the plant at least twice after four hours have passed. Note your observations each time. Let the flower continue to stand overnight. Note your observations the next day.**

3. **Observe the white flower over several days and record your observations?**

4. **Observe the flower petals over several days and record your observations?**

5. **What conclusion can you make based on your observations?**

6. **How does this experiment help you understand how water moves from the lithosphere, through the biosphere, into the atmosphere?**

Stop and Think

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

Fertilizer and animal waste are two sources of nitrogen. Use this information and your knowledge of science to answer questions 1 and 2.

1. How do the nitrogen cycle and the water cycles overlap?

_____

_____

_____

2. How could excessive fertilizer use and large numbers of livestock in one area affect this overlap?

_____

_____

_____

3. Which is an effect of rising global temperatures?

(1) nitrogen levels decreasing
(2) carbon levels increasing
(3) reservoir levels reducing
(4) sea levels rising

4. What is the function of reservoirs and exchange pools?

(1) to store matter
(2) to release matter
(3) to balance earth systems
(4) to prevent excessive build up

Dear Ms. Understanding,

I'm concerned about my impact on the environment. I don't want the things I do to contribute to our Earth cycles changing. How do I know if I am having a negative impact on the environment?

Eco-conscious in Elmira

Dear Eco,

To find out, calculate your carbon footprint. A carbon footprint is how much carbon is released into the environment from your energy consumption. There are Web sites that can help you calculate your carbon footprint. Once you know what it is, you can work on reducing it by using less energy. Shut off the lights when you leave a room. Unplug appliances when they're not in use. And ride a bike or walk instead of driving.

Ms. Understanding

Glossary

abiotic – without life or living organisms

atmosphere – the mixture of gases that surrounds Earth

biogeochemical cycle – the flow of chemical elements between living organisms and the non living environment

biosphere – all the living organisms on the planet and the areas of Earth capable of supporting life

biotic – the aspects of a natural system that are living or pertain to living organisms

closed system – a system that does not allow the transfer of matter in or out of it

decay – the process of rotting that occurs in organic matter

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

dynamic – ever changing

Earth's crust – earth's outer most solid layer

Earth's upper mantle – the layer beneath Earth's crust consisting of less dense solid rock

element – any substance that cannot be broken down into a different substance

evaporation – the process by which matter changes from a liquid to a vapor without boiling

exchange pool – any form of vessel that stores matter for a brief period of time before transferring it in a biogeochemical cycle

finite – with an end of limit

gas – a substance that is neither solid or liquid with the ability to expand indefinitely

hydrologic cycle – the cycle that moves water through Earth's systems

hydrosphere – the area of Earth that is composed of water

insulate – to protect or isolate one thing from another

liquid – a substance that is fluid at room temperature and whose shape can change but not its volume

lithosphere – the solid outer layer of Earth consisting of the crust and upper mantle

matter – the substance of the universe that has mass, occupies space and is convertible to energy

natural process – the action or the phenomenon caused by natural forces

open system – a system that can exchange energy or materials in and out of it

photosynthesis – a process by which green plants can use the energy from sunlight to convert carbon dioxide into organic material

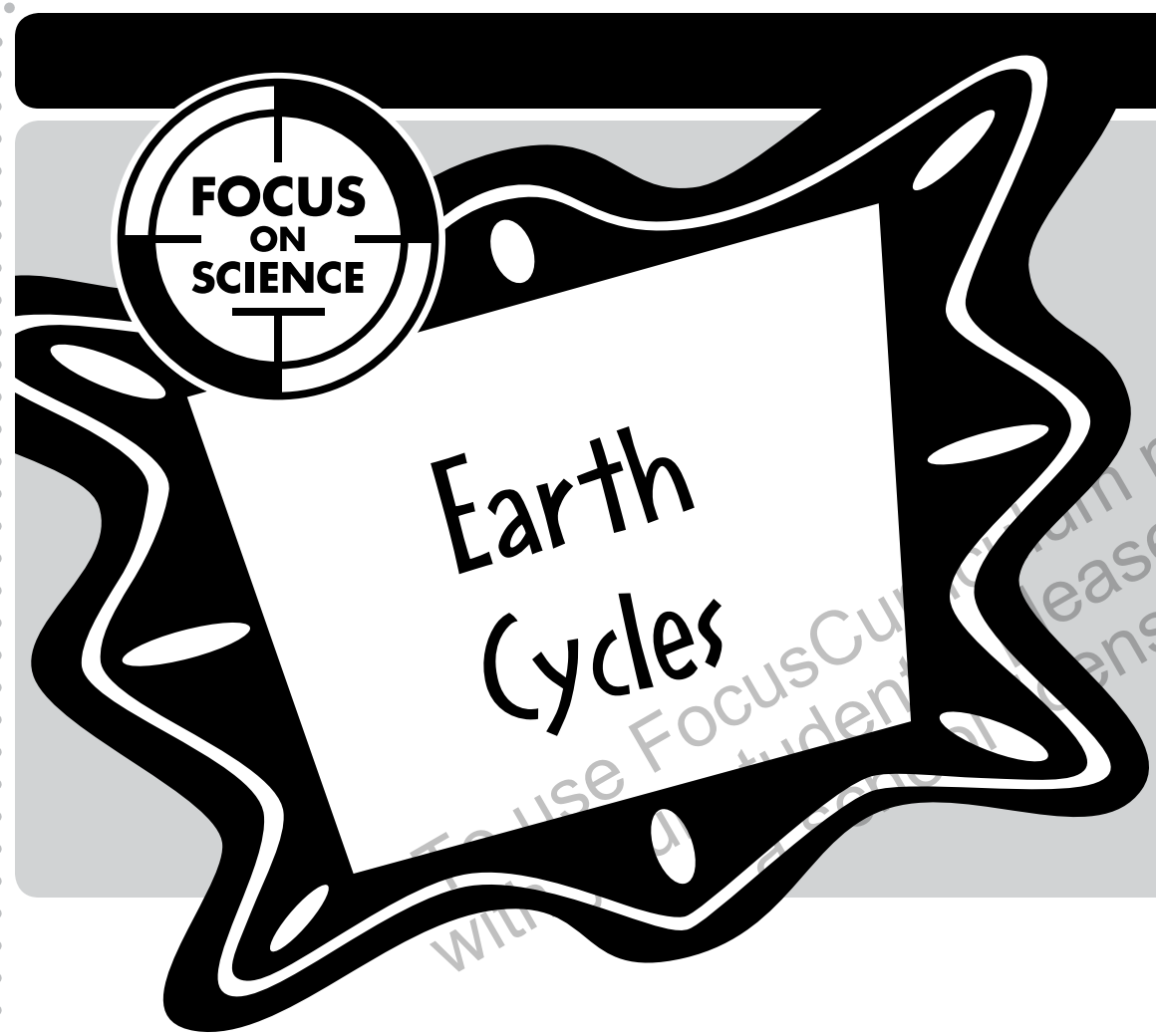
replenish – to resupply a material when it is used up

reservoir – a large supply of material that is stored

residence time – the amount of time matter stays in a reservoir or exchange pool

solid – matter with a shape that resists moderate stress or deformation that is not a liquid or gas

transpiration – the process by which plants lose water from their leaves



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. What are the three forms of matter?

   (1) ice, solid, vapor

   (2) liquid, solid, and gas

   (3) liquid, form, and mass

   (4) liquid, fluid, and matter

2. Which six elements make up 95 percent of all mass on Earth?

   (1) carbon, magnesium, iron, zinc, helium, and nitrogen

   (2) oxygen, carbon, nitrogen, helium, sulfur, and phosphorous

   (3) carbon, nitrogen, oxygen, magnesium, sulfur, and calcium

   (4) sulfur, nitrogen, oxygen, hydrogen, carbon, and phosphorous

3. Which of the following natural processes function as part of the water cycle?

   (1) plate tectonics

   (2) photosynthesis

   (3) transpiration

   (4) decay

4. The biogeochemical cycles move matter through which four Earth systems?

   (1) lithosphere, hydrosphere, biosphere, and stratosphere

   (2) lithosphere, hydrosphere, biosphere, and atmosphere

   (3) hemisphere, biosphere, lithosphere, and atmosphere

   (4) stratosphere, biosphere, atmosphere, and hemisphere

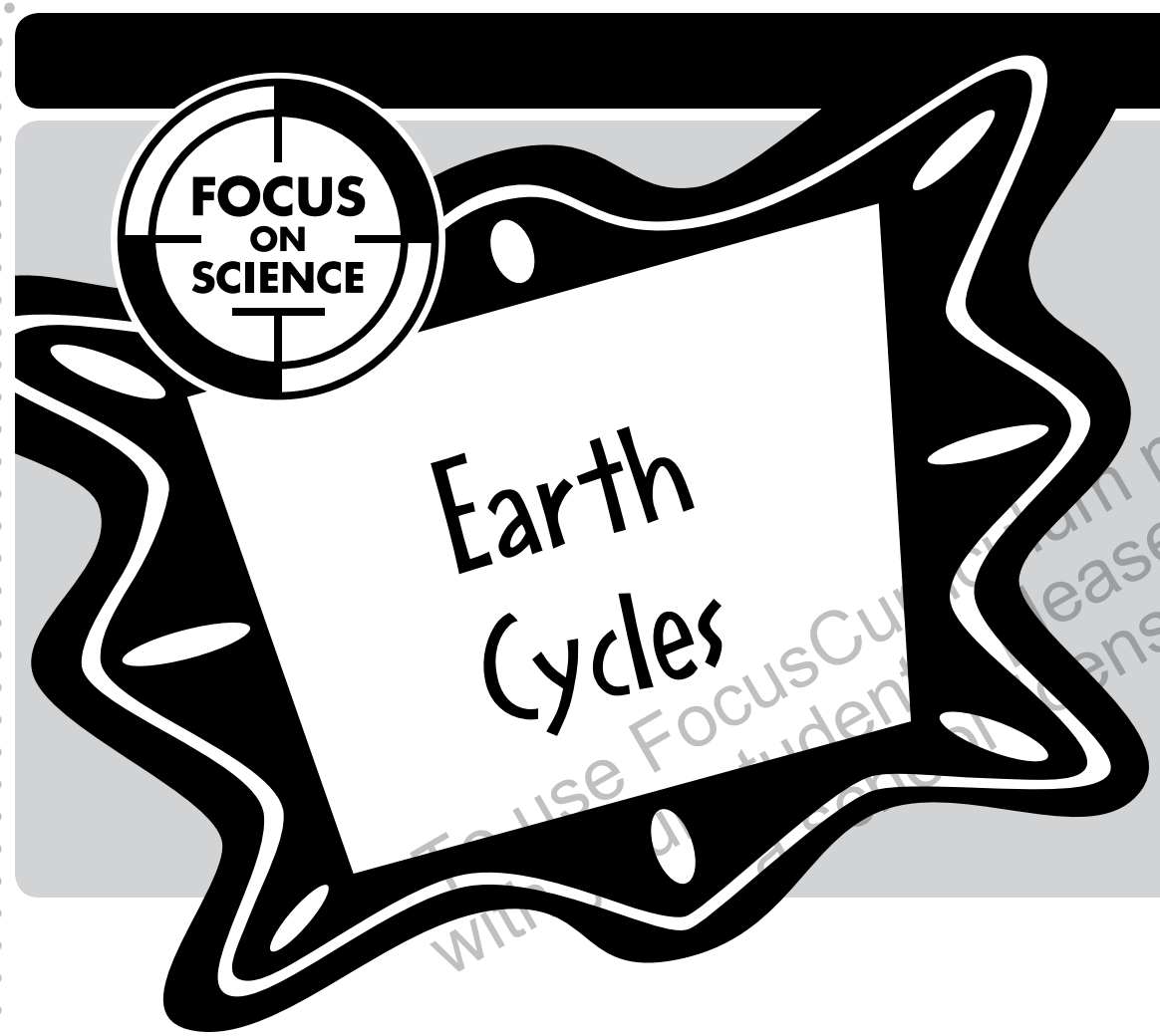
Answer Document

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

Check Understanding

5. There are three key abiotic systems on Earth. Identify two of these systems and explain their functions on Earth.

Identify	Identify
Explain	**Explain**



Answer Key

Answer Key

Page 8: Starting Points:
Build Background
Predict: Answers will vary.
Brainstorm: Answers will vary.
Define: Answers will vary.

Page 9: Starting Points: Key Vocabulary
Rate Your Knowledge: Answers will vary.

Page 10: Starting Points: Key Vocabulary
Use Roots to Unlock Meaning:
1. bio- means "life": biography; 2. biodegradable; 3. biology; 4. hydro- means "water": hydrated; 5. hydrofoil
Multiple Meanings: Student answers will vary but should include the idea that a system is a functionally related group of interacting elements that organize to form a whole.

Page 11: Starting Points: Key Concepts
Active Reader: Answers will vary.

Page 12: Chapter 1
Active Reader: 1. Illustrations should show a water cycle or a season.; 2. Answers will vary.

Page 13: Chapter 1
Active Reader: Students should explain that bio refers to life, geo to earth, and chemical to physical sciences.

Page 14: Chapter 1
Active Reader: 1. The biogeochemical cycles transport and transform matter between Earth's systems.; 2. Without them life could not exist on the planet.
Focus Questions: 1. The events have to be related and occur repeatedly on a regular schedule.; 2. Six.; 3. Energy moves in an open system and matter moves in a closed system.

Page 15: Chapter 1
Stop and Think: 1. This is an open system.; 2. The energy flows from the sun to Earth and back out to space.; 3. (4)

Page 16: Chapter 2
Active Reader: Answers may vary.
Focus Question: 1. lithosphere, atmosphere, hydrosphere, and biosphere

Page 17: Chapter 2
Active Reader: 1. Answers will vary, but most places on the Earth's surface are examples; 2. Answers will vary.

Page 18: Chapter 2
Active Reader: Earth's systems interact through a series of natural processes. These processes transform and circulate matter through each system.
Focus Questions: 1. A biotic system is composed primarily of living organisms and an abiotic system is composed of non-living elements.; 2. Living organisms can exist in abiotic systems. For example earthworms and plants live in the lithosphere, but the ground itself is made up of non-living rocks and minerals, making it an abiotic system.

Page 19: Chapter 2
Stop and Think: 1. (4); 2. Answers should include one of the following: Lithosphere: Earth's crust and upper mantle; Atmosphere: insulates Earth, where weather occurs; Hydrosphere: all the water on the planet and in the atmosphere; B Biosphere: all living creatures. 3. (2); 4. (1)

Page 20: Chapter 3
Hands On Science: Answers will vary, but students should collect and identify both biotic and abiotic samples from the lithosphere and the hydrosphere.

Page 21: Chapter 3
Active Reader: 1. Answer should include labels for the lithosphere, hydrosphere, atmosphere, and biosphere.; 2. Answers will vary.

Page 22: Chapter 3
Active Reader: 1. Water collects in such places as glaciers, oceans, lakes, and aquifers
Focus Questions: 1. evaporation, condensation, transpiration, and run off.; 2. Because it is a cycle by nature it can have no beginning or end. The events continually repeat.

Answer Key

Page 23: Chapter 3
Active Reader: Photosynthesis allows plants to use solar energy to take carbon dioxide from the atmosphere and turn it into organic matter. Carbon is released again when the plants decay and return to the lithosphere or are burned as fuel.

Page 24: Chapter 3
Active Reader: A reservoir stores matter for a long period of time while an exchange pool stores matter for a shorter period of time.
Focus Questions: 1. Carbon is released when we burn fossil fuels, it is absorbed by plants. 2. Nitrogen is released when plants decay, it is absorbed by other plants.

Page 25: Chapter 3
Stop and Think: 1. (3); 2. Sulfur is released into the sulfur cycle when volcanoes erupt or when plants decompose.

Page 26: Chapter 4
Active Reader: 1. Plants get nitrogen from the water it absorbs. It gets into the water from animal waste and sewage.

Page 27: Chapter 4
Active Reader: Answers may include that the melting glaciers and rising sea levels resulting from global warming may have a negative effect on Earth's biochemical cycles.

Page 28: Chapter 4
Active Reader: Answers may vary.
Focus Questions: 1. Earth cycles can absorb some of the carbon we produce when burning fossil fuels.; 2. When too much carbon is released into the atmosphere, it creates air pollution.

Page 29: Chapter 4
Hands on Science: Results may vary, but all students should see some discoloration of the white flower petals as the food coloring is absorbed into the flower through the stem. Conclusions should relate transpiration back to Earth cycles.

Page 30: Chapter 4
Stop and Think: 1. Nitrogen in the soil washes into the water system, causing the two cycles to overlap.; 2. When too much fertilizer is used on the land and many
animals live in one place, this causes an excess of nitrogen in the soil that can't be processed by Earth as quickly as it is made. When the excess nitrogen runs off into the water systems, it pollutes the water.; 3. (4); 4. (4)

Page 35: Assessments
Check Understanding: 1. (3); 2. (2); 3. (2); 4. (4)

Page 36: Assessments
Check Understanding: 5. Answers should include two of the following.
Lithosphere; Earth's crust and mantle providing land and resources; Atmosphere: layers of gas that insulates Earth; Hydrosphere: provides water on Earth's surface, underground as well as in the atmosphere.