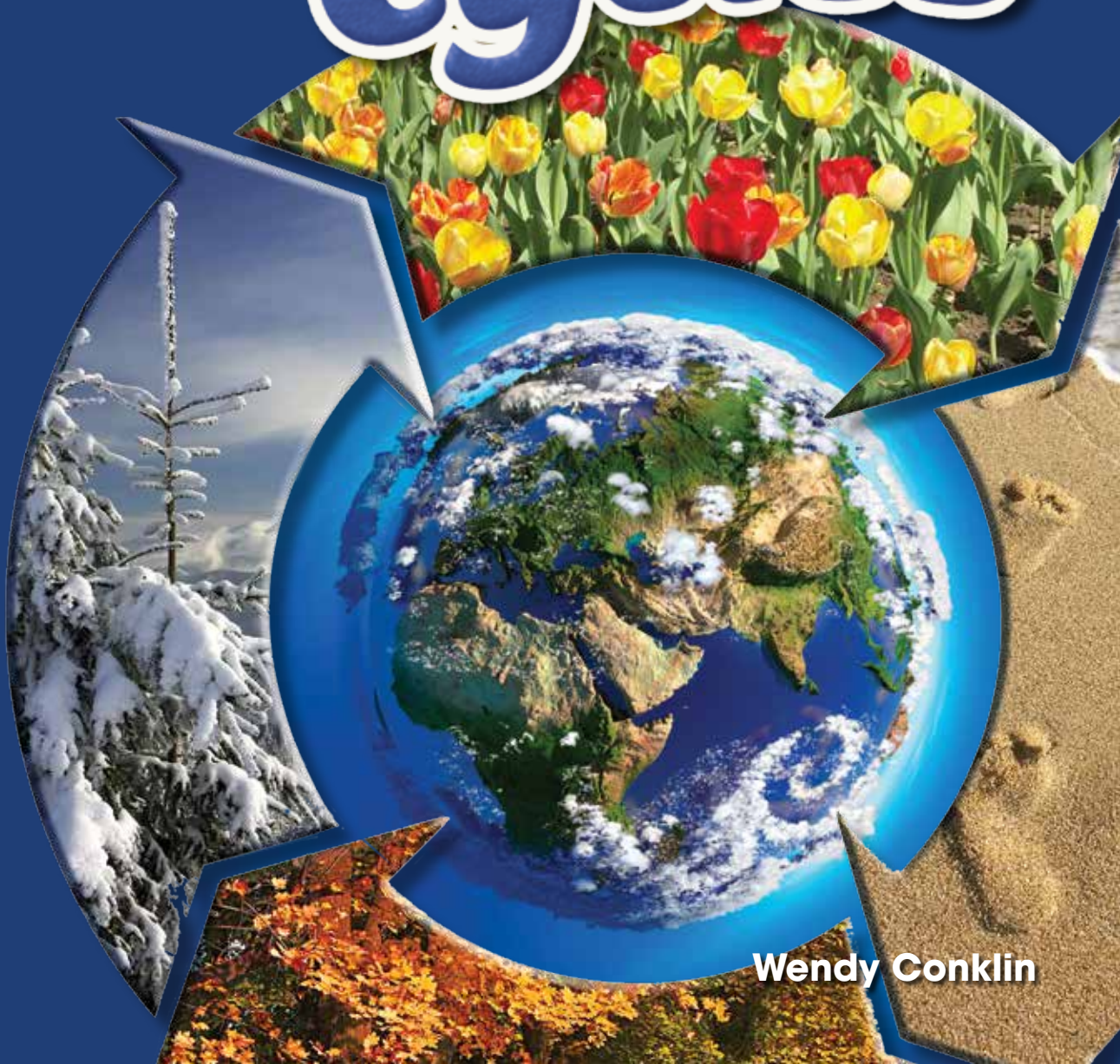
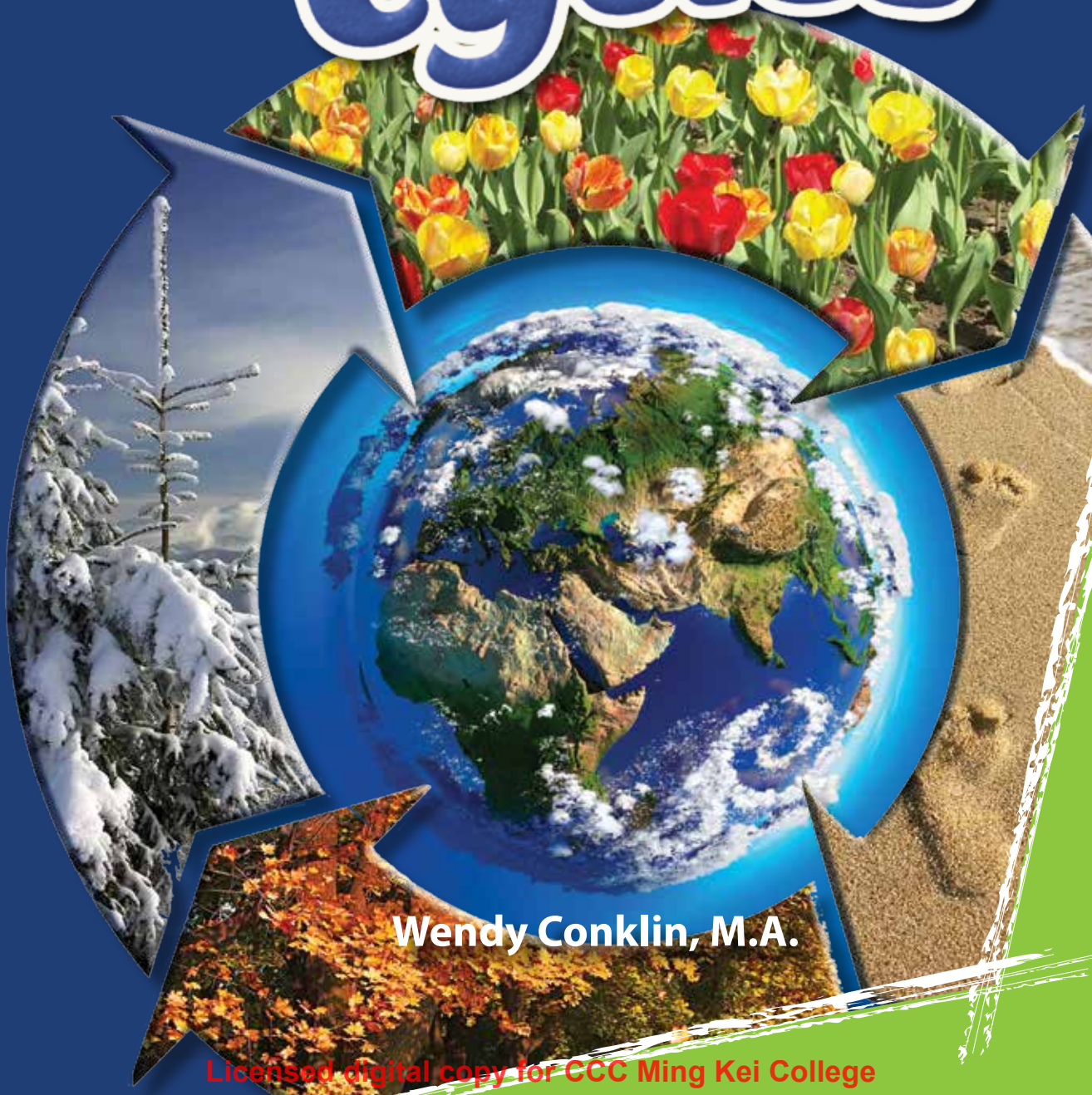
Earth's Cycles



Wendy Conklin

Earth's Cycles



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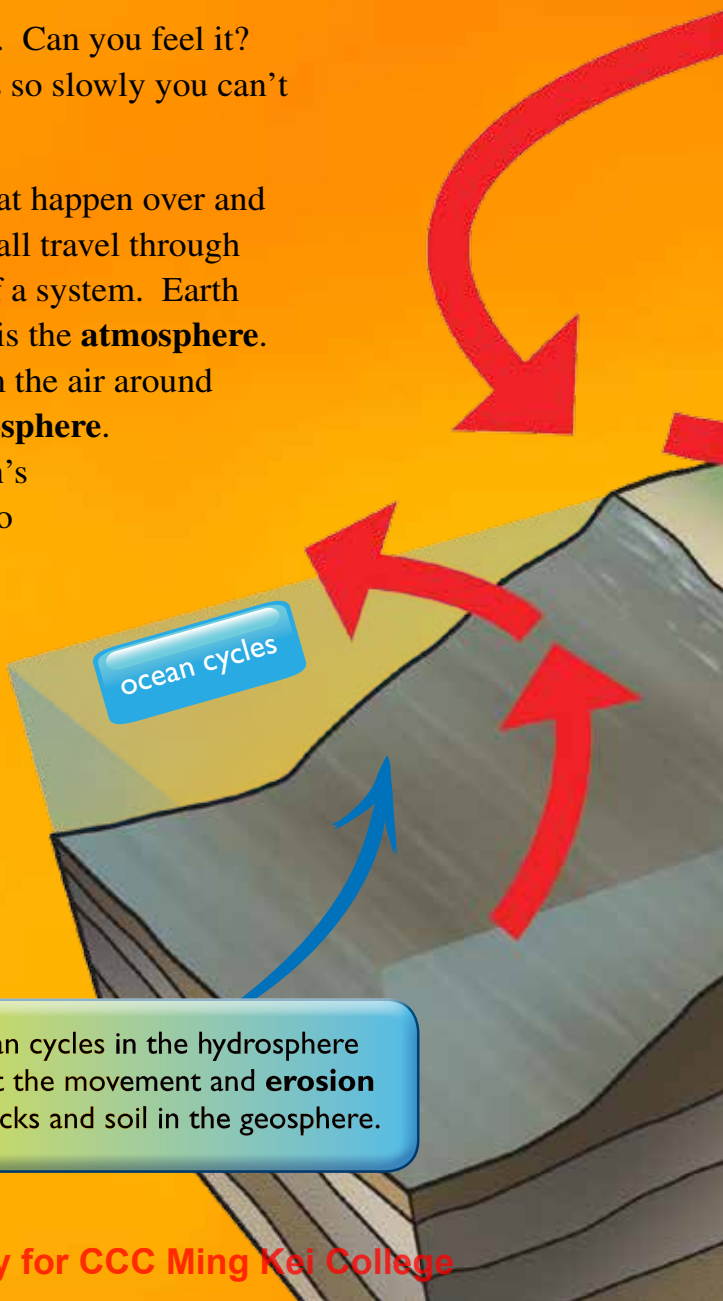
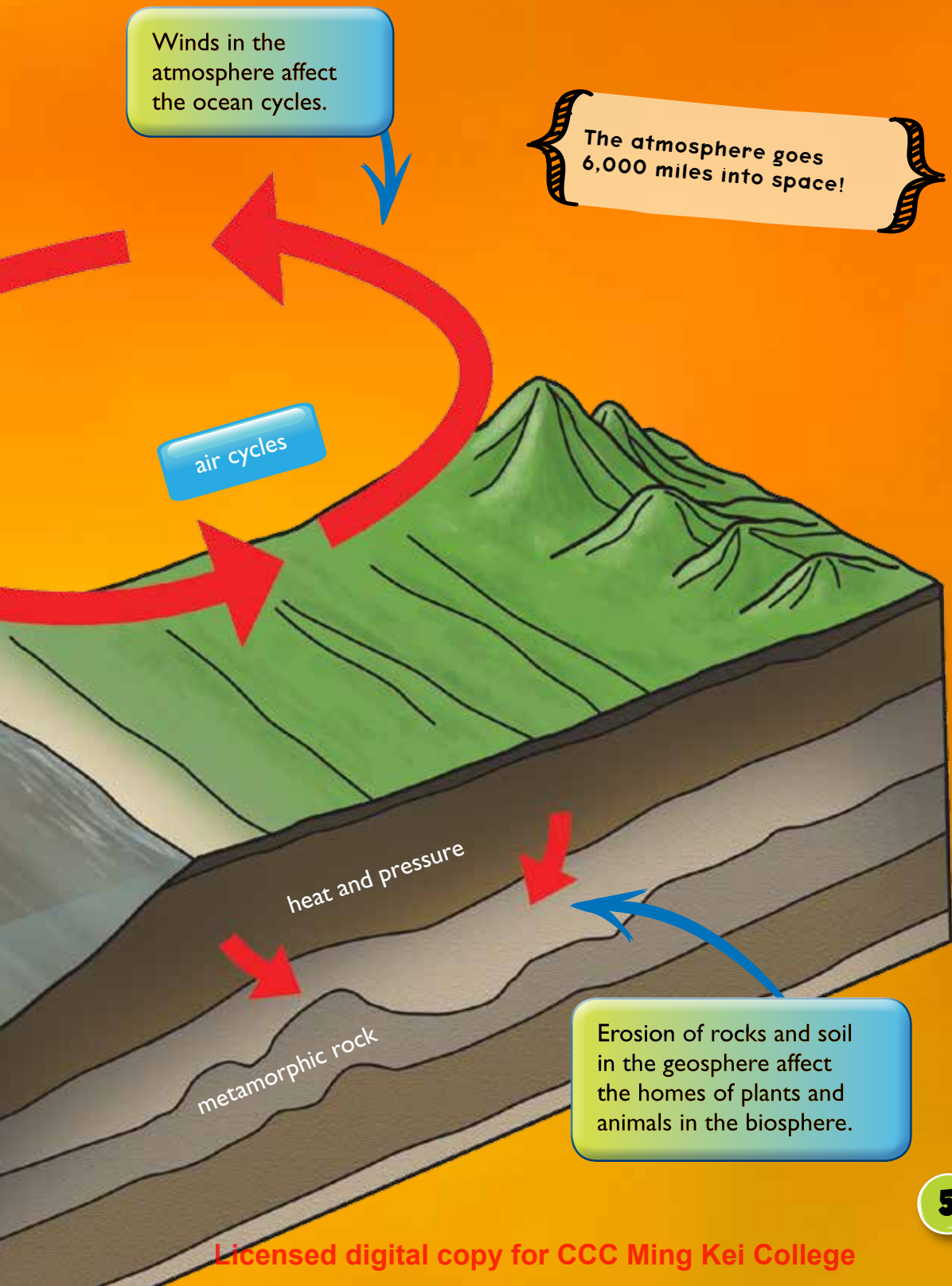
Cycles Make Earth Go 'Round

Earth is constantly in motion. Can you feel it? Much of this movement happens so slowly you can't detect it.

A cycle is a set of patterns that happen over and over. Water, seasons, and rocks all travel through cycles. These cycles are parts of a system. Earth has many systems. One system is the **atmosphere**. This includes the gases that form the air around us. Another system is the **hydrosphere**. This system includes all of Earth's water. All living things belong to the **biosphere**. And rocks and soil belong to the **geosphere**. These systems connect Earth's cycles together. And because of this, many of these cycles interact. For example, wind patterns directly affect ocean cycles. The carbon cycle affects the climate. Around and around they go….



Ocean cycles in the hydrosphere affect the movement and **erosion** of rocks and soil in the geosphere.



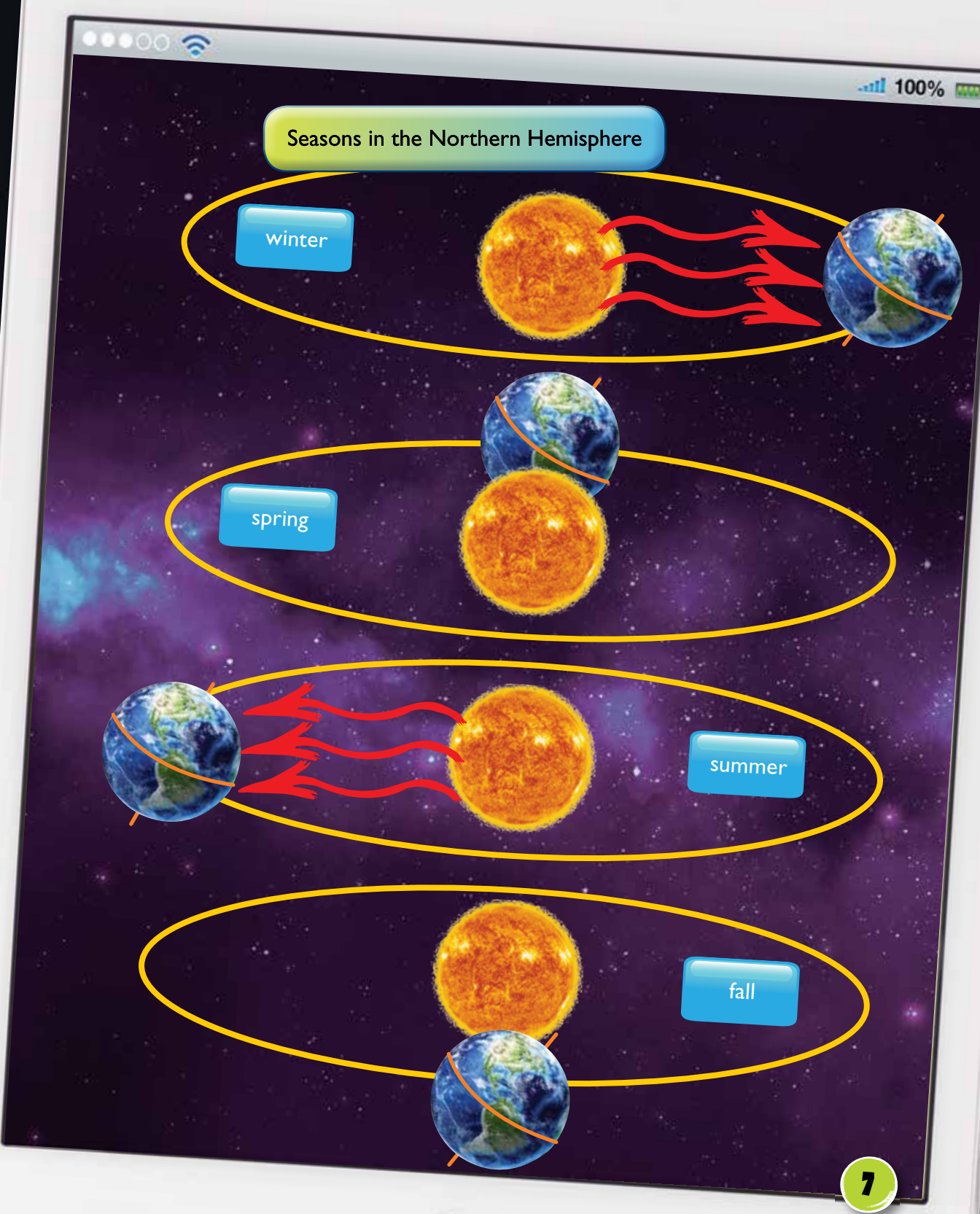
Mother Nature's Cycles

We depend on cycles to help us grow and thrive every day of every year. People aren't the only ones affected by cycles. Plants, animals, and even the planet itself are affected by nature's cycles.

Seasons

Depending on where you live, you experience Earth's seasons to some degree. You might have wet and dry seasons if you live near the **equator**. You might have four seasons that include spring, summer, fall, and winter. No matter what seasons are found where you live, you can count on the same seasons occurring every year. That's because the seasons occur in a cycle.

Seasons change as Earth **revolves** around the sun. It takes a year for Earth to complete its revolution. It doesn't matter how far Earth is from the sun. The distance from the sun doesn't affect the seasons. What does affect the seasons is Earth's tilt. The area of Earth tilted toward the sun receives more direct rays of sunlight. This part of the world has summer. The part of Earth that tilts away from the sun has winter. Seasons are influenced by the sun's rays hitting Earth at an indirect angle.



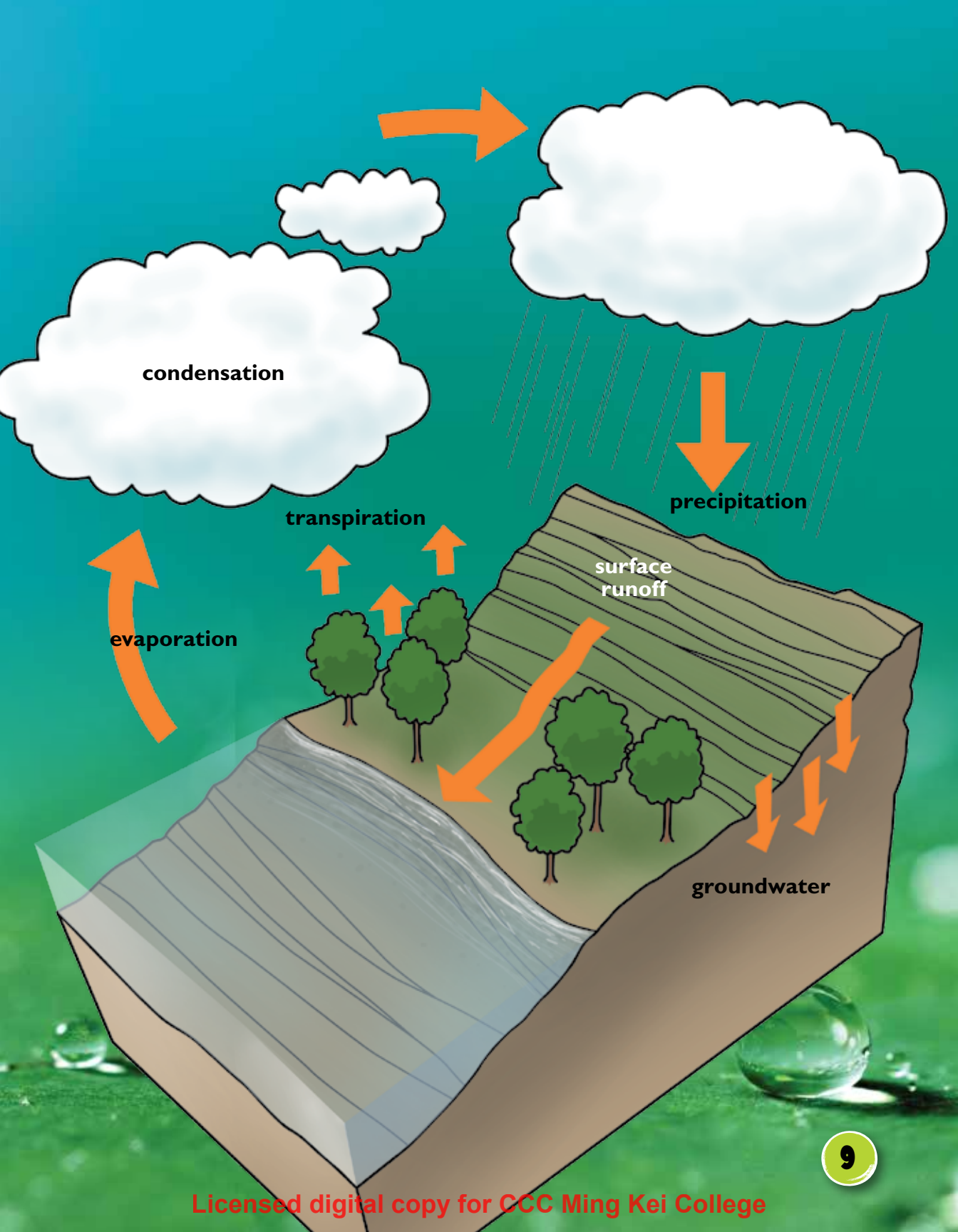
Water

During some seasons, certain areas may flood or have a drought. But did you know the amount of water on Earth never changes? The water in the sky, oceans, and ground recycles.

Water seems to be everywhere! It collects in oceans, rivers, and other places. When the heat of the sun turns this water into vapor, or gas, it evaporates. The water vapor rises into the sky and at some point begins to cool. When cooled, water vapor turns back to liquid and forms clouds—it **condenses**. It falls to the ground as snow, hail, rain, or sleet. This is called *precipitation*.

Water turns to vapor in a few other ways. Animals take in water when they drink. They also lose water when they breathe out. This is part of respiration. Plants take in water through their roots. Vapor releases through their leaves. This is called *transpiration*. **Combustion** happens when cars burn fuel. During this process, water vapor releases into the air. And the water cycle continues again and again, using the same water.

The oldest groundwater is called *fossil water*.



magma

melting

Rocks

Rocks are always moving. They continually form, break down, and recycle. But these changes can take millions of years. Think about how long it would take for a mountain to become sand! This is only one example of how rocks change. It takes heat, pressure, weathering, and erosion to change rocks. This set of changes is called the *rock cycle*.

melting

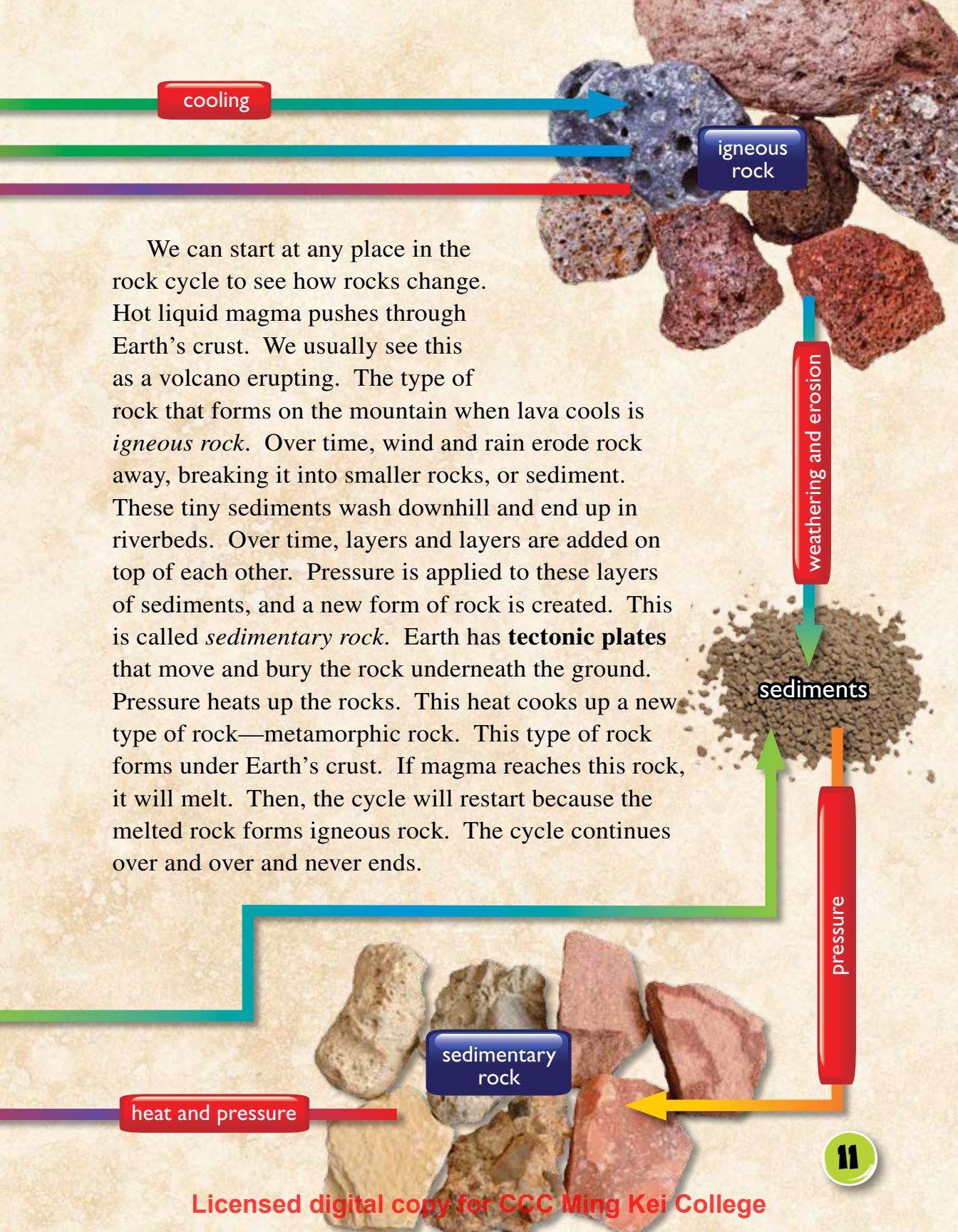
heat and pressure

Minerals

Rocks contain minerals like iron and calcium. When rocks break down, minerals are released. Living things use these minerals to help them grow.

metamorphic rock

weathering and erosion



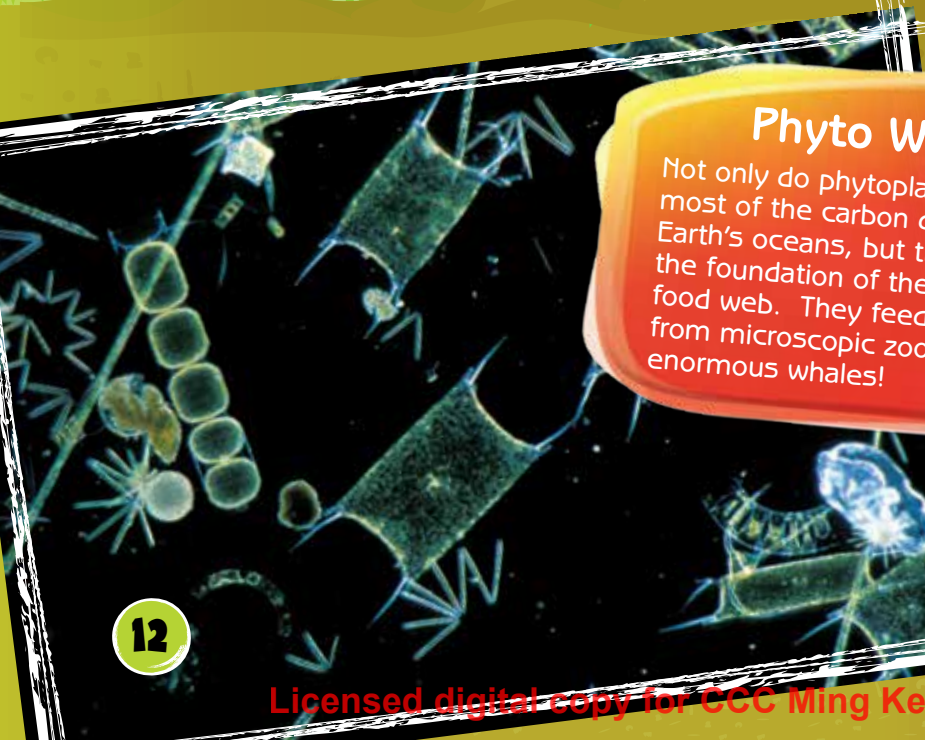
We can start at any place in the rock cycle to see how rocks change. Hot liquid magma pushes through Earth's crust. We usually see this as a volcano erupting. The type of rock that forms on the mountain when lava cools is *igneous rock*. Over time, wind and rain erode rock away, breaking it into smaller rocks, or sediment. These tiny sediments wash downhill and end up in riverbeds. Over time, layers and layers are added on top of each other. Pressure is applied to these layers of sediments, and a new form of rock is created. This is called *sedimentary rock*. Earth has **tectonic plates** that move and bury the rock underneath the ground. Pressure heats up the rocks. This heat cooks up a new type of rock—metamorphic rock. This type of rock forms under Earth's crust. If magma reaches this rock, it will melt. Then, the cycle will restart because the melted rock forms igneous rock. The cycle continues over and over and never ends.

Oxygen

The oxygen cycle is the movement of oxygen on Earth. You can find oxygen in water, air, living things, and soil. Rocks store oxygen, too! In fact, most of the oxygen on Earth is stored in rocks. Oxygen makes up about half the weight of a rock. And it stays there for millions of years. When rocks break down, oxygen is released.

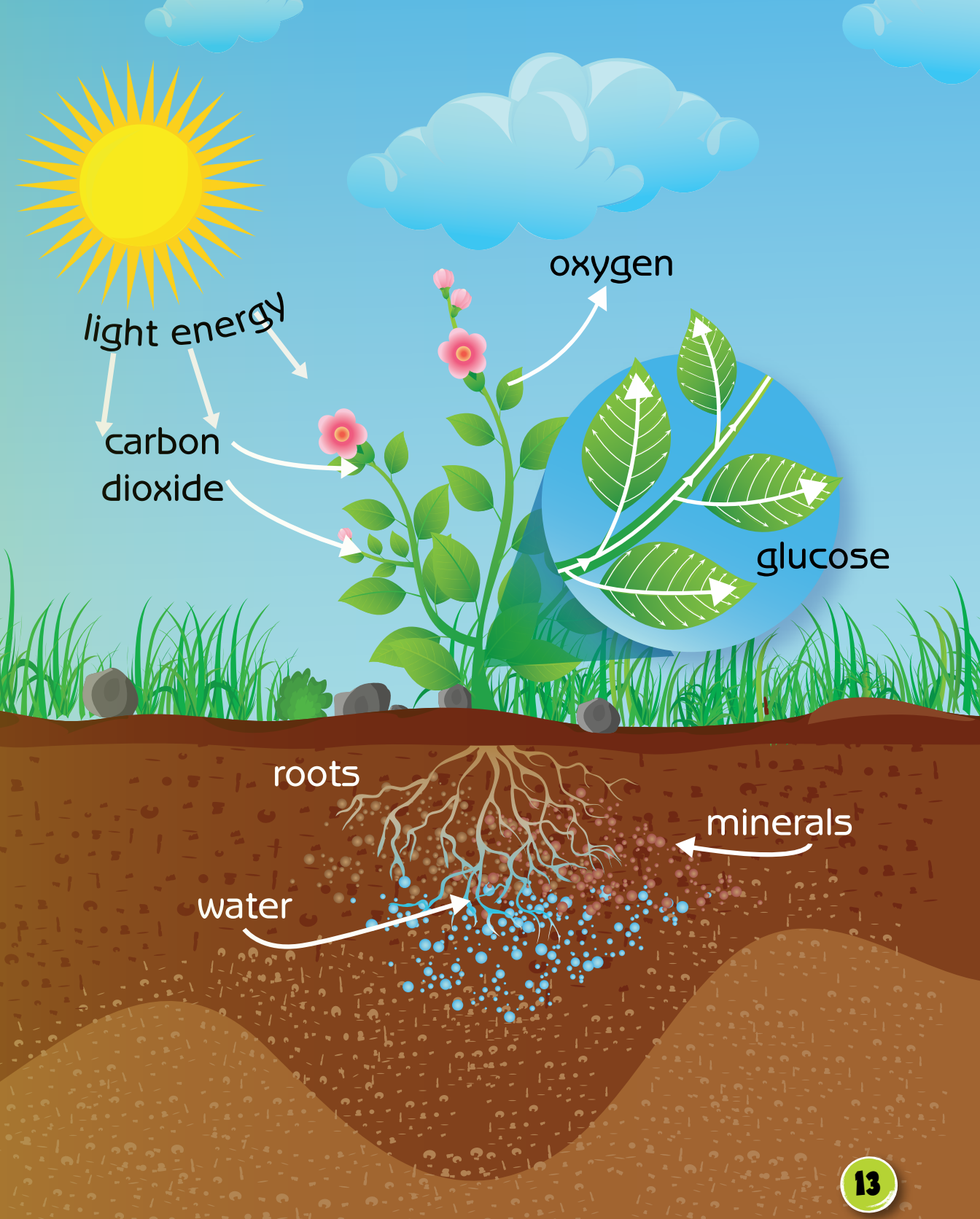
People and animals breathe in oxygen. Then, they breathe out carbon dioxide, or CO_2. Plants absorb CO_2 from the air. They use it in a process called *photosynthesis*. Then, they release oxygen back into the air. People and animals take in the oxygen that plants release. And so on.

Oxygen is in water, too. Creatures living in water take in oxygen and breathe out CO_2, just like we do. Phytoplankton take in CO_2 and release oxygen. And the cycle repeats.



Phyto What?

Not only do phytoplankton absorb most of the carbon dioxide in Earth's oceans, but they are also the foundation of the aquatic food web. They feed everything from microscopic zooplankton to enormous whales!

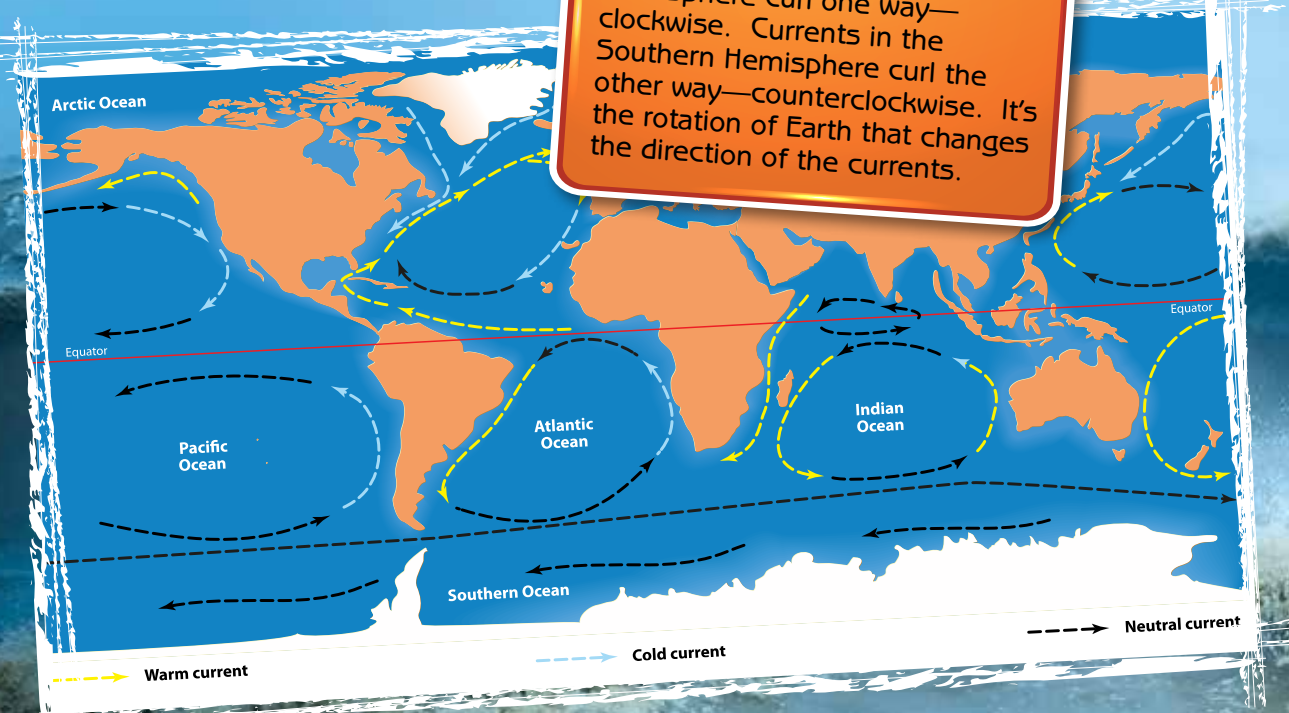


Ocean and Wind Currents

Ocean water is always on the move. Ocean **currents** are affected by many things, such as wind, temperature, and **salinity**. The sun's rays hit the surface of the ocean and warm the water. Water is warmest near the equator because it receives the most direct sunlight. The warm **molecules** in the water spread out. When molecules spread out, they can't hold as much salt. So, warm water is lighter and moves faster than cold water.

Curling Currents

Surface currents in the Northern Hemisphere curl one way—clockwise. Currents in the Southern Hemisphere curl the other way—counterclockwise. It's the rotation of Earth that changes the direction of the currents.



Ocean currents are also affected by temperature. Winds blow because Earth's surface is not heated evenly. The winds move the surface of the oceans. These currents force warm water to move toward the poles.

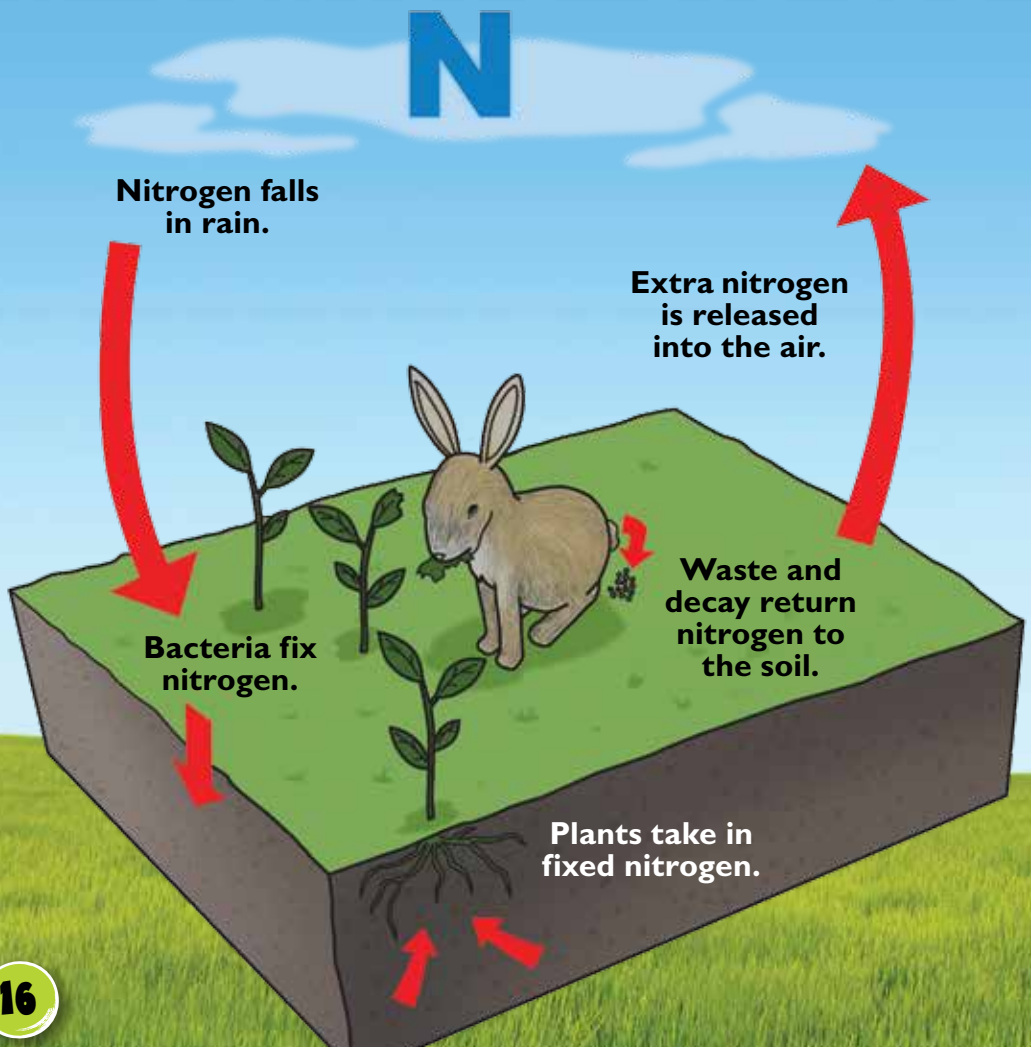
The temperature of the water slowly changes from warm to cold. Since the cold water is denser or more closely packed, it sinks. Deep currents move the cold water away from the poles back to the equator. This can take thousands of years! Then, warm water rises to replace the cold water taken away by the currents. And the cycle continues.

Streaming Summer

The Gulf Stream is a surface current that moves warm water north. The current stretches all the way from Florida to Europe. The Gulf Stream is the temperature of a warm bath!

Cycling the Elements

The cycles happening on Earth are essential. Seasons, water, rocks, oxygen, wind, and ocean cycles affect Earth and humans in crucial ways. But there are other cycles that occur around us daily and are just as important!



Nitrogen-fixing bacteria also digest nitrogen that plants release when they die.

Nitrogen

Take a deep breath. When you breathe in air, you inhale oxygen. But oxygen is just one part of air. You primarily inhale nitrogen. Nitrogen is a gas that's all around us. Your body needs nitrogen to grow. But this nitrogen is too pure for your body to use. The nitrogen your body really needs actually comes from food.

When it rains, nitrogen in the air falls to Earth. But most living things can't use the nitrogen that falls from the sky. Only some types of microscopic bacteria use pure nitrogen. Scientists call them *nitrogen-fixing bacteria*. They break down the nitrogen so plants can use it. Plants take in fixed nitrogen through the soil. Animals and people eat the plants. They eat other animals that have consumed plants, too. The nitrogen in these plants and animals help animals and people grow.

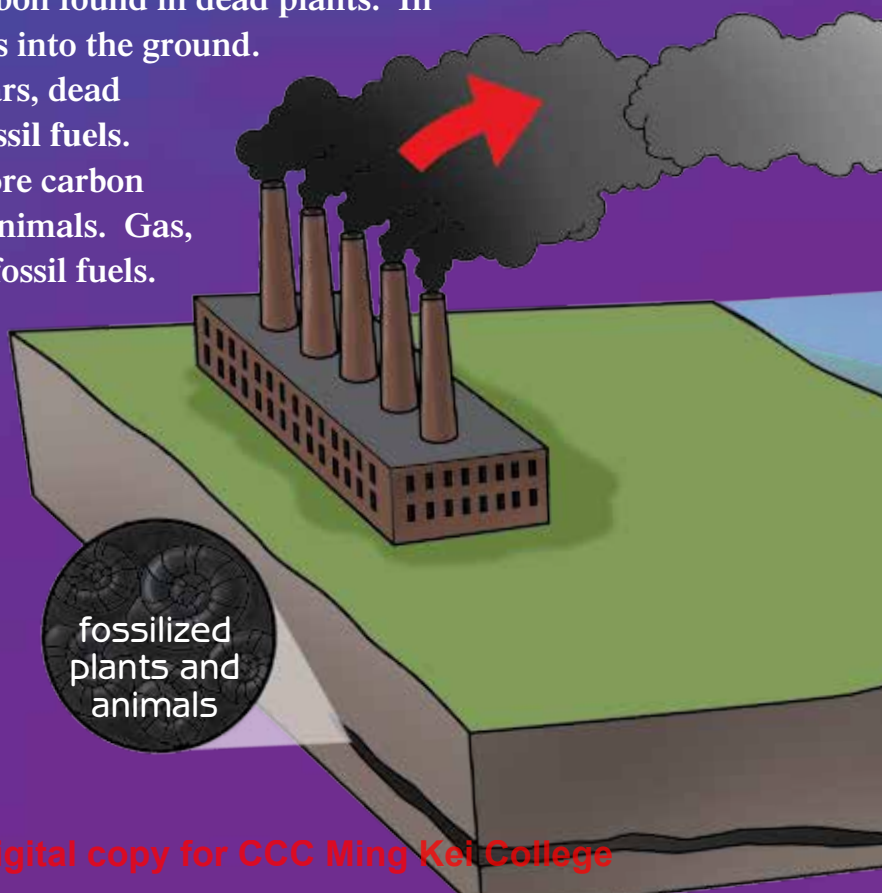
Eventually, the animals die and decay, or break down. Then, nitrogen returns to the soil. It also goes back to the soil through waste. And the cycle begins again.

nitrogen-fixing bacteria

Carbon

Look around you. Carbon is everywhere! You can find it in the air, rocks, oceans, and all living things. Carbon is the building block of life and easily combines with other elements. For example, carbon combines with oxygen in the air, making carbon dioxide (CO_2). Carbon moves and is always being exchanged. This process is called the *carbon cycle*.

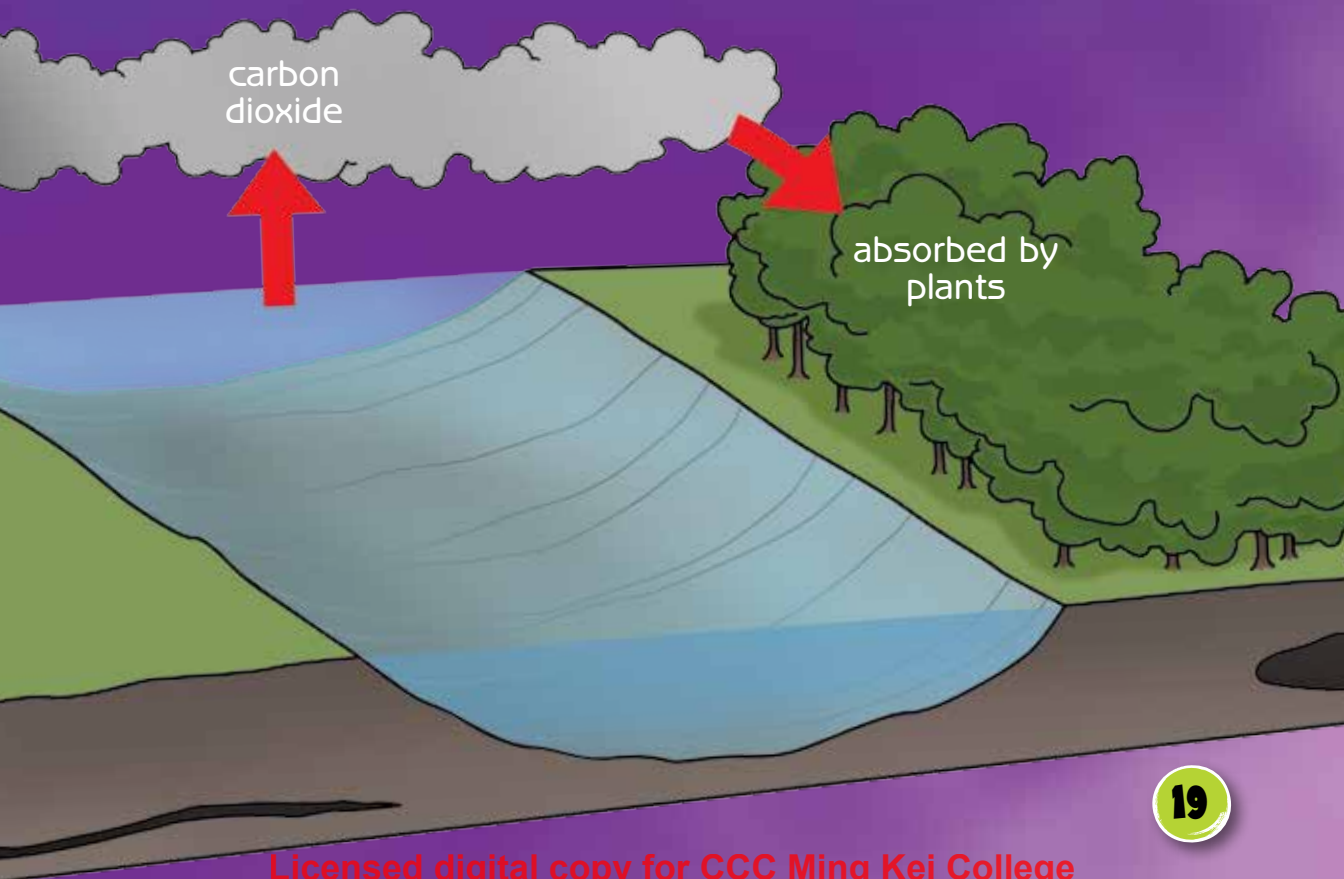
Carbon is stored in many places. Oceans store the most carbon. They take in large amounts of carbon dioxide from the air. Even shells in the ocean are made of calcium carbonate, a compound of carbon. When fish and sea animals die, they fall to the ocean floor. Their remains turn into sediments. These sediments store carbon. The earth stores carbon found in dead plants. In time, carbon releases into the ground. After millions of years, dead animals turn into fossil fuels. These fossil fuels store carbon left from decaying animals. Gas, oil, and coal are all fossil fuels.



Miracle Material

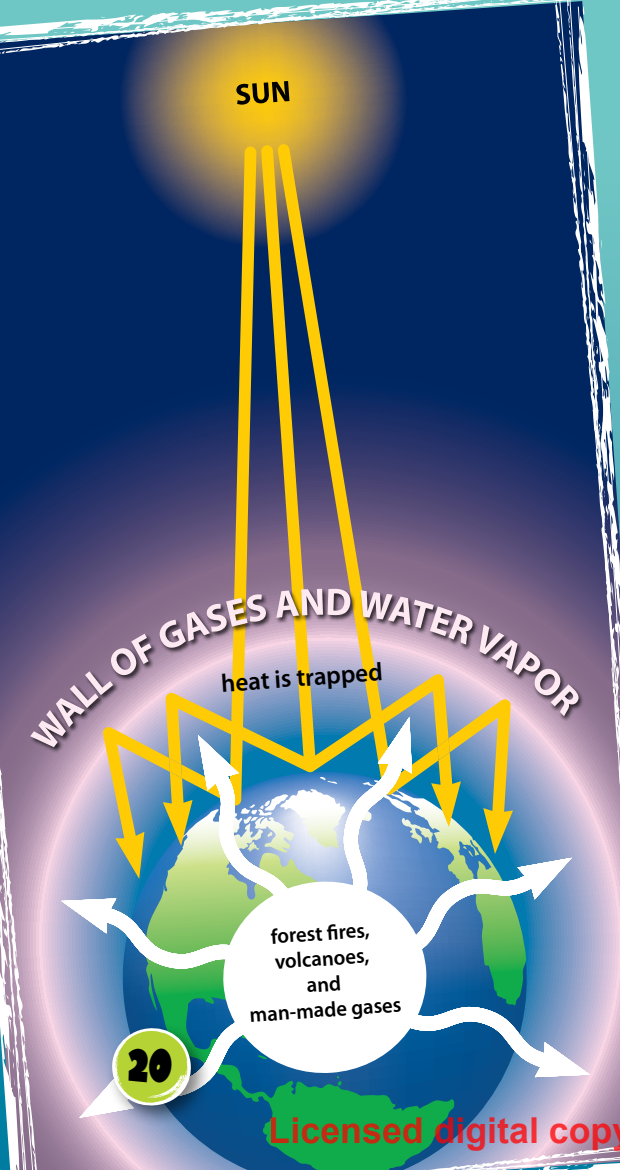
Graphene is a sheet of carbon in which atoms are arranged in a hexagonal pattern. Not only is it ultralight and flexible, but it is also the strongest material known to exist. It even conducts electricity better than copper.

Carbon gets its name from the Latin word *carbo*, which means "coal."



There are plenty of places where carbon is stored. But how does it get into the air in the first place? Trees store carbon for years and years. Carbon is released into the air when the trees are cut down and burned. Volcanic eruptions also produce large amounts of gas, including CO_2. Even in underwater eruptions, this gas is released.

Since plants store carbon, humans and animals that eat plants take in the carbon. We exhale CO_2 into the air. Plants release CO_2 into the air, too. For photosynthesis to occur, sunlight is needed. At night, when there is no sunlight, plants release CO_2 back into the air.



Carbon constantly moves around Earth. And just like all cycles, there needs to be balance. Plants and oceans keep this balance. When people burn fossil fuels, CO_2 is released into the air. Instead of releasing heat, CO_2 absorbs and holds onto heat. So, more heat is absorbed than is released. **Global warming**, the gradual increase of Earth's average temperature, is a natural process. But increased CO_2 in the atmosphere creates an imbalance in the carbon cycle. Global warming then happens at a much faster rate.

Carbon can take many forms, from a rock-hard diamond to something as soft as graphite, or lead, in a pencil.

A volcano erupts on Java Island in Indonesia, releasing ash and carbon dioxide into the atmosphere.

Staying in Balance

Have you noticed that on cloudy days, the air feels cooler? Or that the temperature drops when the night sky is clear? All this happens because of the exchange of Earth's energy.

Energy powers all of the cycles on Earth. And almost all of Earth's energy comes from the sun. Sunlight causes Earth to warm up. Air absorbs some of this heat before it reaches land. The air gets warmer. Land and oceans absorb some of the heat. The land and oceans get warmer. Plants absorb the sun's energy and use it for photosynthesis. Cold-blooded animals absorb the sun's rays to keep warm.

But not all of this energy is absorbed. About 30 percent of the sun's energy is reflected back into the atmosphere. For example, the snow of the arctic region reflects the sun's rays. Some types of clouds act as an umbrella. They shield the sun's heat from reaching land, and it stays cooler. Other kinds of clouds trap heat so it can't leave the atmosphere.

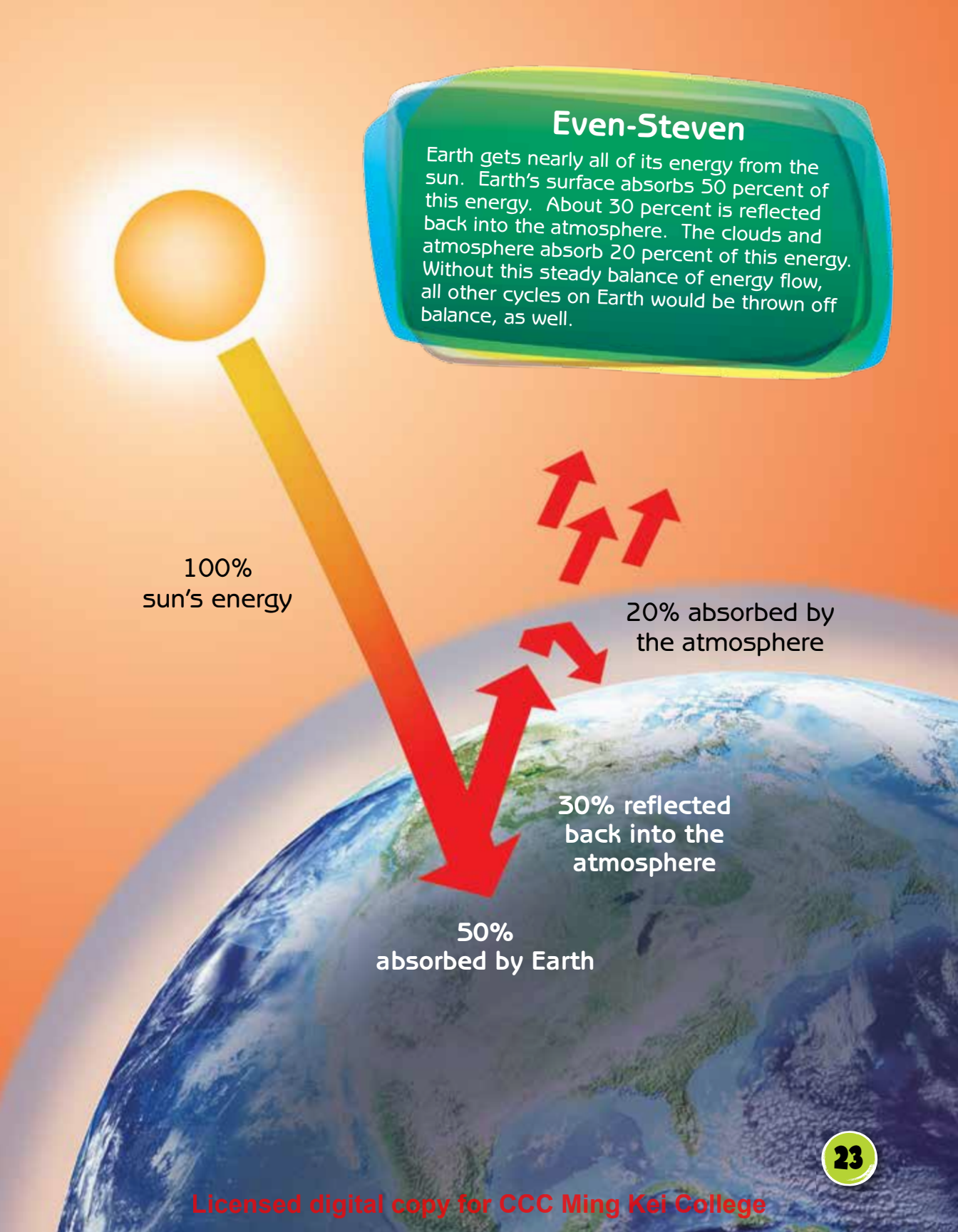
Tokyo, Japan

Urban Heat Island

Crowded cities with lots of buildings and pavement tend to have higher temperatures than open areas with lakes and streams. These urban heat islands lack trees and water that have a cooling effect on surrounding areas.

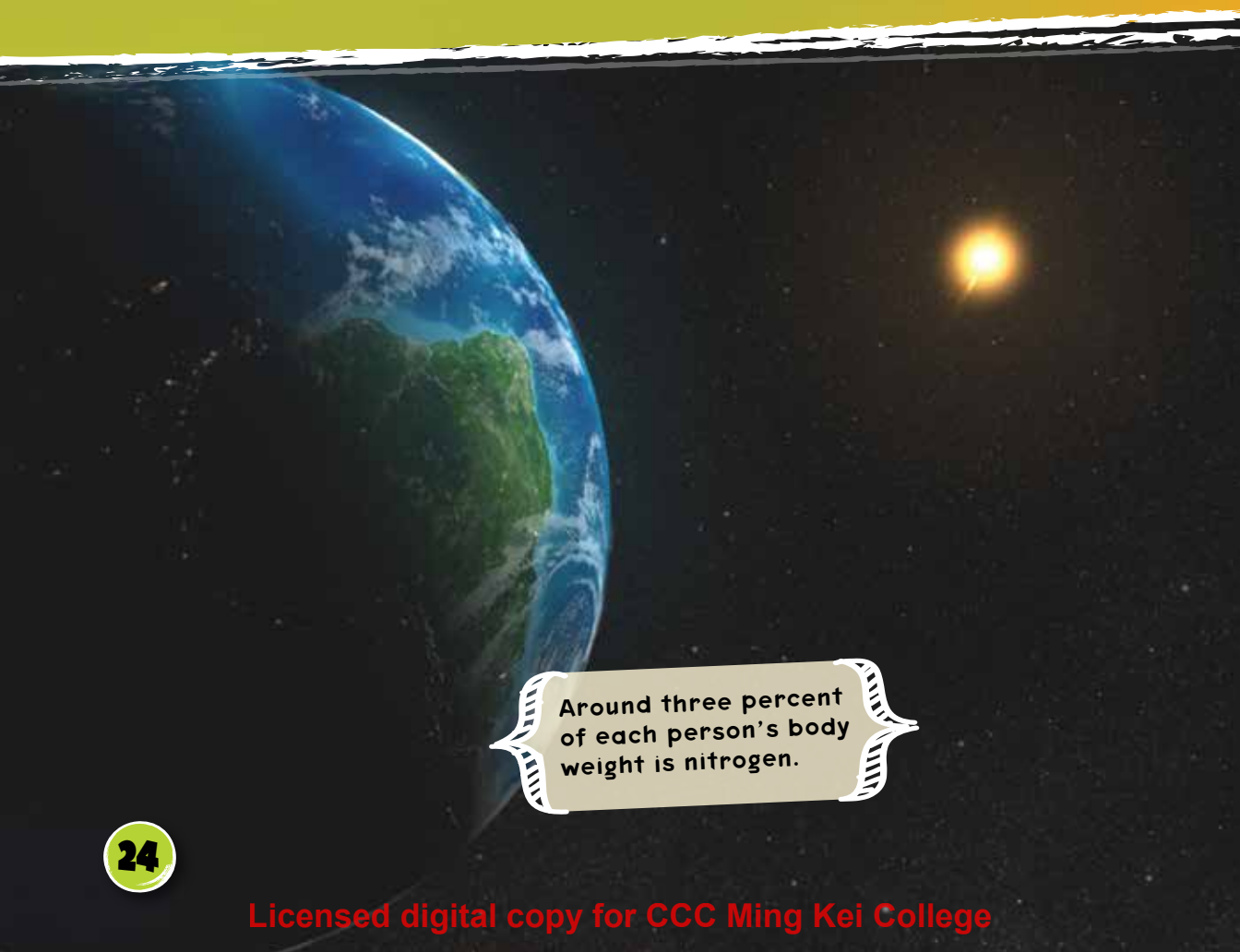
Even-Steven

Earth gets nearly all of its energy from the sun. Earth's surface absorbs 50 percent of this energy. About 30 percent is reflected back into the atmosphere. The clouds and atmosphere absorb 20 percent of this energy. Without this steady balance of energy flow, all other cycles on Earth would be thrown off balance, as well.



Earth absorbs some of the sun's energy. And Earth reflects some energy back into space. These two things must balance. If too much energy is absorbed, Earth will get too hot. If too much energy is reflected, Earth will get too cool. The balance of Earth's energy is key for all living things.

But the energy balance on Earth is changing. This change is sped up by the activity of people. Even activities such as farming impact the balance of Earth's systems and cycles.



Farmers want their crops to grow, so some of them choose to add nitrogen to the soil. As a result, the crops grow big and strong. But this nitrogen can flow into streams, rivers, and oceans. It can make phytoplankton grow too fast. This eventually shrinks the amount of oxygen in the water. Sea creatures need oxygen to live. So, a change in the nitrogen cycle affects the oxygen cycle.

A rice farmer uses nitrogen fertilizer on his field.

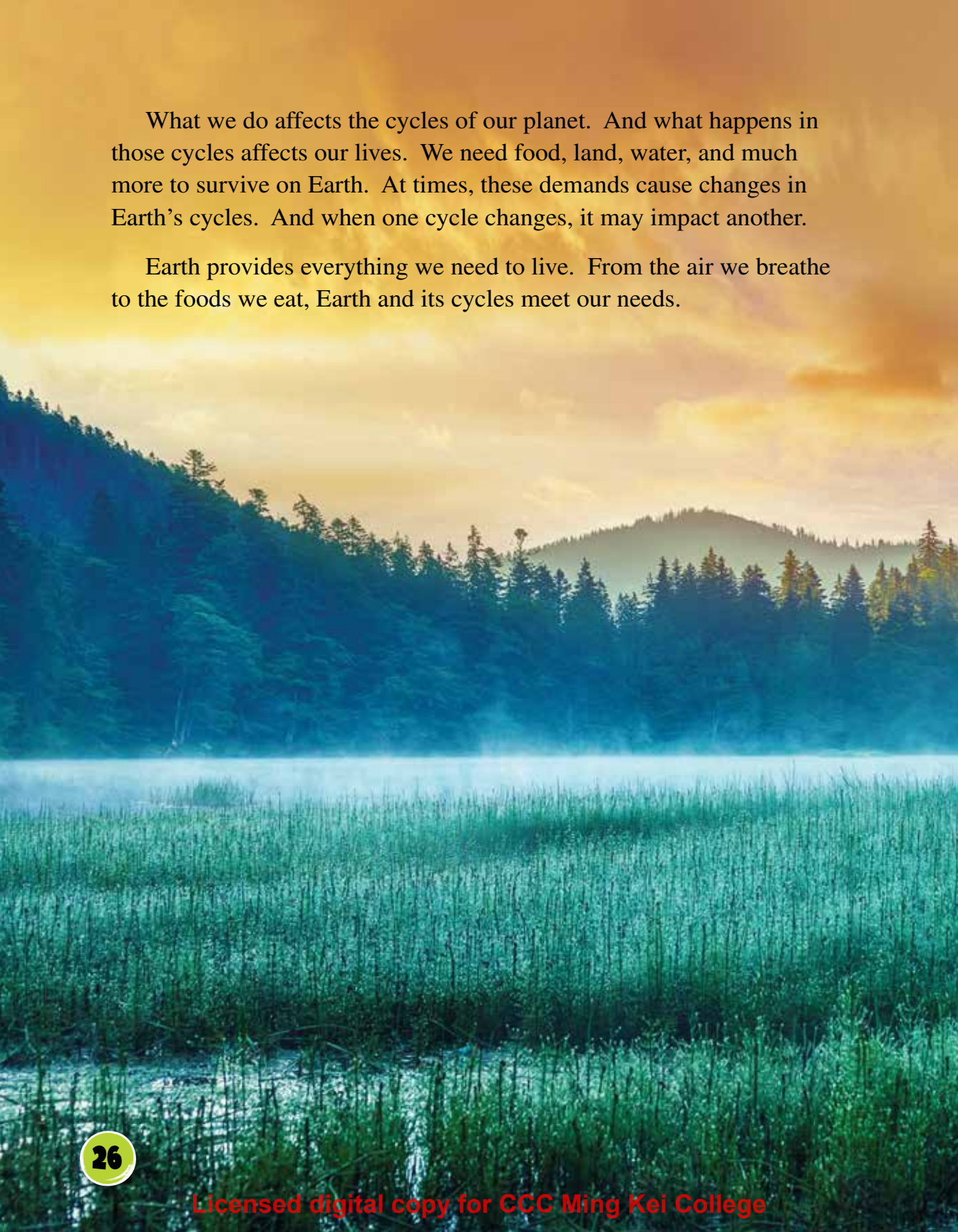
red blood cells

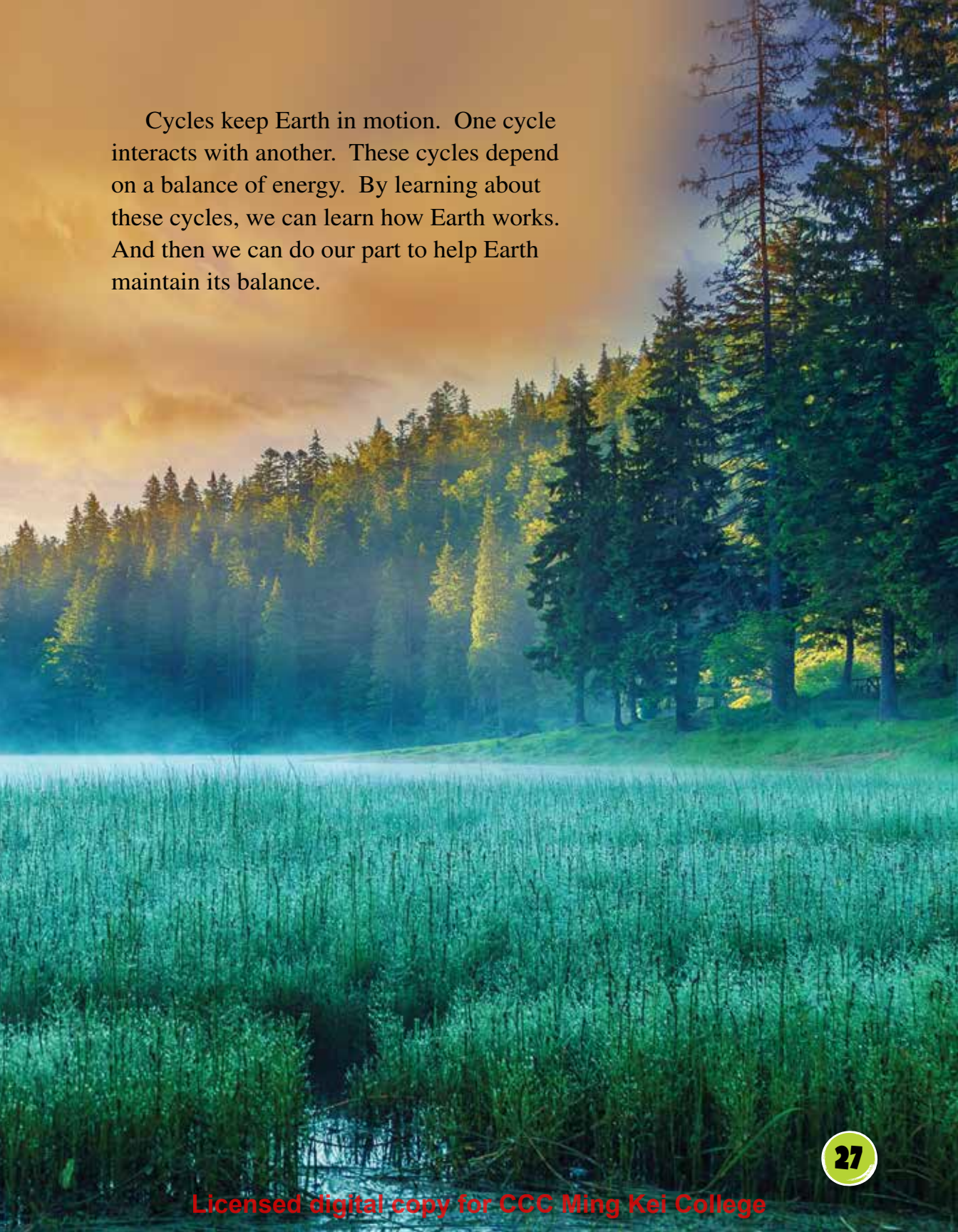
Cell Cycles

Your body has many cycles, too! Your red blood cells are replaced about every four months. Your skin cells are replaced every two to three weeks. Your brain cells can last a lifetime. It's a delicate balance that makes you who you are!

What we do affects the cycles of our planet. And what happens in those cycles affects our lives. We need food, land, water, and much more to survive on Earth. At times, these demands cause changes in Earth's cycles. And when one cycle changes, it may impact another.

Earth provides everything we need to live. From the air we breathe to the foods we eat, Earth and its cycles meet our needs.





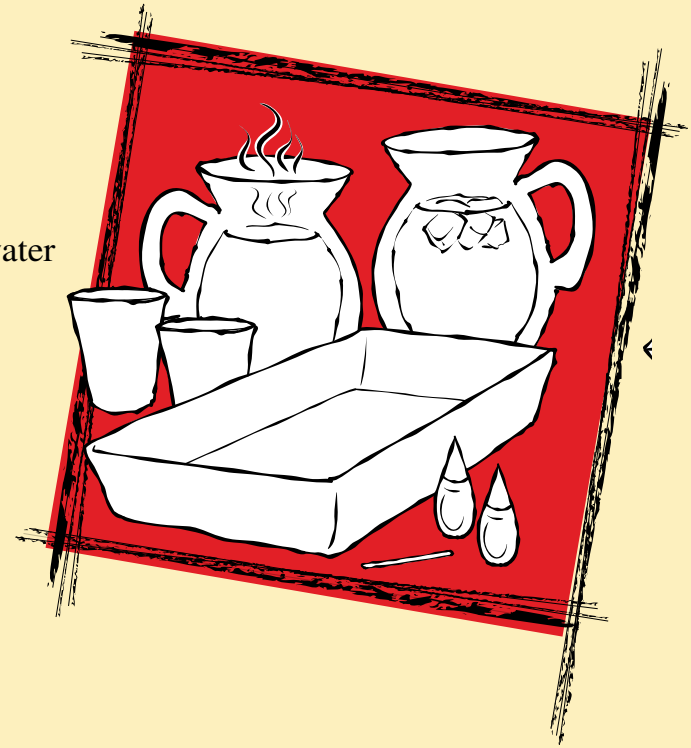
Cycles keep Earth in motion. One cycle interacts with another. These cycles depend on a balance of energy. By learning about these cycles, we can learn how Earth works. And then we can do our part to help Earth maintain its balance.

Think Like a Scientist

How does temperature affect water currents? Experiment and find out!

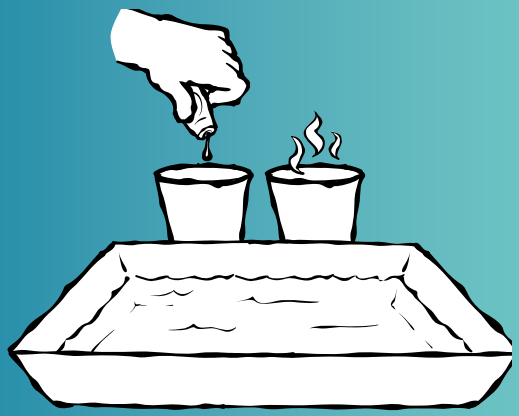
What to Get

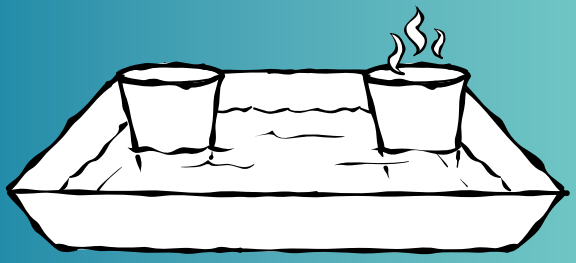
- 2 paper cups
- food coloring (red and blue)
- hot water
- ice water
- large clear pan
- room-temperature water
- toothpick



What to Do

1. Fill the pan with room-temperature water. Then, fill one paper cup with hot water and the other with ice water.
2. Put a few drops of red food coloring in the hot water and a few drops of blue food coloring in the cold water.
3. Place one of the cups on one side of the pan. Place the other cup on the other side of the pan.
4. Use the toothpick to poke a hole near the bottom of each cup, so the colored water can leak into the pan. Observe and record the movement of the hot and cold water. What patterns do you see?





Glossary

atmosphere—the mass of air that surrounds Earth

biosphere—the part of Earth in which life can exist

combustion—a chemical reaction that occurs when oxygen combines with other substances to produce heat and usually light

condenses—changes from a gas into a liquid

currents—continual movements of water or air in the same direction

equator—an imaginary circle around the middle of Earth

erosion—movement of weathered rock and sediment

fossil fuels—fuels that are formed in the earth from dead plants or animals

geosphere—the rocks and soil that make up the outer layer of Earth

global warming—the recent increase in the world's temperature that is believed to be caused by the increase of certain gases in the atmosphere

hydrosphere—all the water in the atmosphere and on the surface of Earth

molecules—the smallest possible amounts of a particular substance that have all the characteristics of the substance

revolves—moves around something in a circular path

salinity—the concentration of salt that is dissolved in water

tectonic plates—giant pieces of Earth's crust that move

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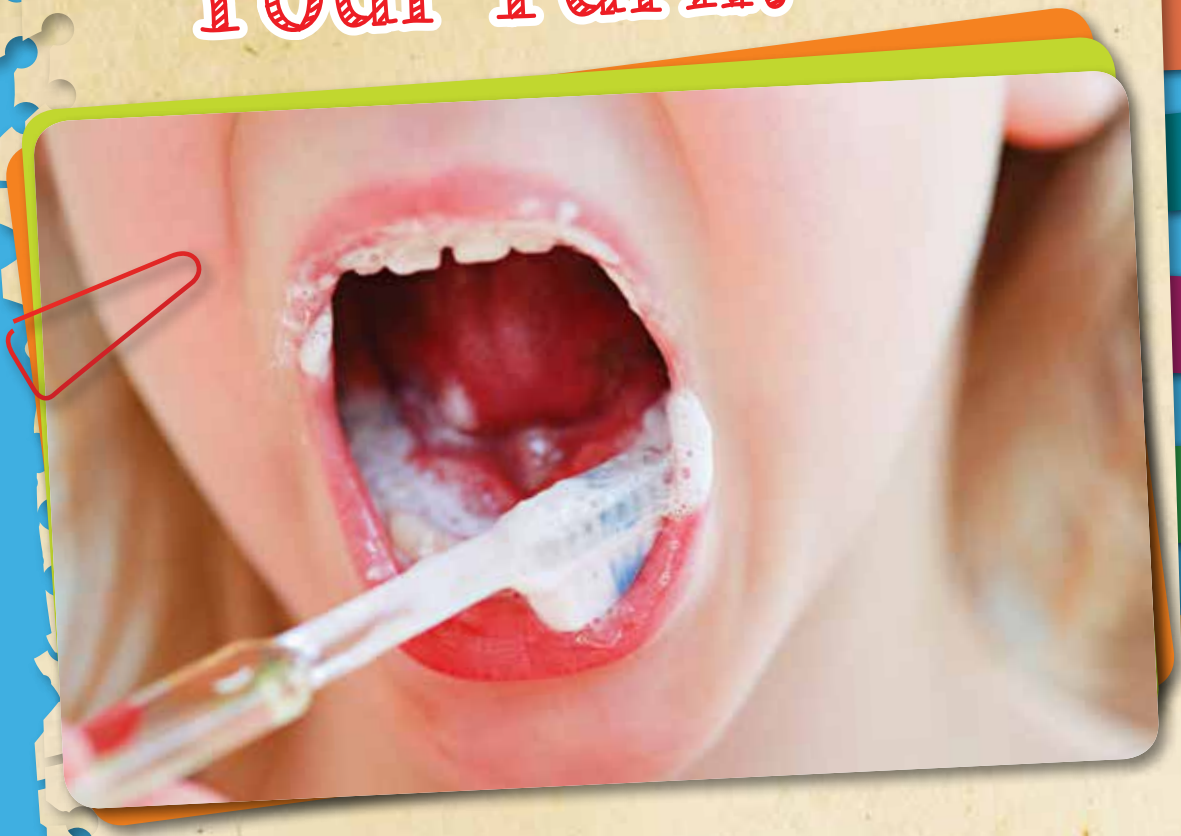
Your Turn!



Everyday Cycles

Observe the cycles that occur in your everyday life. Are there things you do over and over again? What cycles keep your body and mind healthy? Compare and contrast these everyday cycles with Earth's cycles.