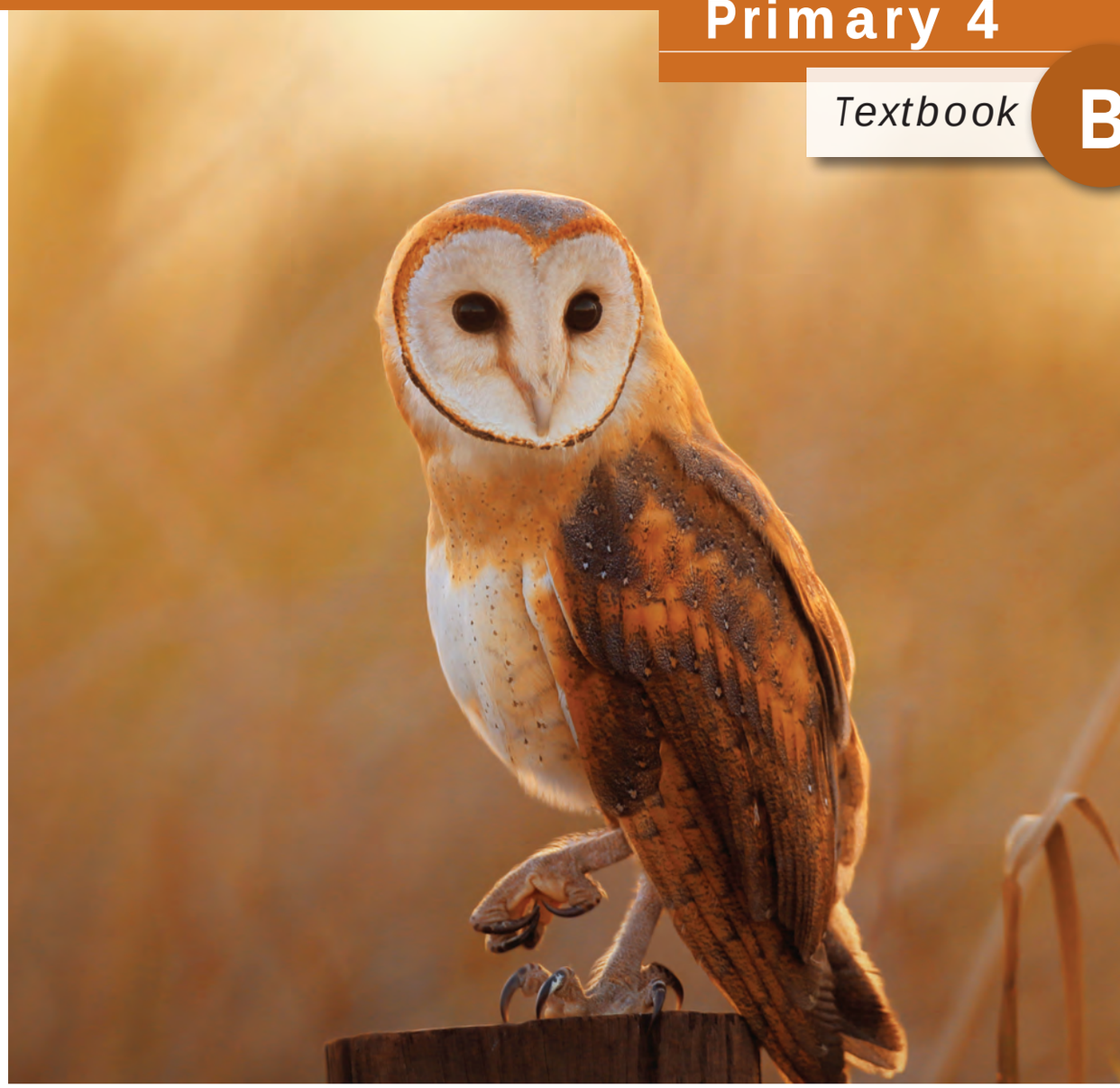
Let's Do SCIENCE

Primary 4

Textbook B



The 5E Model – Guided Inquiry

The Let's Do Science series is based on the Biological Sciences Curriculum Study (BSCS) 5E teaching and learning instructional model. The 5E model is centered on the idea that students understand science concepts best by using prior knowledge to pose questions and find answers through guided inquiry.

This hands-on approach, integrated with engineering and design skills, has students learn science by doing science. Teachers guide the learning process and are able to assess student performance by evaluating student explanations and the application of newly acquired knowledge and skills.

Engage

The Engage phase of the 5E model provides students with the opportunity to demonstrate their prior knowledge and understanding of the topic or concept. Students are presented with an activity or question which serves to motivate and engage students as they begin the lesson. Teachers identify and correct any misconceptions and gather data from students which will guide informed teaching and learning.

Essential to stimulating and engaging students is the use of mixed media such as colorful photos, illustrations and diagrams found throughout the textbooks and activity books. Let's Do Science also includes extensive digital resources such as narrated videos, interactive lessons, virtual labs, slideshows and more.

Explore

This phase encourages exploration of concepts and skills through hands-on activities and investigations. Students are encouraged to work together and apply various process skills while gaining concrete, shared learning experiences. These experiences provide a foundation for which students can refer to while building their knowledge of new concepts. This student-centered phase comes before formal explanations and definitions of the concept which are presented by the teacher.

Explain

This phase follows the exploration phase and is more teacher-directed. Students are initially encouraged to draw on their learning experiences and demonstrate their understanding of the concept through explanations and discussion. After the students have had the opportunity to demonstrate their understanding of the concept, the teacher then introduces formal definitions and scientific explanations. The teacher also clarifies any misconceptions that may have emerged during the Explore phase.

Elaborate

In the Elaborate phase, students refine and consolidate their acquired knowledge and skills. Opportunities are provided for students to further apply their knowledge and skills to new situations in order to broaden and deepen their understanding of the concept. Students may conduct additional investigations, share information and ideas, or apply their knowledge and skills to other disciplines.

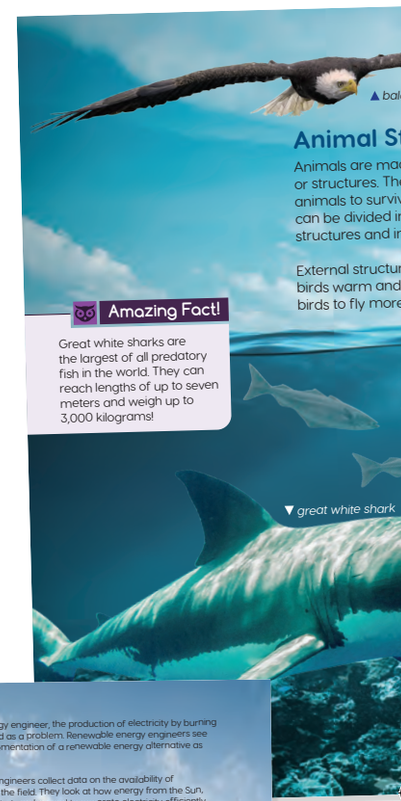
Evaluate

This final phase includes both formal and informal assessments. These can include concept maps, physical models, journals as well as more traditional forms of summative assessment such as quizzes or writing assessments. Students are encouraged to review and reflect on their own learning, and on their newly acquired knowledge, understanding and skills.

Let's Do Science

Let's Do Science is based on the United States Next Generation Science Standards (NGSS). The series consists of full-color textbooks and full-color activity books for Grades K to 6.

Let's Do Science engages students with a highly visual presentation of the disciplinary core ideas in the textbooks and places an emphasis on applying scientific knowledge using NGSS practices through numerous scientific investigations. Let's Do Science sees engineering as an essential element of science education and as such is tightly integrated into both the textbooks and activity books.



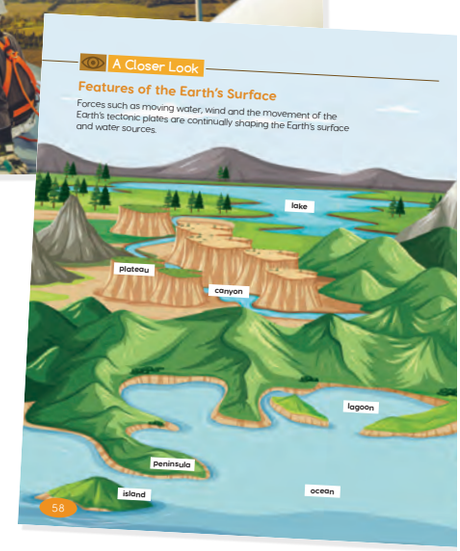
The Let's Do Science textbooks include the following features:

Think Deeply

Topic-related questions for group discussion aimed at deepening students' understanding of the topic.

Engineer It!

Goes beyond inquiry by encouraging students to design, model and build to engineer solutions to defined problems.

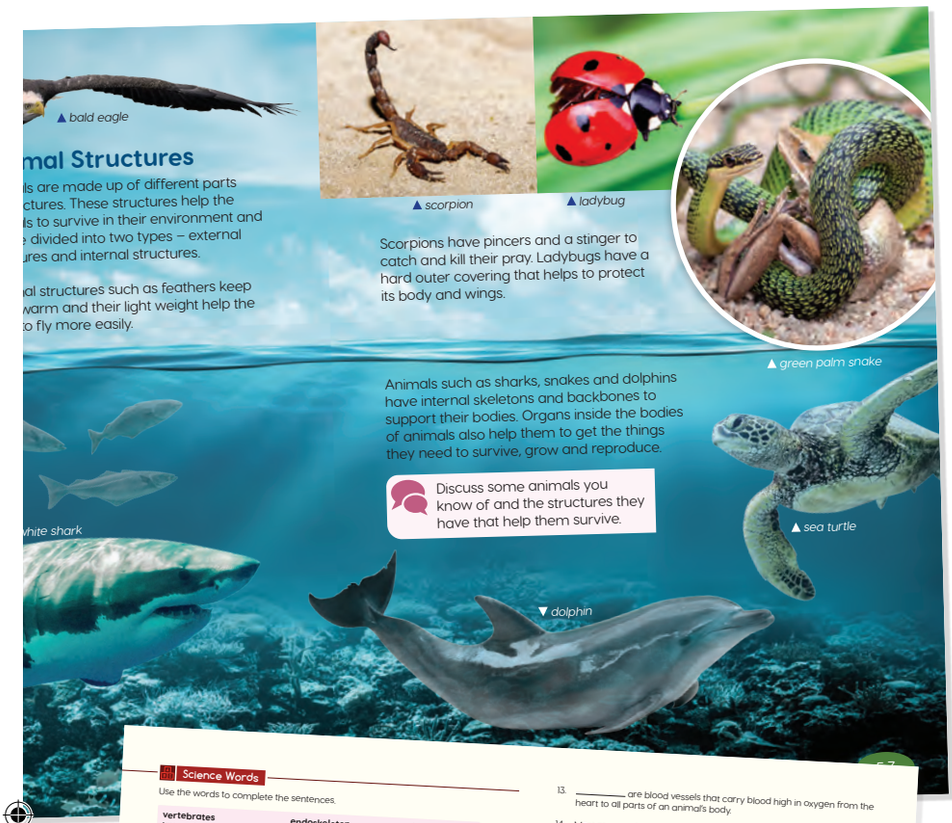


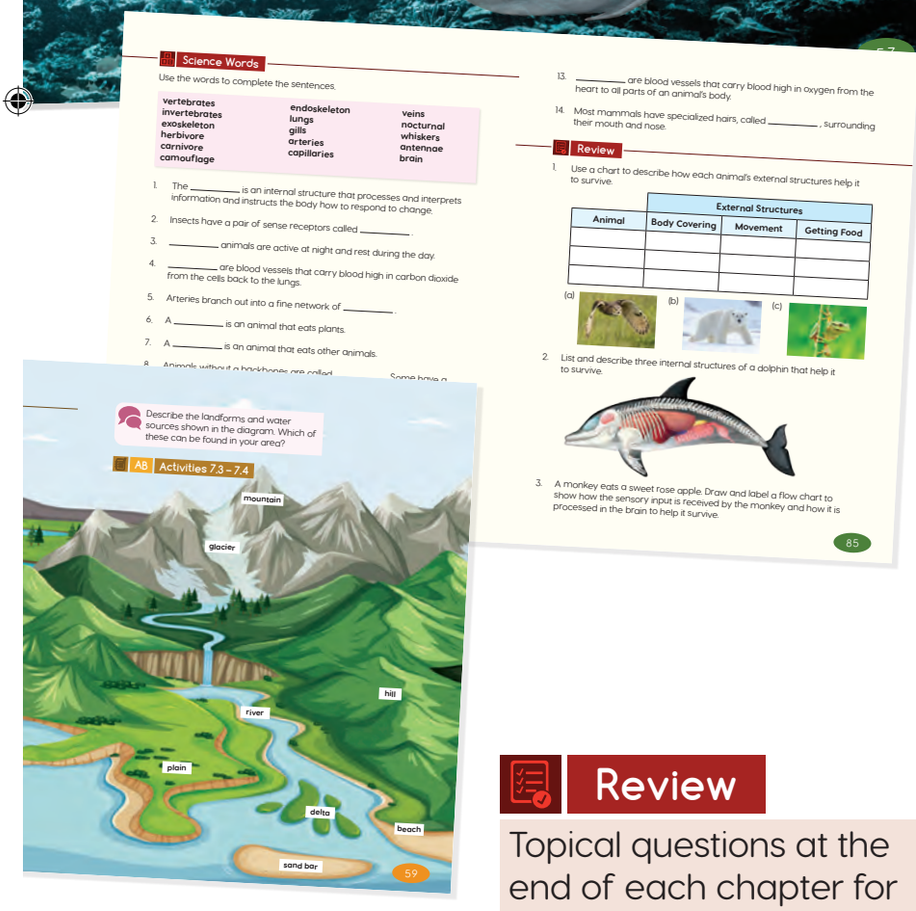
In the Field

Inspirational science-related professions to stir interest in science-related careers.

A Closer Look

Invokes enthusiasm in science by presenting interesting topics beyond the syllabus.





Amazing Fact!

Interesting facts to build interest and enthusiasm.

Did You Know?

Extra information to build students' knowledge base of the current topic.

Try This!

Optional hands-on activities to be conducted in groups or at home.

AB Activity

Links students to the Let's Do Science Activity Book at the appropriate juncture.

Discussion

Topic-related questions and situations for class discussion to build a deeper understanding of topics.

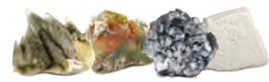
Review

Topical questions at the end of each chapter for formative assessment.

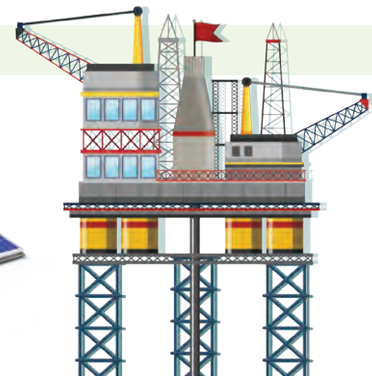
Science Words

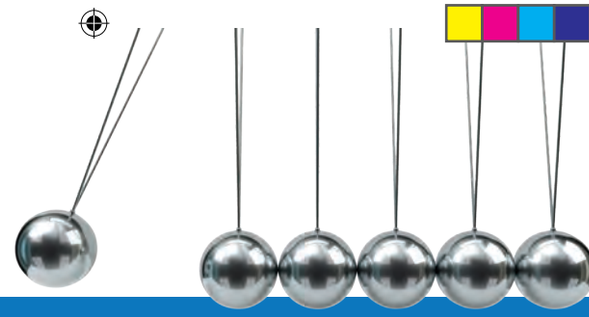
Lists the essential science vocabulary covered in each chapter.

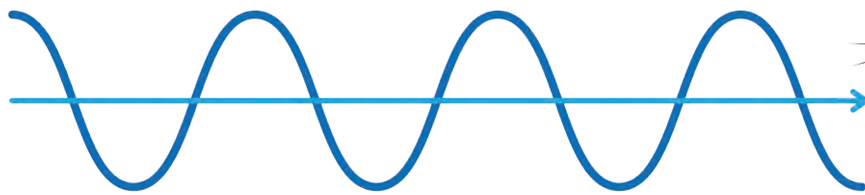
Contents

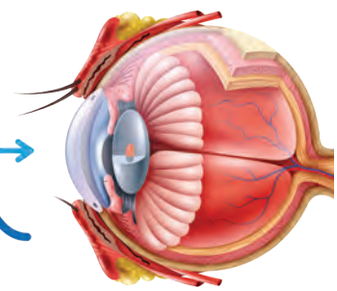











6 Processes That Shape the Earth

In this chapter you will ...

- describe minerals, rocks and soil and their properties.
- list the three main types of rocks and describe how they form.
- list and describe processes that shape the Earth's surface rapidly and slowly.
- identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.
- make observations and measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind and vegetation.

What are minerals, rocks and soil? How are they used by people?

What processes change the shape of the Earth's surface?

Go Online!

Access interactive content relating to this topic on the NGScience website.
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▲ *talc mine*

Minerals, Rocks and Soil

What Are Minerals?

Minerals are naturally occurring inorganic substances that are found in rocks and soil on and under the Earth's surface. Inorganic means they do not come from the remains of living things.

Many minerals are metals. Gold, silver and copper are minerals. Other common minerals include salt, talc and diamond.

Using Minerals

Plants, animals and other organisms need minerals to survive. Plants take in minerals salts through their roots. The minerals are essential for the healthy growth of the plant. They are also important for photosynthesis.

Animals and people need minerals. Many of these essential minerals come from water and food. Calcium is a mineral that helps animals develop healthy, strong bones and teeth. Iron is a mineral essential to animals for the transport of oxygen and production of energy.

Minerals are also mined and used by people in many ways. They are used in the construction of roads, buildings and cars. They are used in manufacturing, the production of cosmetics and in cleaning products. Gemstones and diamonds are often used to make jewelry.

▲ *gold*

AB Activity 6.1

Try This!

Use a mineral collection to observe, test and describe the properties of different minerals. Describe their color, luster and hardness.

Properties of Minerals

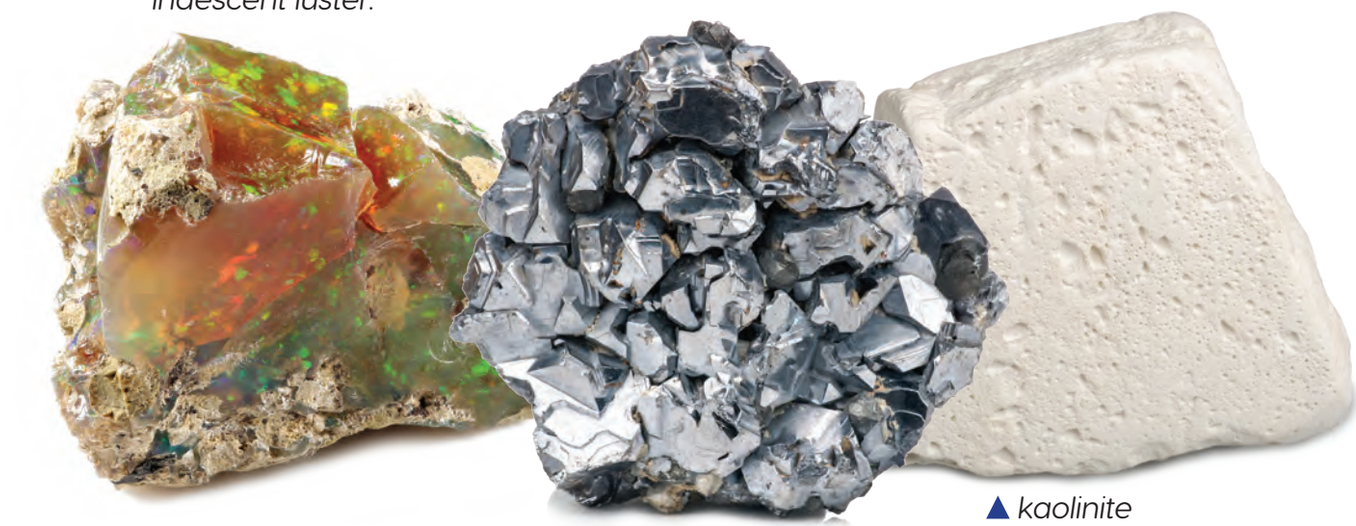
Scientists who study minerals, called mineralogists, identify minerals by looking closely at their properties. By observing and measuring the properties of minerals, they are able to determine how the minerals can be useful to people.

Some properties of minerals include color, luster, streak, hardness and cleavage.

The color of a mineral is often the most obvious property of a mineral. However, many minerals occur in more than one color, making this property not very useful.

The **luster** of a mineral describes its appearance when it reflects light. Minerals may be transparent, translucent or opaque. Some minerals have a metallic luster – they look similar to a shiny metal. Others have an earthy luster – they have a dull, clay-like appearance. A mineral can also have an iridescent luster. This means its color changes as light hits its surface from different directions.

▼ *Opals have an iridescent luster.*



▲ *magnetite*

▲ *kaolinite*

Earth Long Ago

Continual processes like weathering, erosion and deposition, along with natural hazards like earthquakes and volcanic eruptions, have been changing the Earth's surface for billions of years.

Scientists are able to learn what the Earth was like long ago by studying patterns in rock formations and fossils in rock layers.

The discovery of marine shell fossils above rock layers with plant fossils and no shells, indicates a change from land to water over time. By studying the fossils in an area, scientists are also able to infer things about the climate, vegetation and other organisms that lived there.

Think Deeply

Antarctica is the coldest continent on Earth. The ground is covered in ice and snow and almost no plants can survive in the harsh conditions. Scientists have discovered a variety of different plant fossils in Antarctica. What can they infer from this discovery?

In the United States, the discovery of shells and marine fossils in the center of the country led scientists to infer that a large body of water, called the Western Interior Seaway, ran through the center of the country long ago.

Scientists are also able to learn about the Earth long ago by observing land formations. A canyon with different rock layers in the walls and a river at the bottom, indicates that over time a river cut through the rock.

How can scientists find out what an area of the Earth's surface was like long ago?

▲ *Marine fossils in sedimentary rock.*

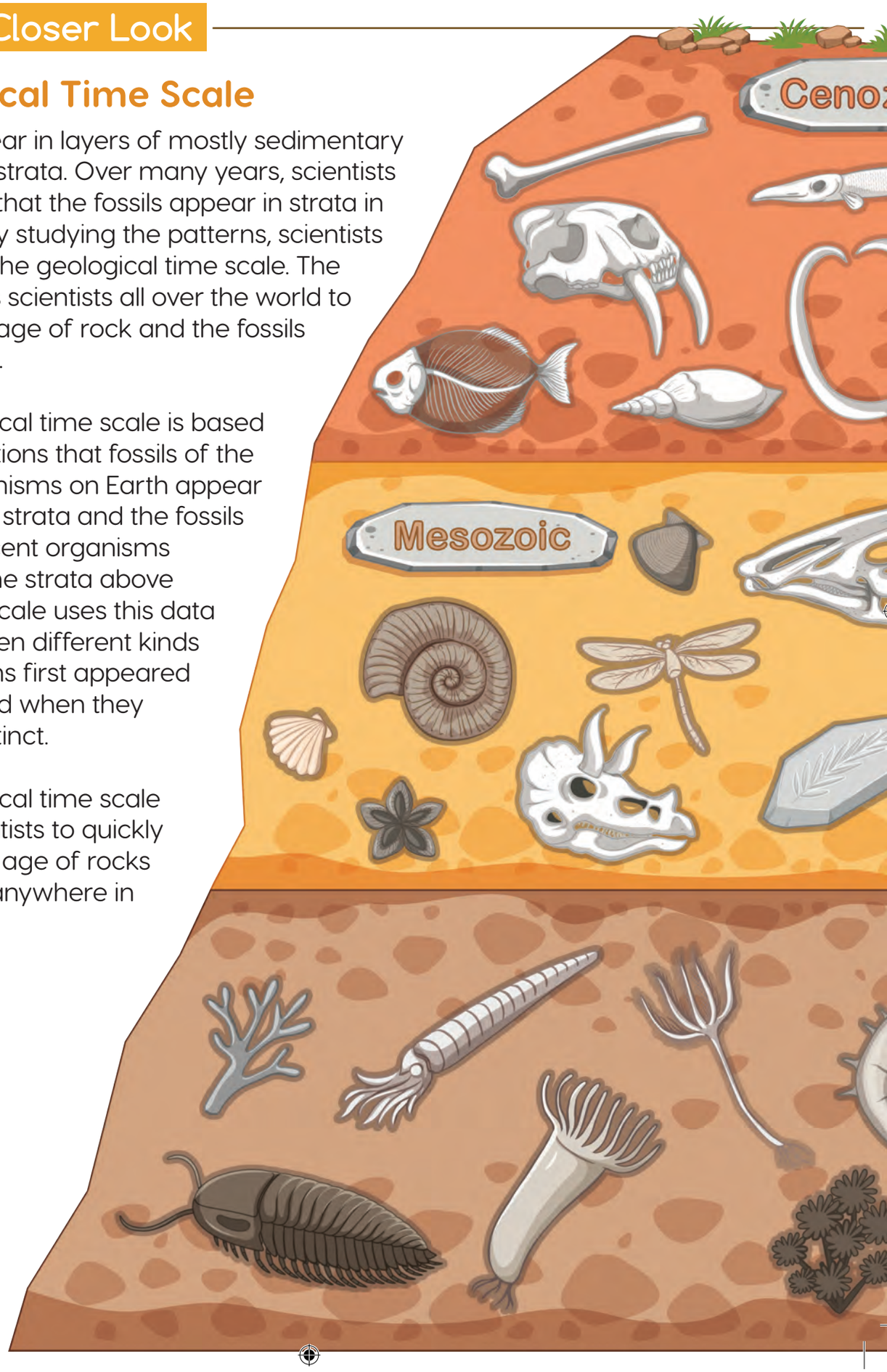
A Closer Look

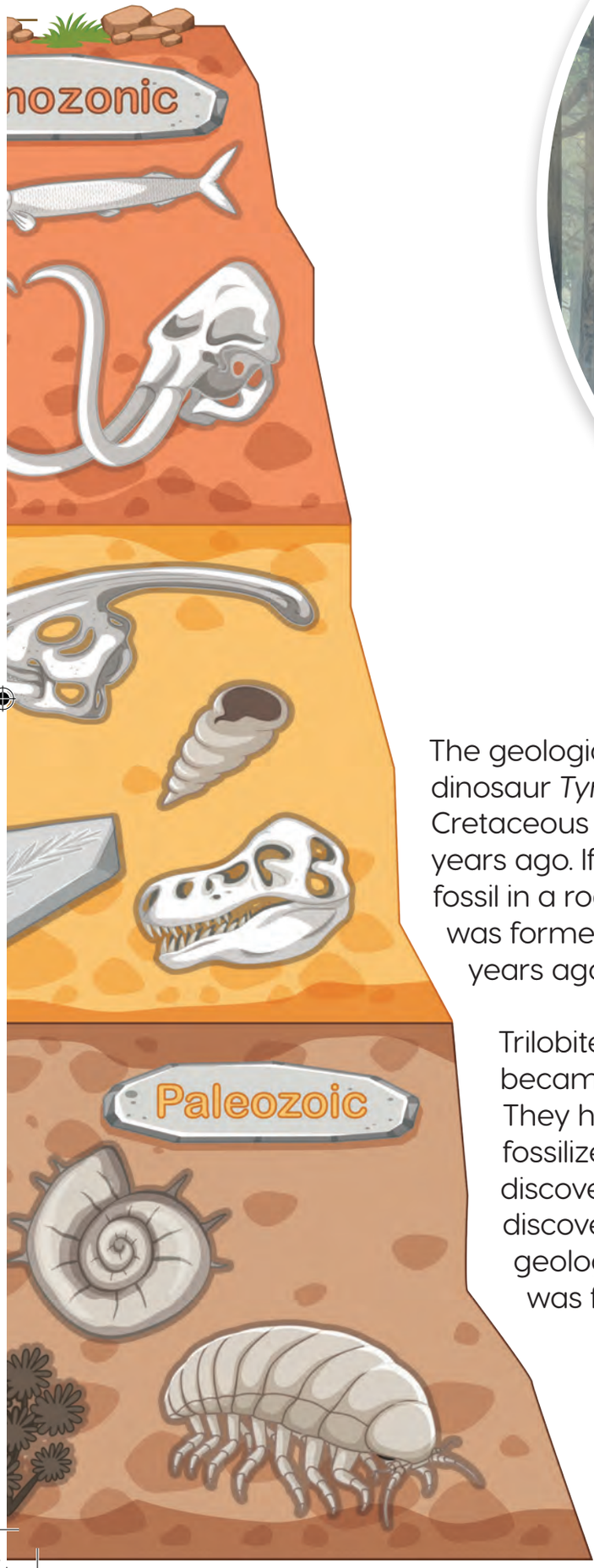
Geological Time Scale

Fossils appear in layers of mostly sedimentary rock called strata. Over many years, scientists discovered that the fossils appear in strata in a pattern. By studying the patterns, scientists developed the geological time scale. The scale allows scientists all over the world to explain the age of rock and the fossils within them.

The geological time scale is based on observations that fossils of the oldest organisms on Earth appear in the lower strata and the fossils of more recent organisms appear in the strata above them. The scale uses this data to show when different kinds of organisms first appeared on Earth and when they became extinct.

The geological time scale allows scientists to quickly find out the age of rocks and fossils anywhere in the world.





▲ *Tyrannosaurus rex*

The geological time scale shows that the well-known dinosaur *Tyrannosaurus rex* lived on Earth during the Cretaceous period which was roughly 85 to 65 million years ago. If scientists discover a *Tyrannosaurus rex* fossil in a rock strata, they will know that the strata was formed somewhere between 85 to 65 million years ago.

Trilobites were ancient marine animals that became extinct about 250 million years ago. They had an exoskeleton that was easily fossilized and many trilobite fossils have been discovered all over the world. When a scientist discovers a trilobite fossil in rock strata, the geological time scale can tell them the strata was formed at least 250 million years ago.

AB Activities 6.18 – 6.19

Science Words

Use the words to complete the sentences.

minerals	**humus**	**monsoon**
luster	**weathering**	**hurricane**
streak	**chemical weathering**	**tectonic plates**
hardness	**physical weathering**	**earthquake**
igneous rock	**erosion**	**fault**
magma	**deposition**	**volcano**
sedimentary rock	**flood**	**magma chamber**
metamorphic rock	**landslide**	**tsunami**
soil		

1. A _____ is a series of fast-moving waves caused by a disturbance in the ocean.

2. A _____ is a large rotating storm that forms over warm ocean waters.

3. The outer part of the Earth is divided into large, slow-moving pieces of solid rock called _____ .

4. _____ forms when molten rock, called _____, cools beneath the Earth's surface.

5. The appearance of a mineral when it reflects light is its _____ .

6. _____ is the color of a mineral in powdered form.

7. The _____ of a mineral is how easily it can be scratched.

8. _____ are inorganic substances found under the Earth's surface.

9. _____ is a mixture of weathered rock, air, water and decomposing organic matter called _____ .

10. A _____ can occur when the water in rivers and lakes flows onto land.

11. _____ forms when minerals and organic particles settle in layers.

12. _____ forms when rock is subject to immense heat and pressure deep below the Earth's surface.

13. _____ occurs when chemicals come in contact with rocks causing a chemical reaction.

14. An _____ is a shaking of the Earth's surface caused by the movement of tectonic plates.

15. _____ occurs when rocks are broken down by forces.

16. The process of laying down rocks and rock particles in new places is called _____ .

17. _____ is the breaking down of rocks into smaller pieces.

18. The process of moving weathered rock particles to a new location is called _____ .

19. A _____ is a crack in the Earth's crust.

20. A _____ is an opening in the Earth's crust.

21. Beneath a volcano is a _____ containing hot molten rock called magma.

22. A _____ is a weather pattern of strong winds and rain that lasts for several months.

23. A _____ occurs when a large piece of land is pulled down a slope by the force of gravity.

Review

1. List two minerals used by people.
2. How could you test the hardness of a mineral?
3. List the three main types of rock.
4. Which type of rock forms when lava cools?
5. List the three main types of soil.
6. What is the difference between chemical weathering and physical weathering?
7. What is the difference between erosion and deposition?
8. How does weathering, erosion and deposition change the Earth's surface?
9. List two factors that can affect the rate of erosion.
10. Describe two ways human activities can change the Earth's surface.
11. List four ways the Earth's surface can change rapidly.
12. What are tsunamis and how do they occur?
13. How can rock layers tell scientists what the Earth was like long ago?
14. Scientists discovered reptile and dinosaur fossils in the same layer of sedimentary rock. What can they infer about the reptile and dinosaur that formed the fossils?

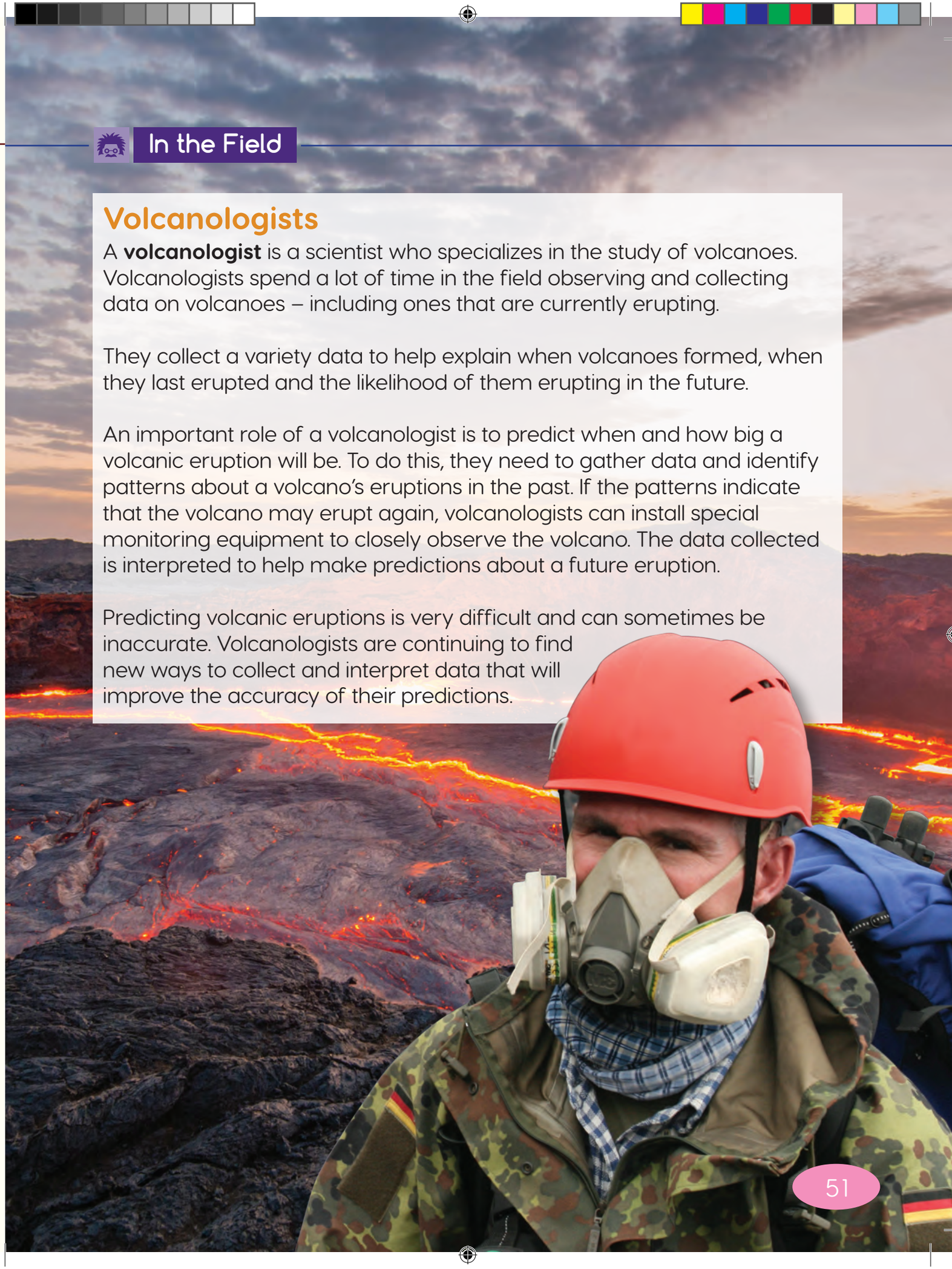
Volcanologists

A **volcanologist** is a scientist who specializes in the study of volcanoes. Volcanologists spend a lot of time in the field observing and collecting data on volcanoes – including ones that are currently erupting.

They collect a variety data to help explain when volcanoes formed, when they last erupted and the likelihood of them erupting in the future.

An important role of a volcanologist is to predict when and how big a volcanic eruption will be. To do this, they need to gather data and identify patterns about a volcano's eruptions in the past. If the patterns indicate that the volcano may erupt again, volcanologists can install special monitoring equipment to closely observe the volcano. The data collected is interpreted to help make predictions about a future eruption.

Predicting volcanic eruptions is very difficult and can sometimes be inaccurate. Volcanologists are continuing to find new ways to collect and interpret data that will improve the accuracy of their predictions.



9 Energy and Motion

In this chapter you will ...

- describe and provide examples of potential and kinetic energy.
- use evidence to construct an explanation relating the speed of an object to the energy of that object.
- ask questions and predict outcomes about the changes in energy that occur when objects collide.
- provide evidence that energy can be transferred from place to place by sound, light, heat and electric currents.
- design and test a device that converts energy from one form to another.

How can the energy of a moving object be transferred to another object?

What are some different forms of energy? What are some examples of energy transformations?

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Access interactive content relating to this topic on the NGScience website.
ngscience.com

▲ *A panda gets the energy it needs from the stored energy in bamboo leaves.*

What Is Energy?

Everything around us happens because of energy. **Energy** is the ability to do work or cause change.

Plants use the energy from the Sun to make food. The food gives them the energy they need to live and grow. Animals and people get energy from the food they eat. They need energy to move about and carry out all life processes.

Energy is needed to power cars, light up our cities and cook our food. Energy makes things move, warm up, produce light and make sound.

How do you use energy in your daily activities?

◀ *A television transforms electrical energy into light, heat and sound.*

Think Deeply

A light bulb uses electrical energy. Describe what energy transformation takes place when a light bulb is switched on.

Energy cannot be made and cannot be destroyed. It exists in many forms and can be transformed from one form to another.

A television is a device that uses electrical energy. The electrical energy is transformed into light, heat and sound energy.

What energy transformations take place during a motorcycle race?

AB Activity 9.1

▼ *Motorcycles use the stored energy in gasoline.*

Potential and Kinetic Energy

All forms of energy can be described as either stored energy or moving energy.

The stored energy in an object is called **potential energy**. Food has potential energy. The energy is transformed into other forms when we eat the food and use the energy to move about, keep warm and stay healthy.

Potential energy is also related to the shape and position of an object. If you hold a ball above your head, the ball has potential energy due to its position. If you drop the ball, the potential energy is transformed into moving energy.

The arrow is not moving. Explain why the arrow has potential energy.

When potential energy is released, it is converted into kinetic energy. **Kinetic energy** is the energy of an object due to its movement. All moving objects, from the tiny particles that make up our air to an airplane flying in the sky, have kinetic energy.

The amount of kinetic energy in an object depends on how fast it is moving. The faster an object moves, the greater its kinetic energy.

The amount of kinetic energy also depends on the mass of an object. If two objects are moving at the same speed, the object with the greater mass has the greater amount of kinetic energy.

Discuss how the kinetic energy of the train changes as it leaves the station.

Did You Know?

Doubling the mass of an object in motion, doubles its kinetic energy. If you double the speed of an object, its energy increases by four times.

Think Deeply

A car and a bicycle are moving at the same speed. Which object has more energy? Explain your answer.

▲ *The kinetic energy of the train increases with its speed.*

Engineer It!

A stretched elastic band is an example of an object with potential energy. Design an object that can move by converting the potential energy in a stretched elastic band to kinetic energy.

Go Online!

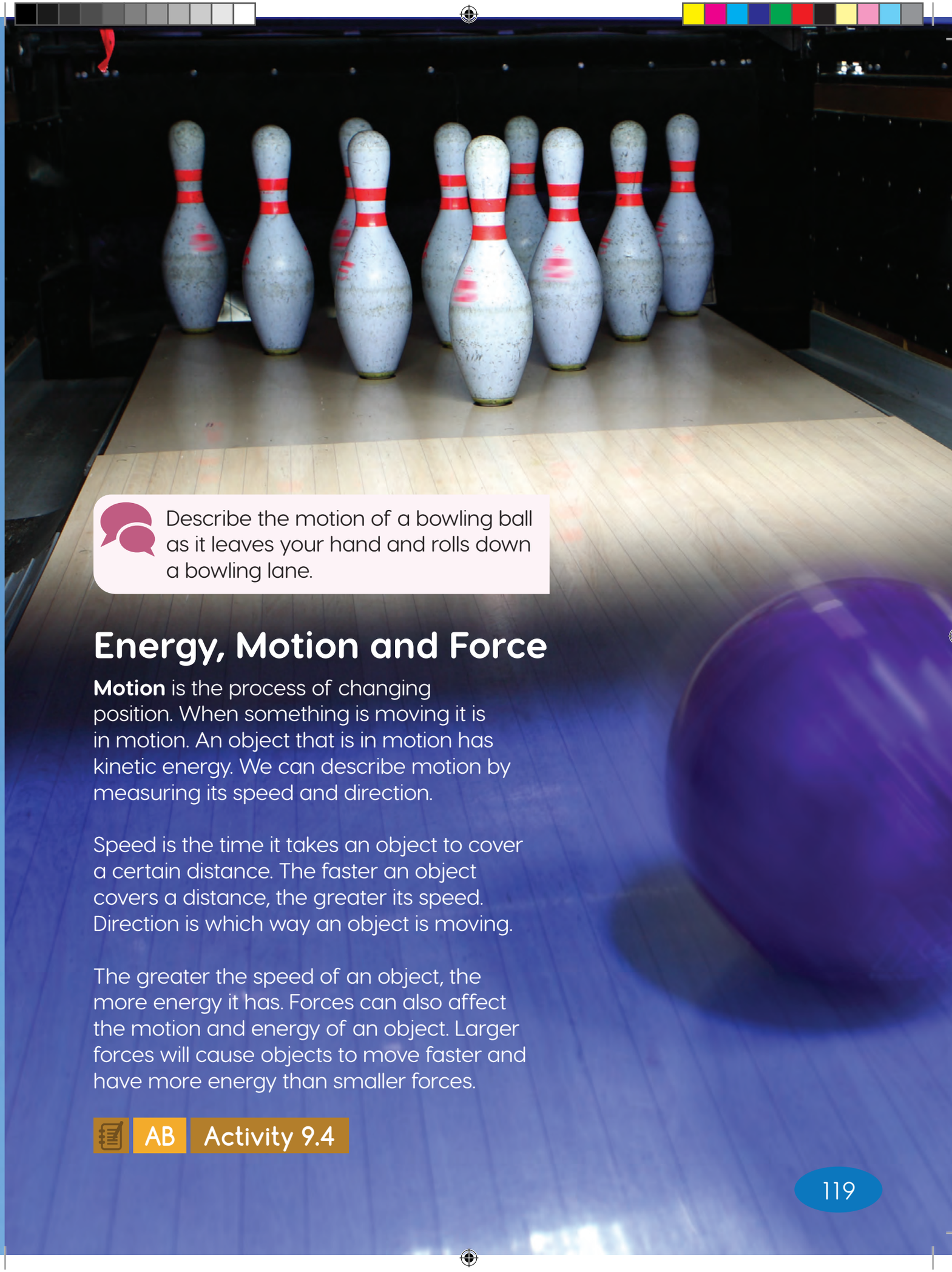
Observe how different kinds of potential energy can be converted into other forms of energy on the NGScience website.
QuickCode: **G9L6**

We can compare the potential energy and kinetic energy of an object by looking at what happens during a roller coaster ride. As the cars climb up the track, their potential energy increases as they get higher.

At rest on the top of the track, the cars have the most potential energy and no kinetic energy. As the cars move down the track, the potential energy is converted into kinetic energy. As the cars get faster, their kinetic energy increases. As they get lower, their potential energy decreases.

Discuss some other examples of the conversion of potential and kinetic energy at an amusement park.

AB **Activities 9.2 – 9.3**



Describe the motion of a bowling ball as it leaves your hand and rolls down a bowling lane.

Energy, Motion and Force

Motion is the process of changing position. When something is moving it is in motion. An object that is in motion has kinetic energy. We can describe motion by measuring its speed and direction.

Speed is the time it takes an object to cover a certain distance. The faster an object covers a distance, the greater its speed. Direction is which way an object is moving.

The greater the speed of an object, the more energy it has. Forces can also affect the motion and energy of an object. Larger forces will cause objects to move faster and have more energy than smaller forces.

AB Activity 9.4

Collisions

A **collision** occurs when an object hits another object. A collision can occur between two objects in motion, or by an object in motion and an object at rest. During a collision, kinetic energy is transferred between the colliding objects.

Think Deeply

Describe how kinetic energy is transferred when the balls collide in a Newton's cradle.

A collision occurs when a tennis player hits a tennis ball. Kinetic energy is transferred from the player's moving tennis racket to the ball, causing it to move. The more kinetic energy that is transferred, the faster and farther the tennis ball will move.

How is kinetic energy transferred when dominoes collide?

During a collision, the faster an object is moving, the greater the energy transfer and the greater the impact on the other object.

We can see this by looking at car accidents. If the cars are traveling slowly at the time they collide, there may be little damage to the cars. If the cars are traveling faster, there is a much more observable impact. There is likely to be more damage to the cars.

Think Deeply

Use your knowledge of energy and collisions to explain why there is more damage to the cars in an accident the faster the cars are traveling at the time of the collision.

The observable impact of a collision reflects how much energy was transferred between objects and relates to the amount of energy of the moving object.

At the start of a game of billiards, a player uses a large force to hit one ball into the other balls. The ball gains kinetic energy from the billiard cue and moves down the table. As it hits the other balls, a loud sound is made. Kinetic energy is transferred to the other balls as they scatter all over the table.

When a player uses a smaller force, less kinetic energy is transferred. The balls produce a softer sound when they collide and move more slowly.

What effect does hitting a drum harder or softer have on the sound produced? What does this tell you about the kinetic energy of the drumstick?

A sledgehammer hits a wall. What observations would indicate the amount of energy transferred when the sledgehammer and wall collide?

AB Activity 9.5

Try This!

Plan and conduct an investigation to demonstrate how changing the size of a collision during a ball sport affects the distance the ball travels.