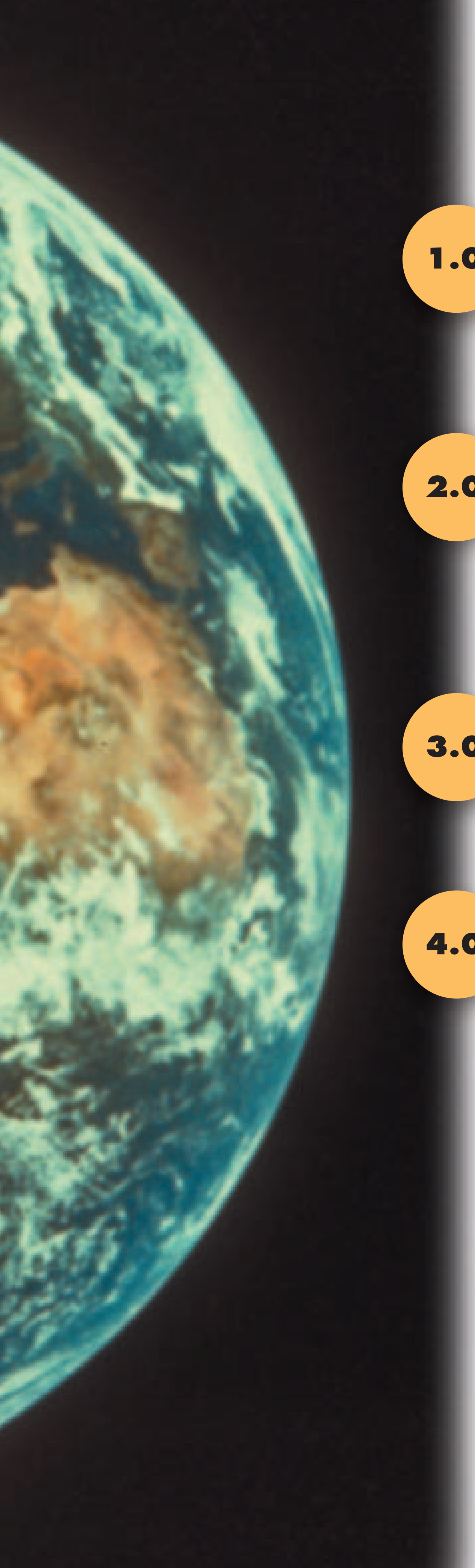
UNIT E

Planet Earth



In this unit, you will cover the following sections:

Exploring

Oldman River, Alberta

If you look out the window of your classroom, what kind of land features do you see: mountains? hills? valleys? What characteristics do you notice about these features? Are the mountains tall with steep, jagged cliffs or are they rounded like huge hills? Is there a river running through the valley or is the bottom of the valley a large, flat plain? In this unit, you will learn about Earth—our constantly changing planet. You will learn about its surface features and the forces that affect its interior. This knowledge will help you understand the models scientists have developed to explain the changes that Earth has undergone over its long history.

Earth-Shattering Events

Most of what people have known about Earth they have known because of what they could directly observe. However, observations don't always tell the whole story. Consider the two news stories on the next page. One shows a volcano in Washington State that literally "blew its top!" The other describes an earthquake that happened in Kobe, Japan.

Mountain blows its top

On May 18, 1980, Mount St. Helens in Washington State exploded. Gas and ash shot 19 km into the sky. The mountain's top collapsed—it lost 400 m of its original height.

Shocking shock waves!

At 5:46 a.m. on January 17, 1995, the million plus residents of Kobe, Japan, were thrown from their beds by a massive earthquake. Broken gas lines led to huge fires and thousands died.

What caused these dramatic natural disasters? Surely not wind or water or other events that you have noticed occurring on Earth's surface.

Earth is a planet that is in constant motion and change. Intense heat from deep inside Earth creates volcanoes that spew lava. Huge plates of rock moving across its surface cause earthquakes that shake and split the ground. Mountains grow upward, while wind and water wear them down and carry them away.

Give it a TRY **ACTIVITY**

EXAMINING EARTH

What do you know about Earth and the events that shape and change its surface features? Look at the photos below. They show situations where Earth's features have been changed in some way. Discuss with a partner what you think is happening in each picture, and answer these questions in your notebooks:

- What do you think caused these features to occur?
- Do you think this change happened slowly or quickly?

A

What forces could have shaped this rock?

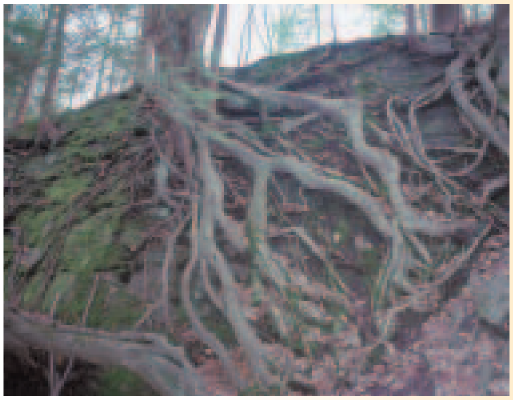
B

Why are the bands of rock not straight across the sides of the mountain?

C

What can this fossilized insect in amber tell us about insects today?

D



What are the roots of this tree doing to the rock?

As you go through this unit, think about what you are learning, and modify or revise your answers to these questions.

Focus On The Nature of Science

While studying this unit, you will be asked to organize your thoughts based on your own observations and the evidence of the science community. This evidence has come about in a number of ways:

- through experimentation
- by interpreting facts and observations
- by creating and interpreting models

Think about the following questions while you study how the forces of Earth have transformed its features. The answers to these and other questions about Earth will help you understand the nature of the forces that shape and change our planet.

1. **What do we know about Earth, its surface, and what lies below?**
2. **What forces act on Earth to change its landforms?**
3. **What are the processes and techniques we use to develop an understanding of Earth and its changes?**

Ocean inlets, British Columbia

The Badlands in southern Alberta

1.0

Earth's surface undergoes gradual and sudden changes.

Canada's Precambrian Shield

Key Concepts

In this section, you will learn about the following key concepts:

- developing models
- Earth models
- earthquakes
- volcanoes
- tools and techniques for studying Earth
- the effects of water, wind, and ice
- glaciers

Learning Outcomes

When you have completed this section, you will be able to:

- interpret models of Earth's interior structure
- investigate evidence that Earth's surface undergoes both sudden and gradual changes
- identify tools and techniques for studying Earth
- interpret and investigate examples of weathering, erosion, and sedimentation
- use suitable terms and conventions in describing Earth's substances

It may seem to you that Earth's landscape doesn't change very much. Earth is, after all, made up largely of rocks, and rocks are hard and difficult to move. But the fact is, nothing could be further from the truth. Rocks and the structure of Earth are part of a landform cycle of *creation, loss,* and *renewal*.

Most of the time this change goes unnoticed, but sometimes, it shows up in dramatic and devastating ways. Sudden geologic events, such as earthquakes, volcanic eruptions, and landslides, can occur quickly with catastrophic results. Other events, such as glacial and river erosion, happen more slowly and are not nearly as harmful to humans.

For Web links relating to 1.0, visit **www.pearsoned.ca/scienceinaction**

1.1 A Model for Earth

Think of Earth's long history as a story, a cross between an adventure and a mystery. The adventure part of the story is about people facing the powerful forces of Earth—earthquakes, mountain building, volcanoes—in their efforts to understand it. The mystery is about the fact that we can't easily see inside our home planet. We live on its outermost skin. We have only indirect evidence of what is happening deep below its surface.

Have you ever looked at a present you've received and wondered what is inside? Its wrapping paper keeps you from quickly figuring it out, but that shouldn't stop you from guessing. You can still note the size of the package, lift it and guess its weight, and shake it to hear how it sounds. Using this information, you can make an "educated guess" as to what is inside.

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Our Ancient Past

Geologists estimate that Earth is about 4.6 billion years old. Human-like creatures did not appear on Earth's surface until about 3 million years ago, making us newcomers to an ancient planet.

Developing a Model

A **model** is an idea of something that can't be fully known or seen. It is a way of demonstrating an object or an idea that is difficult to picture in its real form. Models are useful when something is too big or too small or too complicated for us to study easily. They can take many forms: drawings, actual constructions, or comparisons to familiar things. For example, a globe is a model for Earth.

Give it a TRY ACTIVITY

What's Inside?

You will be given a "mystery container." It may contain one or more different objects, and you will be asked to create a model to help explain what's inside. Your goal, in co-operation with your group, is to use your senses to gather as much evidence as possible about what might be inside the mystery container. After gathering your evidence, each member of your group should independently sketch a diagram, or "model," of the container's contents.

- Compare the diagrams and discuss the similarities and differences and the evidence that supports them. You may want to revise and improve your model as you gather more evidence.
- Sketch a final diagram of what your group believes the contents to be.
- Explain to another group how you came up with your model.
- What further evidence could you get to provide you with even more information about your mystery container?
- Now open the container. How does your model differ from the real object?

What you have just done is very similar to the methods scientists use to develop, debate, and change the models that they use to explain the structure of Earth.

What's inside Earth

In 1864, the French author Jules Verne wrote a novel called *Journey to the Centre of the Earth*. He described a land deep inside the core of Earth populated by strange plants and animals. The story captured everyone's imagination, and for years afterward, people wondered about what really lay below Earth's surface.

Scientists began to wonder, too. What are the layers that make up Earth? How thick is its outer skin? Is the interior solid or molten liquid? What does the centre core look like?

Because Earth is so large, **geologists**, who are scientists that study Earth, have had to use a model to help them understand its inner structure. They know a lot about its surface because they can easily study it, but digging a hole to Earth's centre to examine its core is out of the question. The extreme conditions there prevent any kind of exploration. Geologists would have to travel more than 1700 times the depth of the deepest mine in the world (a gold mine in South Africa, which reaches a depth of 3.8 km).

Figure 1.1 It's never cold in deep mines. At 1 km below the surface, temperatures can be around 29°C—even on the coldest day in winter.

Geologists also use many indirect methods of studying Earth, some of which you will learn about later in this unit. What they have discovered is that there's more to Earth than what can be seen on its surface. Earth appears to be made up of three major layers. Each layer surrounds the layer beneath it, much like an onion.

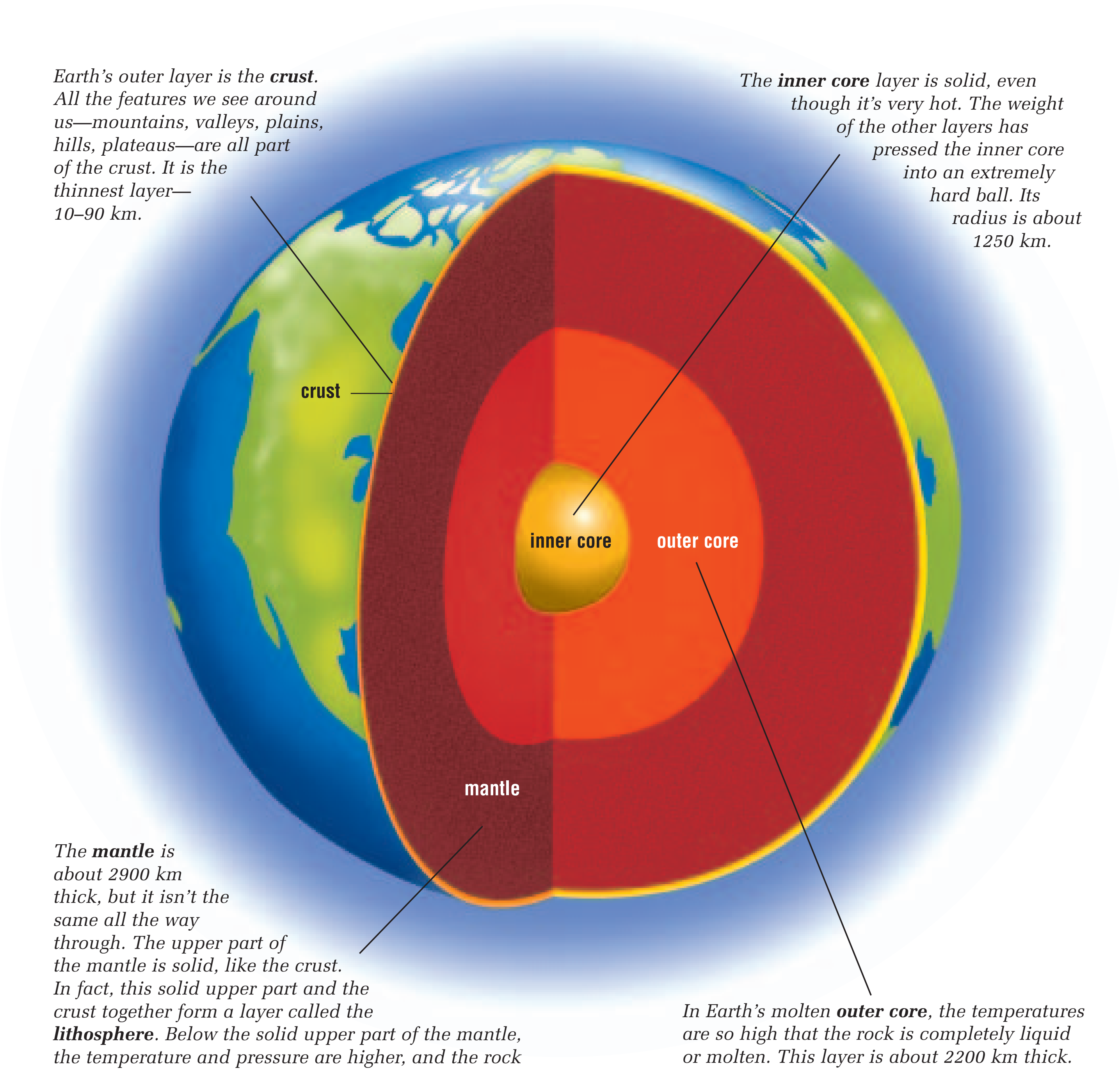

Figure 1.2 Model of Earth's interior

Here are some more facts about Earth's interior:

- **Inner Core**—Geologists believe it consists mainly of *solid* iron and nickel. It reaches temperatures as high as 7000°C.
- **Outer Core**—The outer core is thought to be liquid because the pressure isn't great enough to make the molten rock into a solid.
- **Mantle**—The mantle makes up about two thirds of Earth's mass.
- **Crust**—Because Earth is so hot in the inner core, the crust radiates heat into the atmosphere.

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Two Rock Ridges

There are many stories about the structure of Earth. One of these is the Dene story, "The Two Rock Ridges." Research this or any other idea about Earth's structure. In a paragraph, describe the story, briefly explaining its origin.

The Crust

The **crust** is the layer that covers the surface of Earth. All living things are found here. It is the rich storehouse of minerals, such as iron and copper ore, used in manufacturing many of the products you buy. It is also here we get the fossil fuels, such as oil, natural gas, and coal, that supply our energy needs.

As you can see in Figure 1.2, it is the thinnest layer of Earth, with an average thickness of about 50 km. Under the ocean, it can be as thin as 10 km. Beneath tall mountain ranges, such as the Rocky Mountains, the crust thickens to about 90 km. Still, that's not very thick, considering the total distance from Earth's surface to its centre is nearly 6400 km.

So what exactly makes up the crust? At first glance, Earth's surface seems thickly covered with vegetation and fresh and saltwater areas. Yet these features form only a thin covering. The crust is made up of solid rock.

Check and Reflect

1. Look at the three photos below.

Figure 1.3

Figure 1.4

Figure 1.5

   Do you think that any of these would make a good model for Earth's interior? Give reasons for your answers.

2. Give two examples where models are used to serve different purposes.
3. Why do you think computers are useful in creating and displaying models?
4. Make and label a drawing showing Earth's layers as you would see them if a wedge were cut from Earth. Be sure to use a ruler and try to make your drawing to scale. For example, 1 cm could represent 500 km, or 1000 km. Show the increasing depth as you reach the centre.

1.2 Sudden Earth Events

You wake up suddenly from a deep sleep feeling as though your bed is on a ship in a bad storm. You have trouble reaching the light to turn it on. When you do, you can see the walls of your bedroom changing shape in front of your eyes. And the noise! The whole building sounds as if it's being pulled apart board by board. Everything on the shelves crashes to the floor. But outside you can hear the twisting of metal and shattering of concrete mixed with the shouts of people.

Figure 1.6 Armenia, Columbia, January 1999 (6.0 on the Richter scale)—This earthquake lasted less than a minute, but look at the results!

Few forces in nature are as dramatic and devastating as earthquakes and volcanoes. In a matter of moments, they can transform a peaceful countryside into a violent, twisted landscape. The earthquake in Kobe, Japan, lasted only a few seconds, but resulted in 5000 deaths. When Mount St. Helens erupted in Washington State, 57 people died, and the ash from its spewing top destroyed an area of 560 km^2. People from as far away as Ontario and Quebec were cleaning the grey dust off their cars a few days later.

Have you ever felt an earthquake? Have you read about its effects? What happened? What do you think it was like? Share your experience with the rest of the class.

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Some Canadian Earthquakes

Date	Richter Scale	Place
1663	?	St. Lawrence region
1700	~9	off coast of B.C.
1918	~7	Vancouver Island
1946	7.3	Vancouver Island
1949	8.1	near the Queen Charlotte Islands, B.C.
1990	4.9	Fraser Lowland, B.C.

What Causes Earthquakes?

Earthquakes are tremblings or vibrations of the ground. They are caused by the sudden release of energy that has slowly been building up in Earth's crust. Large masses of rock in the crust move and sometimes become locked together or stuck. A tremendous force is created until finally the rocks break. This sudden break causes an earthquake.

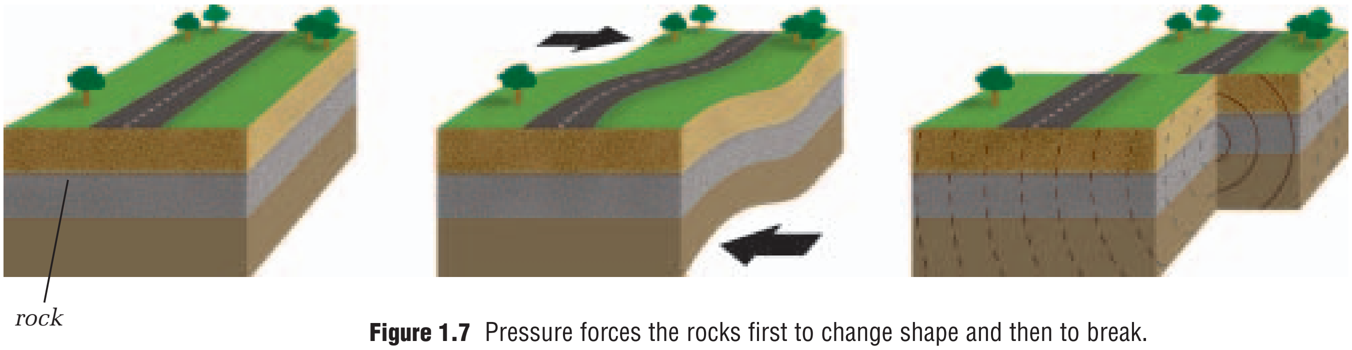

Figure 1.7 Pressure forces the rocks first to change shape and then to break.

The First Break

The first place that the rocks break below the surface in an earthquake is called the **focus**. The sudden breaking of rocks at the focus releases energy that spreads as waves through Earth. These earthquake waves are called **seismic waves** (from the Greek word "*seismos*," meaning "earthquake"). The shaking you feel in an earthquake is caused by the seismic waves moving through the ground. Powerful ones can damage and change Earth's surface. Geologists use these waves to study Earth's interior because the waves travel right through Earth's layers, just like X-rays do inside your body.

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Alberta Quakes

Earthquakes are a rare occurrence in Alberta, but on October 19, 1996, people near Rocky Mountain House were awakened to one. The National Earthquake Hazards Program of Natural Resources Canada records and researches all earthquakes felt in Canada. Use an Internet search engine to find their regional western Web site so you can find out more about this earthquake.

- What time did the earthquake occur?
- What did the quake measure on the Richter scale?
- Were there any aftershocks? If so, how many and how powerful were they?
- Did the quake cause any damage?
- Research where in Canada earthquakes are most likely to occur.

Because of the effect an earthquake can have on the surface of Earth, geologists look for its **epicentre**. This is the point on the surface directly above the focus ("*epi-*" means "above"). Officials need to know where the epicentre is to provide disaster relief. It helps them determine if the earthquake was in a location where it would harm people, buildings, transportation systems, or communications. Figure 1.8 shows how the focus and the epicentre are related.

Measuring the Strength of Earthquakes

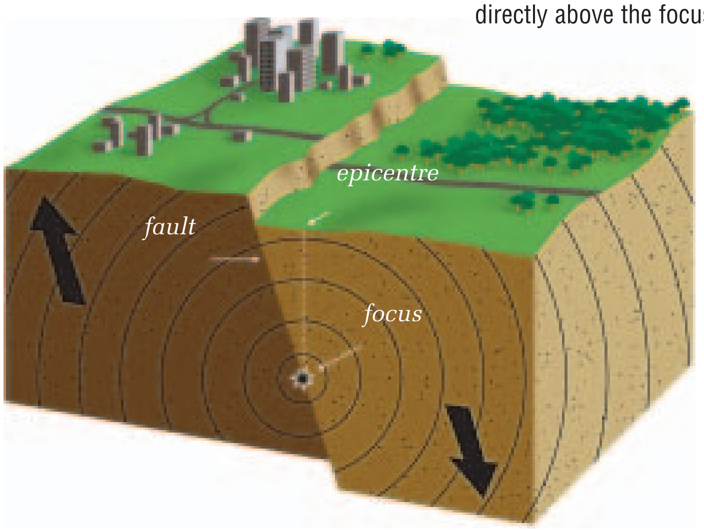
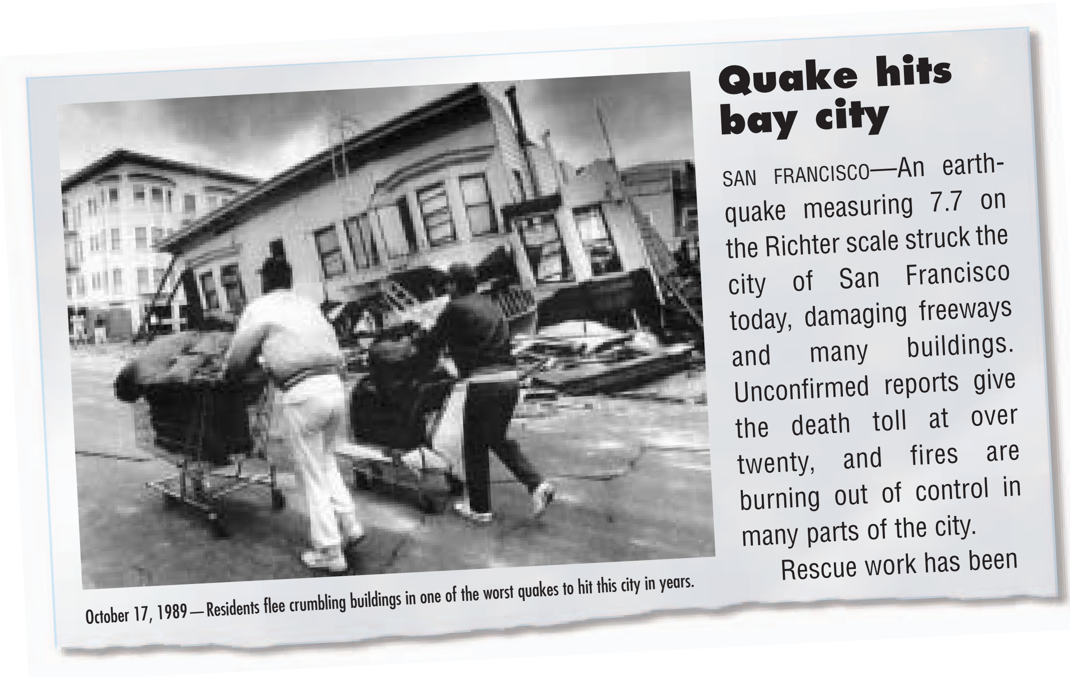


Figure 1.8 The epicentre of an earthquake is directly above the focus.

Geologists have developed various scales to determine the strength or magnitude of an earthquake. These scales allow scientists around the world to share and compare data. When you hear reports of the magnitude of an earthquake, it's usually given as a number on the **Richter scale**.

Charles Richter, an American, developed the scale in 1935. The scale starts at 0, and each increase of 1 represents an increase of 10 times the amount of ground motion of an earthquake. For example, an earthquake of Richter magnitude 2 is 10 times stronger than one that measures 1. Look at the newspaper article below. What was the magnitude of the earthquake? Do you think this was a strong earthquake or a mild one?



Quake hits bay city

SAN FRANCISCO—An earthquake measuring 7.7 on the Richter scale struck the city of San Francisco today, damaging freeways and many buildings. Unconfirmed reports give the death toll at over twenty, and fires are burning out of control in many parts of the city.

Rescue work has been

October 17, 1989—Residents flee crumbling buildings in one of the worst quakes to hit this city in years.

Figure 1.9

VOLCANOES

"A deep rumbling in the ground and a fiery flash in the night sky—the volcano is about to erupt! Run for your life!" How accurate do you think this description is of a volcanic eruption?

A **volcano** is an opening in Earth's crust through which solid and molten rock, ash, and gases escape. Scientists have generally been more successful predicting volcanic eruptions than they have earthquakes. Even though they can't say exactly *when* an eruption will happen, they usually can tell if one is about to occur. As you read through this subsection, think about what signs people could watch for that might tell them when a volcano is going to erupt. Jot down notes as you go along.

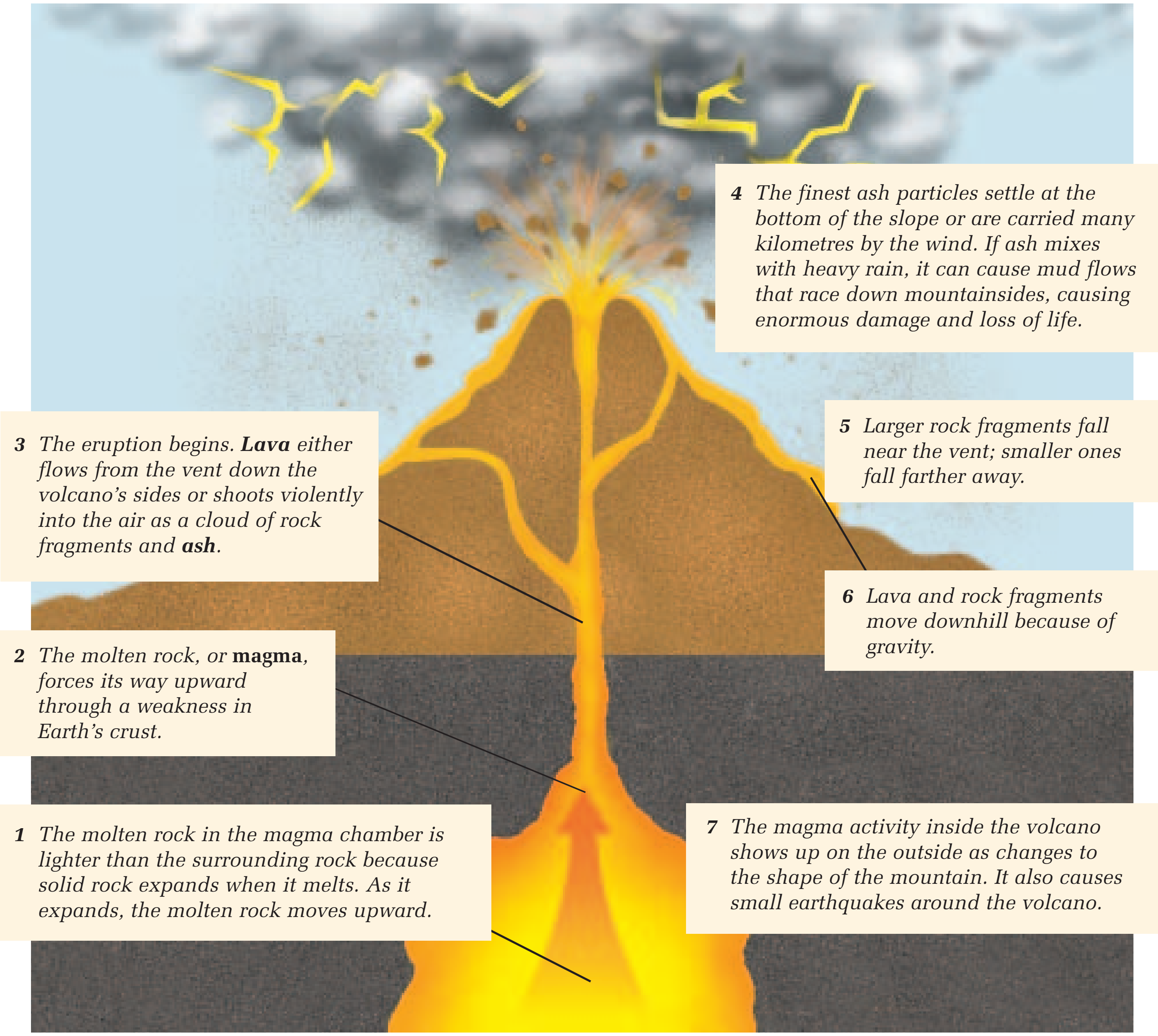


Figure 1.10 What happens when a volcano erupts

Tools and Techniques for Studying Earth

Investigating earthquakes and volcanoes can be a risky business. Geologists often venture into dangerous territory to take measurements or collect samples. Their efforts to learn more about sudden, violent Earth events may one day make these events more predictable. Below are some of the tools and techniques geologists use to get the job done. Use your library resources and the Internet to find out more about how geologists study these Earth events.

math Link

Each number on the Richter scale represents an increase of 10 times in the ground vibrations caused by an earthquake. How would you calculate how much more powerful Richter magnitude 7 is than 3?

Tools of the Trade

Figure 1.11 Geologists studying volcanoes must wear a special suit with a metal coating that reflects these intense temperatures. This allows them to get close enough to an eruption to make observations, take measurements, or collect gas and lava samples.

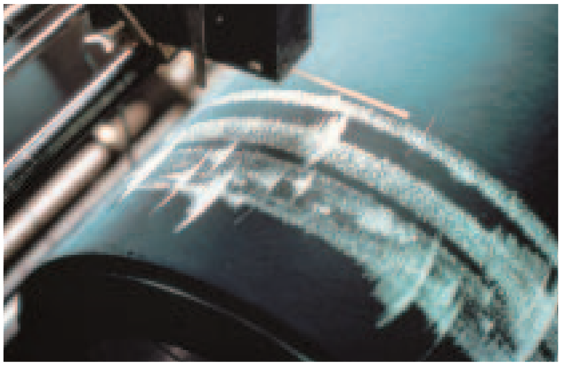


Figure 1.12 A seismograph is a device that detects the waves of energy that spread through Earth from the focus of an earthquake. Geologists read the **seismogram** produced by the seismograph to determine the strength of an earthquake and its location.

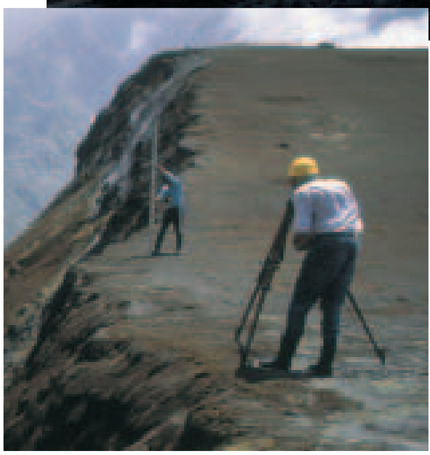


Figure 1.13 Some volcanoes bulge outward slightly when the pressure from rising molten rock inside them builds up. Before an earthquake, stress builds up causing the ground to tilt slightly. These signs, although not visible to the naked eye, can be detected using a **surveyor's level**, a device that measures minute changes in the angle of the ground's slope.

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Frozen in Time

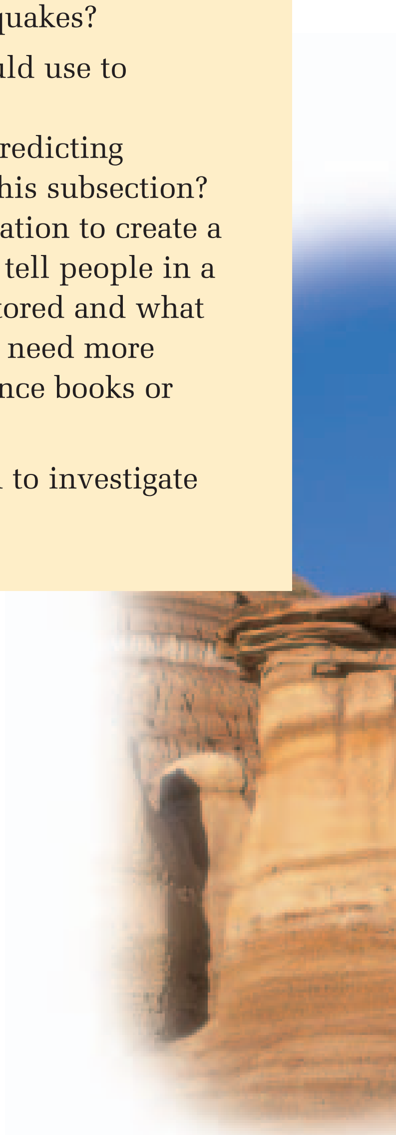
Nearly 2000 years ago, in A.D. 79, a volcanic eruption completely destroyed the city of Pompeii in Roman Italy. Mount Vesuvius suddenly and without warning erupted, spewing out volcanic ash and burying the city and most of its inhabitants. Find out more about Pompeii.

- Why is Pompeii a famous tourist attraction?
- Why didn't the people of Pompeii just close their windows and doors to keep the ash out, or just run away?

A plaster cast of a body at Pompeii, Italy

Check and Reflect

1. What is believed to be the cause of earthquakes?
2. Where in Canada do you think earthquakes are common?
3. Why do you think it is difficult to predict earthquakes?
4. You were asked to look for clues that people could use to determine if a volcano were about to erupt.
   a) What other information might be useful for predicting volcanic activity that was not mentioned in this subsection?
   b) Working with a small group, use your information to create a poster, a television program, or a brochure to tell people in a volcanic area how the volcano is being monitored and what the signs of an upcoming eruption are. If you need more information to complete your task, use reference books or information from the Internet.
5. What are some instruments and equipment used to investigate earthquakes and volcanoes?



1.3 Incremental Changes: Wind, Water, and Ice

While earthquakes and volcanoes offer sudden and catastrophic change, the shaping or sculpting of Earth's surface is accomplished by a combination of slow, step-by-step changes called weathering and erosion. **Weathering** refers to the mechanical and chemical process that breaks down rocks by means of water, glacial ice, wind, and waves. **Erosion** occurs when the products of weathering are transported from place to place. **Deposition** is the process of these materials being laid down or deposited by wind, water, and ice. Throughout the weathering/deposition process, material is not gained or lost—it simply changes form. In other words, weathering or the process that wears down rocks and other objects *never* produces new material. It is just part of a greater process of transforming Earth's features.

Mechanical Weathering

Mechanical weathering happens when rock is broken apart by physical forces, such as water or wind. In our climate, rock is often broken down by water freezing in cracks. This action slowly helps to break apart even the largest rock formations.

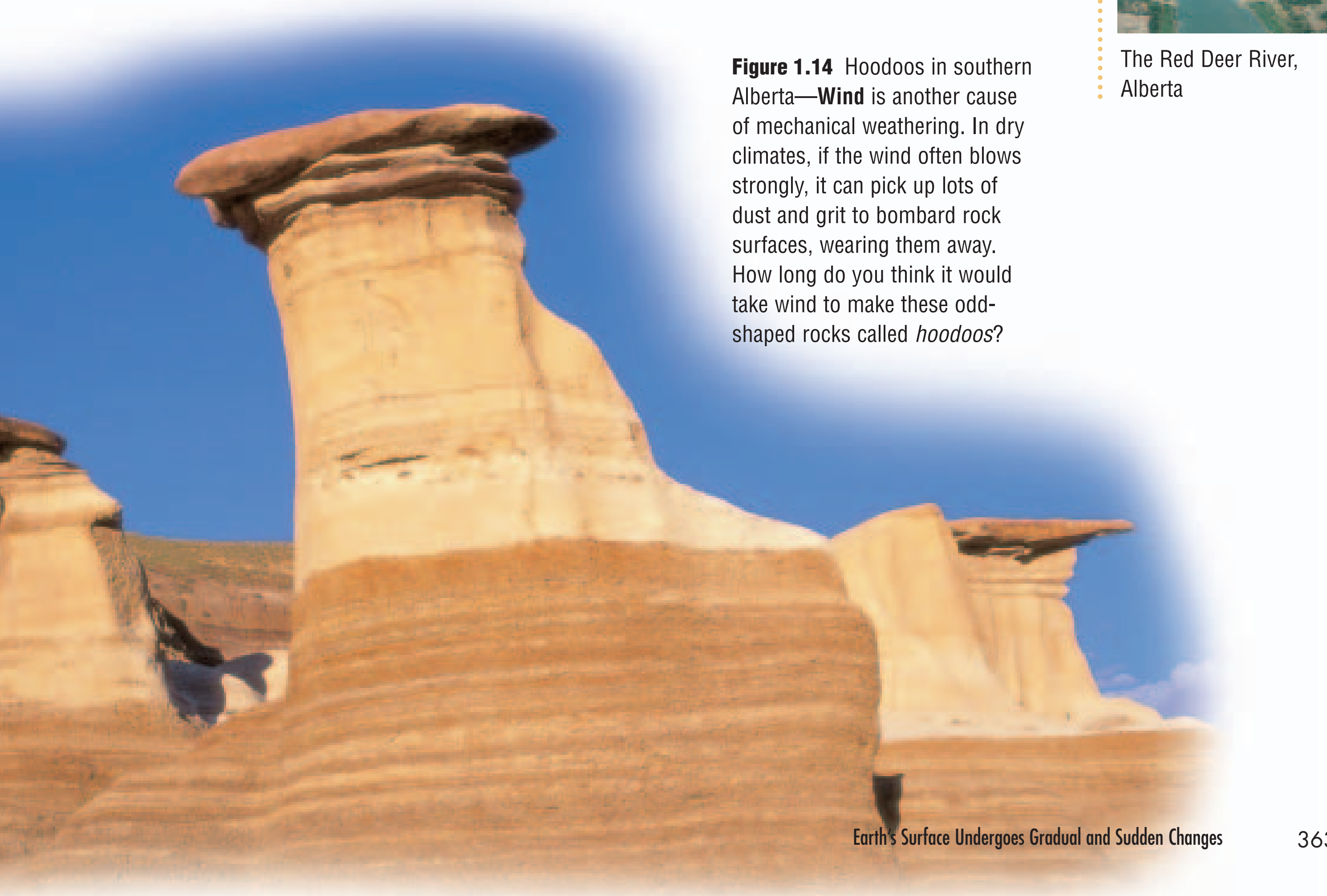


Figure 1.14 Hoodoos in southern Alberta—**Wind** is another cause of mechanical weathering. In dry climates, if the wind often blows strongly, it can pick up lots of dust and grit to bombard rock surfaces, wearing them away. How long do you think it would take wind to make these odd-shaped rocks called *hoodoos*?

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Muddy Rivers

The Red Deer River begins from the crystal clear waters high in the Rocky Mountains of Alberta's southeastern slopes. As the river travels eastward, it accumulates tremendous amounts of silt, sand, and dirt—causing the river to change from clear to chocolate brown.

The Red Deer River, Alberta

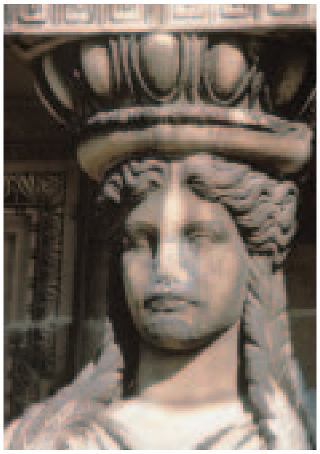

Figure 1.15 Look at older buildings and statues in your community. How have they been affected by acid rain? How can you tell?

Chemical Weathering

Chemical weathering happens when water and oxygen react with the minerals in rocks to produce new minerals. Often these new minerals are softer and can crumble more easily. For example, gases in the air combine with rain or snow to form solutions called *acids*. These acids can wear away rocks by dissolving the minerals in them (see Figure 1.15). Think of a sugar cube dissolving in water—it gets smaller and smaller until it disappears. Certain kinds of rocks exposed to chemical weathering wear away in the same way.

Biological Weathering

Biological weathering is the wearing away of rocks by living things. Growing things can be powerful destructive forces for rocks. The need to grow causes plants to force their roots into any small space where a little soil has collected. Then, as their roots and stems get bigger, they put enormous pressure on their surroundings.

Figure 1.16 This tree started growing in a small crack in the rock. As it grew, it made the crack bigger. What do you think will happen if the tree continues to grow?

The Effects of Moving Water

Have you ever seen a river that looks really "muddy"? Rivers flowing through soil, not rock, pick up fine grains and carry them along, giving the water a muddy appearance. Rivers and streams are probably the most powerful forces of erosion that alter the landscape.

Figure 1.17 How does damming up a river affect its flow below the dam?

Figure 1.18 Bow Falls, Alberta—How do you think waterfalls affect riverbeds?

As rivers flow, they carry a load of silt, sand, mud, and gravel, called **sediment**. This weathering process can take a great deal of time and is influenced by the nature of the moving water (for example, the amount of water or the steepness of the terrain). **Sedimentation** is the process of sediments being deposited, usually at the bottom of oceans, lakes, and rivers.

Landforms that are created by running water are known as **fluvial landforms**. Alberta has many examples of fluvial landforms, such as the Badlands of southern Alberta (see the illustration in Exploring at the beginning of this unit).

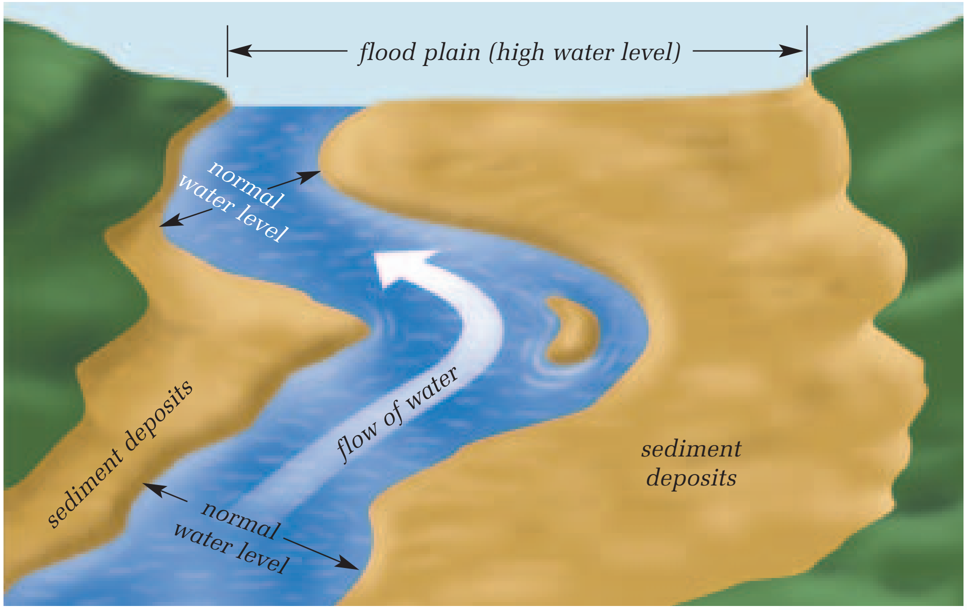

Figure 1.19 A *flood plain* is the high water level caused by the extra water from melting snow and heavy rain. This extra water flow erodes the stream and river banks. *Sediment deposits* are left when the water levels return to normal.

Eroding Away

The powerful forces of erosion caused by moving water gradually wear away rock and soil, transporting them to other locations. Sometimes, though, erosion can change the landscape very quickly. **Landslides** are sudden and fast movements of rocks and soil down a slope. They usually happen where soil on the side of a hill gets soaked with water. The wet soil then slides quickly down the hillside, taking with it all the vegetation. If any houses or other buildings were built there, they slide too.

Figure 1.20 Landslides are common in areas with steep hillsides and high rainfall at certain times of the year. What do you think people could do to prevent landslides?

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Global Warming and Glaciers

Current research suggests that increased burning of fossil fuels is emitting harmful gases (called *greenhouse gases*) that are warming the planet. Search your library or the Internet for information on glaciers and climate change. What do you think will happen if much of the polar glacial ice melts?

Glaciers—Rivers of Ice

Picture a field of snow as far as the eye can see. The air is extremely cold, and the wind tears at your face, stinging you with sharp grains of ice and snow. There are many holes and cracks in the snow that are deeper than you can see. This icy world is thousands of years old and it's not standing still, either. It creeps along, making cracking and groaning noises.

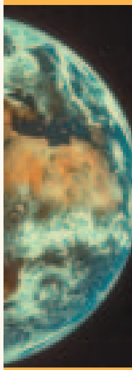
A **glacier** is a moving mass of ice and snow. For over two million years, this force of erosion has visited North America at least four times. In fact, ice once covered areas of Alberta to heights of 600–1000 m and has greatly shaped its landscape.

Figure 1.21 Big Rock, near the Sheep River south of Calgary—This large boulder is called a *glacial erratic*. Weighing 16 500 t and as tall as a 3-storey building, it was moved many kilometres and deposited by glacial ice.

As glaciers flow, they pick up large rock fragments that act as grinding tools to carve and scrape the landscape beneath them. Erosion occurs when this advancing ice mass scoops up rock fragments and drags them along its base. In doing so, the glacier grinds the **bedrock** (the layer of solid rock beneath the loose rock fragments), producing a polished but often scratched or furrowed surface. When the glacier melts (or retreats), it leaves its eroded rock fragments in the form of small hills called *drumlins* and *moraines* and snake-like hills called *eskers*.

Check and Reflect

1. Explain the relationship between erosion and weathering.
2. Give some examples of weathering.
3. How does moving water change the landscape?
4. What might happen to a riverbed if sediments are deposited?
5. How do glaciers change the landscape?



Assess Your Learning

1. a) Why do we use models when we study Earth?
b) Why are some models changed or revised over a long period of time?

2. Name the layers that make up the interior of Earth. Describe some of the characteristics of each one.

3. What is the difference between the crust and the mantle? Explain two causes for this difference.

4. What is the difference between the focus and the epicentre of an earthquake?

5. What instruments do scientists use to help monitor earthquake activity?

6. Explain in your own words what causes a volcano.

7. What kind of indirect evidence do scientists use to study the inside of Earth?

8. What is deposition? Why is this force different from erosion?

9. a) Describe two types of weathering.
b) Where would you look for these types of weathering in your area? Why?

10. Explain how wind, water, rivers, and glacier erosion differ in shaping the landscape.

Focus On — THE NATURE OF SCIENCE

Because science is studied by people from many different language backgrounds and cultures, scientific language and classifying systems need to be precise.

1. Why is it important when studying Earth's surface features for everyone to use the same system of classification?

2. What terms and concepts did you study in this section that you still don't understand?

3. What terms and concepts in this section do you feel you understand?

2.0

The rock cycle describes how rocks form and change over time.

Key Concepts

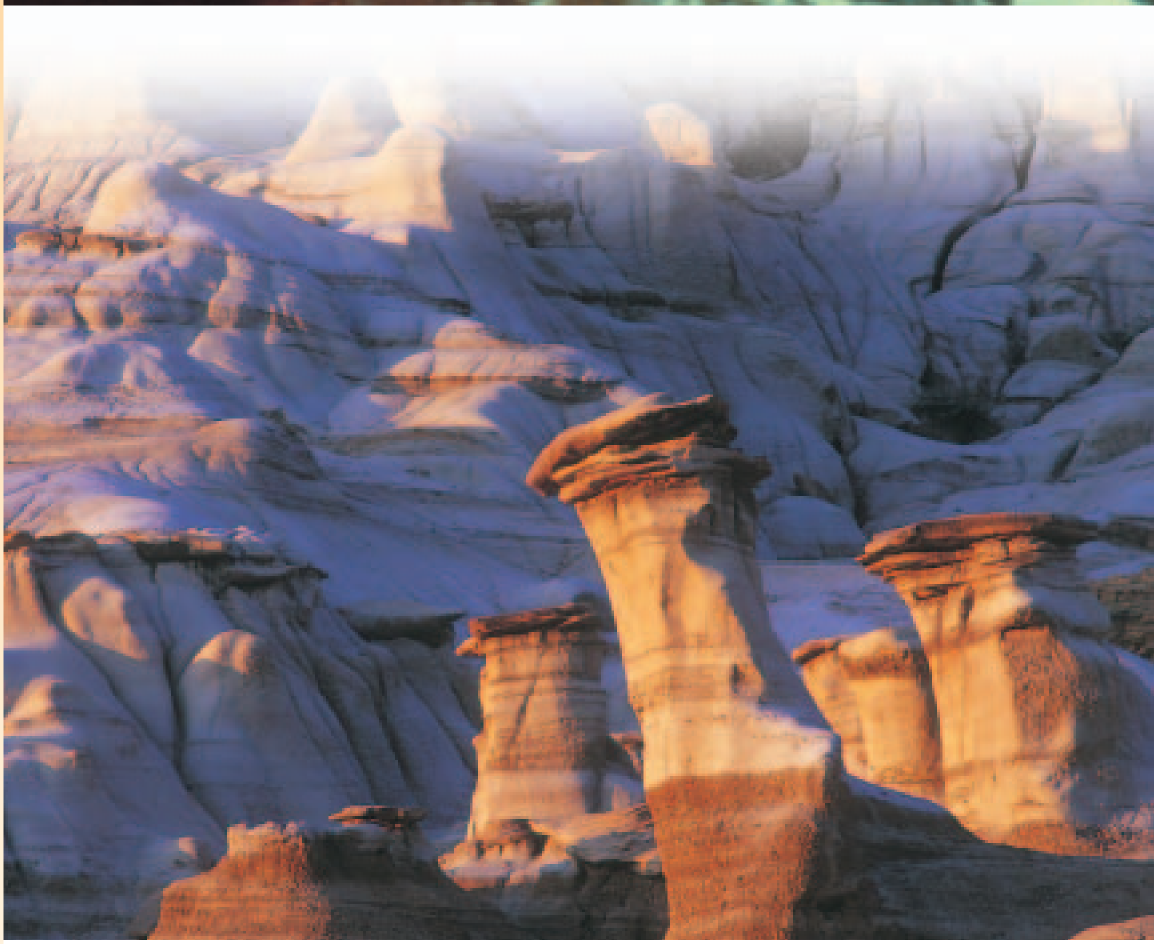
In this section, you will learn about the following key concepts:

- rocks and minerals
- classes of rocks: igneous, sedimentary, and metamorphic
- geology tools and techniques
- the rock cycle
- describing and interpreting local rock formations

Learning Outcomes

When you have completed this section, you will be able to:

- distinguish between rocks and minerals
- describe characteristics of the three main classes of rocks
- use suitable terms and conventions in describing Earth's substances
- describe local rocks and sediments
- interpret and investigate examples of weathering, erosion, and sedimentation (the rock cycle)



What can rocks tell us about Earth? They tell a story of change. Scientists, such as geologists, can "read" rocks to learn their stories. You can start to read the story yourself by carefully looking at rocks. What do you see when you look at a rock? Can you tell what it is made of or how it was formed?

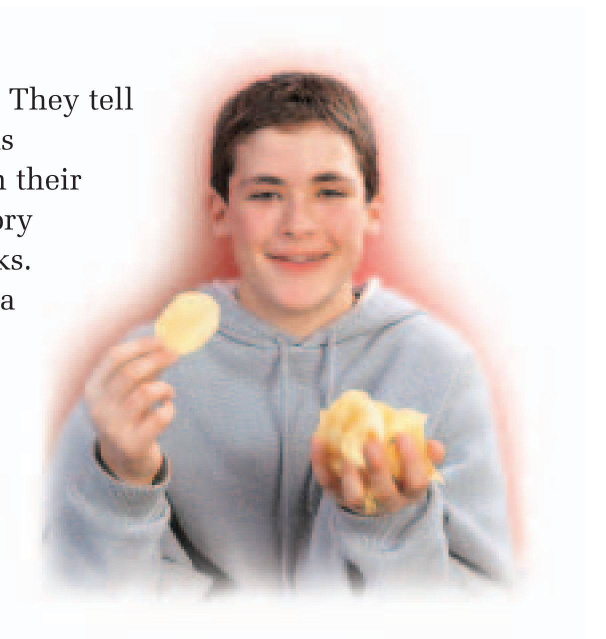


Figure 2.1 Do you realize there is a rock that you eat: the salt on these chips! (See the *info*BIT on page 370.)

For Web links relating to 2.0, visit **www.pearsoned.ca/scienceinaction**

2.1 What Are Rocks and Minerals?

Rocks: You have probably walked on them, ridden over them, and even eaten them! But if you had to describe them to someone, what would you say?

Minerals in Rocks

To read the story of a rock, you have to know something about the substances that are part of it. If you examine a rock closely, you will notice it is made up of many little particles called *grains*. The appearance and properties of a rock depend on the nature of these many grains and the particular materials of which they are made.

The building blocks of rock are pure, naturally occurring solid materials called **minerals**. All rocks are made of minerals. Some rocks, such as limestone, are formed of only one mineral, while others, such as granite, are made up of several different minerals.

*info*BIT

Rock Products

An area of the Bow Valley in the Rocky Mountains near Exshaw, Alberta, is mined for limestone. This mineral is used to make a variety of products, from stomach relief tablets that relieve upset stomachs, to concrete.

Give it a **TRY** ACTIVITY

Mission Control, This Is ...

Pathfinder was a robot vehicle sent by NASA to investigate and gather information from the surface of Mars. Imagine you are with Pathfinder, and you must transmit a description of the rocks and minerals you've found on the planet's surface. Use a hand lens or magnifying glass to study the rock samples your teacher gives you. (Be sure to wash your hands after handling the rocks.) Describe each one using words or pictures, and use the following questions to help you with the description.

- What colour is the sample? Is it the same colour all around? (Wet the surface and see if the colour changes.)
- Does it have a smell?
- What does the surface feel like?
- Is it living or non-living?
- Does it seem to be made up of one substance or a combination of several others?
- Are any of the samples similar to each other?
- What else can you say about these samples?

Figure 2.2 Mars Pathfinder