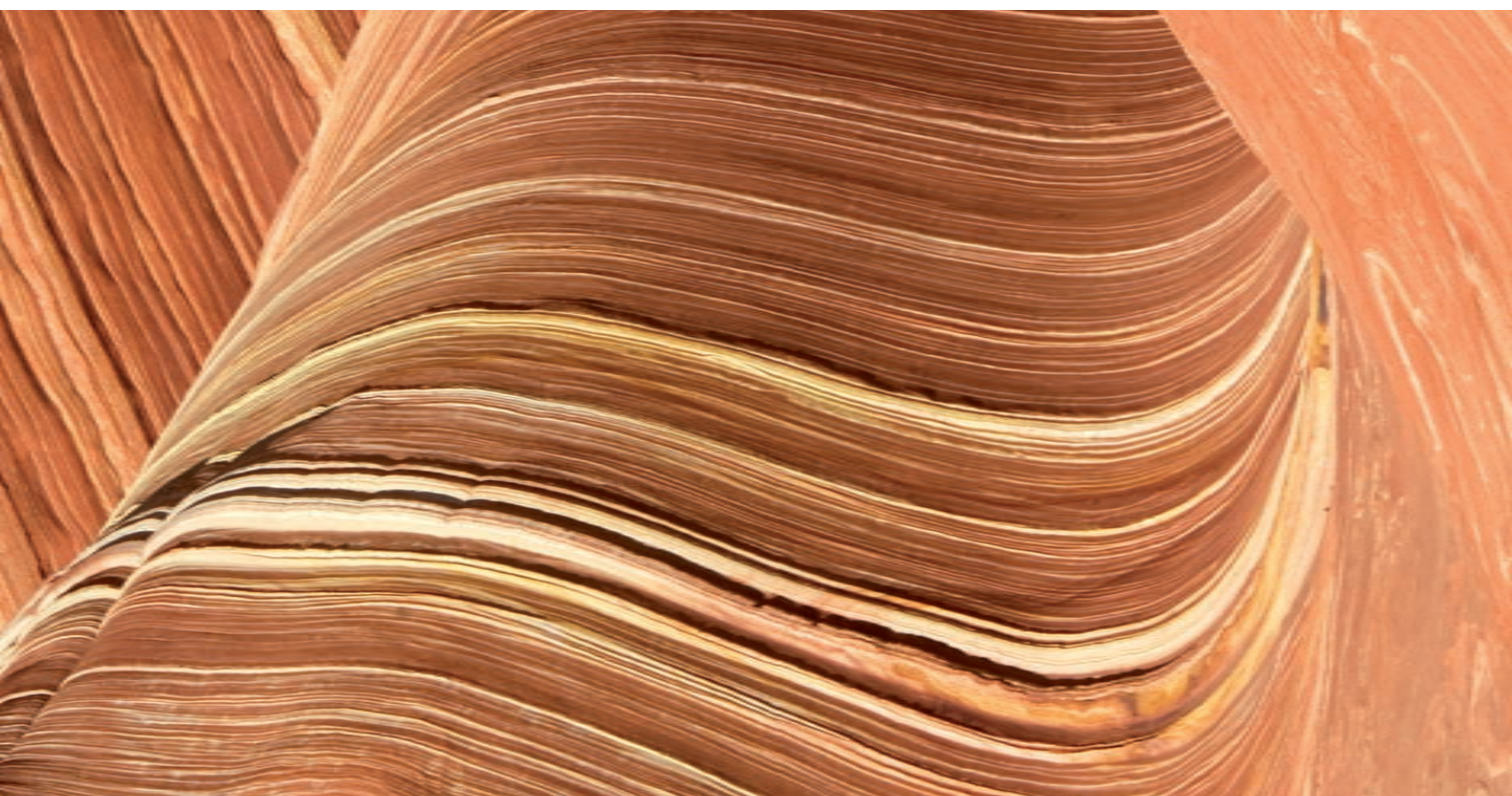
Student Lab Manual

Rocks and Minerals



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sangari active science

sangari **active science**

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Rocks and Minerals

Work designed and produced by Sangari Research and Development Center

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Rocks and Minerals

Dear Student,

Many people collect pretty or interesting rocks. Do you collect rocks? Do you know anyone who does? Are stones and rocks the same thing? In this unit, you will learn more about stones, rocks, and minerals. You will learn how to identify different types of them, and you will learn about how rocks are formed. Scientists called *geologists* study rocks to learn about the earth. They also study ways that show what people see on the surface of the earth is affected by what happens deep inside of it.

Maybe you have some questions before you even begin. If you do, write them in your *Science Notebook* so you don't forget. Try to learn the answers as you study in this *Rocks and Minerals* Unit. Rocks are all around you. How important are they?

Enjoy your discoveries!

Sangari Active Science

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Safety

Sangari Active Science

Safety is important. During science activities, make sure to pay attention to the following safety symbols in your Student Lab Manual.

SO	**WH**	**PM**	**GO**	**ES**	**DT**	**CU**
sharp object	wash hands	poisonous material	wear goggles	energy source	don't taste	clean up

Follow these safety tips:

1. Follow your teacher's instructions.
2. Do not touch your face, eyes, nose, or mouth during investigations.
3. Do not mix things together to see what will happen.
4. Tie back long hair, and roll up sleeves before doing investigations.
5. Move everything out of the way that you do not need for science.
6. Tell your teacher right away if you have any accidents or spill anything.

Where Can You Find Rocks and Minerals?

How do we use rocks?

Where can we find them in our surroundings?

Lab Activity

Rocks and Minerals All Around Us

1 Think about all the materials that are made of rocks or minerals. Name some of these materials. Where are these materials used in your school? Which ones can you see in your classroom?

A. Recognize items in your classroom that contain rocks or minerals.

B. The term "manufacture" means the process during which minerals are used or transformed to make new products. What items in your classroom were made from rocks or minerals?

C. What is a geologist?

D. What materials do you find in the structural elements of your classroom that were manufactured from rocks and minerals for other uses?

2 Walk through the school with your class.

A. Find and identify the many ways that rocks and minerals have been used.

B. Create a list of these things in your *Science Notebook.*

3 Talk about your findings with your classmates. In your discussion, use the terms rocks, minerals, geologists, manufacture, and natural resources.

Learn More

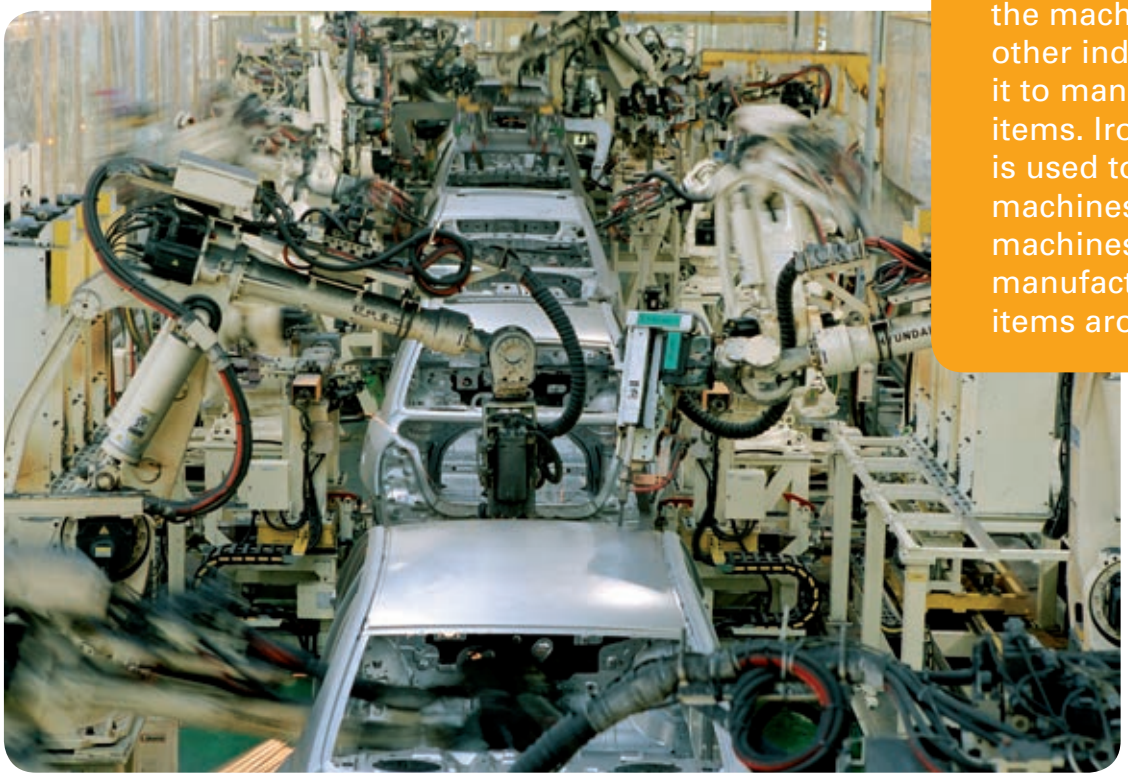
Life without Rocks and Minerals

Imagine waking up to see that everything in your home that is made of minerals or rocks had disappeared.

Would your home still be there? Would the floors and walls still be there? Would the things inside still be there? What would be missing? Write your ideas in your *Science Notebook*.

You might be surprised. Rocks and minerals are part of most objects in your daily life. Tables, windows, stairs, screws, and parts of buildings are made with iron or other metals. All metals come from minerals that are found in rocks. Rocks are natural resources. They are part of the earth.

Steel screws are made of iron or a mixture of iron with other metals.



Just like in this car factory in China, iron is also present in most of the machines used in other industries. We use it to manufacture many items. Iron is a metal. It is used to build most big machines. Iron and big machines made from iron manufacture many of the items around you.

A geologist helps to determine where minerals can be found underground. The plants from this forest are removed, so miners could dig for limestone.

What Are Rocks?

What are rocks?
How are rocks formed?

Lab Activity

Rock Observation

1. Write your number on your rock. Observe your rock closely and record in your *Science Notebook* all of its features, shapes, colors, and textures. Describe your rock to a classmate in such a way as to enable your classmate to select it from among the rocks on the table. Use your observational notes to help you draw conclusions.

2. The phrase "hard as a rock" is a saying we hear often. It compares an item to the hardness of a rock. Name other materials that could replace the word "rock" in the comparison. With your classmates, think about the answers to these questions and check the correct box in your *Science Notebook*.

   A. Are all rocks hard?

   B. Are all hard materials rocks?

   C. Do all hard materials come from rocks and minerals?

3. Write your thoughts and conclusions in your *Science Notebook*.

Learn More

The Origin of Materials

Geology is the science that studies Earth and the processes that formed it. Rocks are a natural part of the earth, so geologists study rocks. Rocks are hard. Many other objects around you are also hard, but they can be made up of different types of materials. Animals and plants, for example, have parts that are hard, but they are not rocks. Hard materials can be made through three processes: biological, geological, or industrial.

Materials of Biological Origin

A material has undergone a biological process if it originally came from a living organism. As you know, living organisms include plants and animals. Your body is supported by bones that make up your skeleton. The bones of your skeleton are hard, so they can protect the organs inside you. Your skeleton is formed by strong, hard bones that do not break easily. A coconut is an example of a hard material that comes from a living organism. A coconut is actually the fruit of a plant.

Materials of Geological Origin

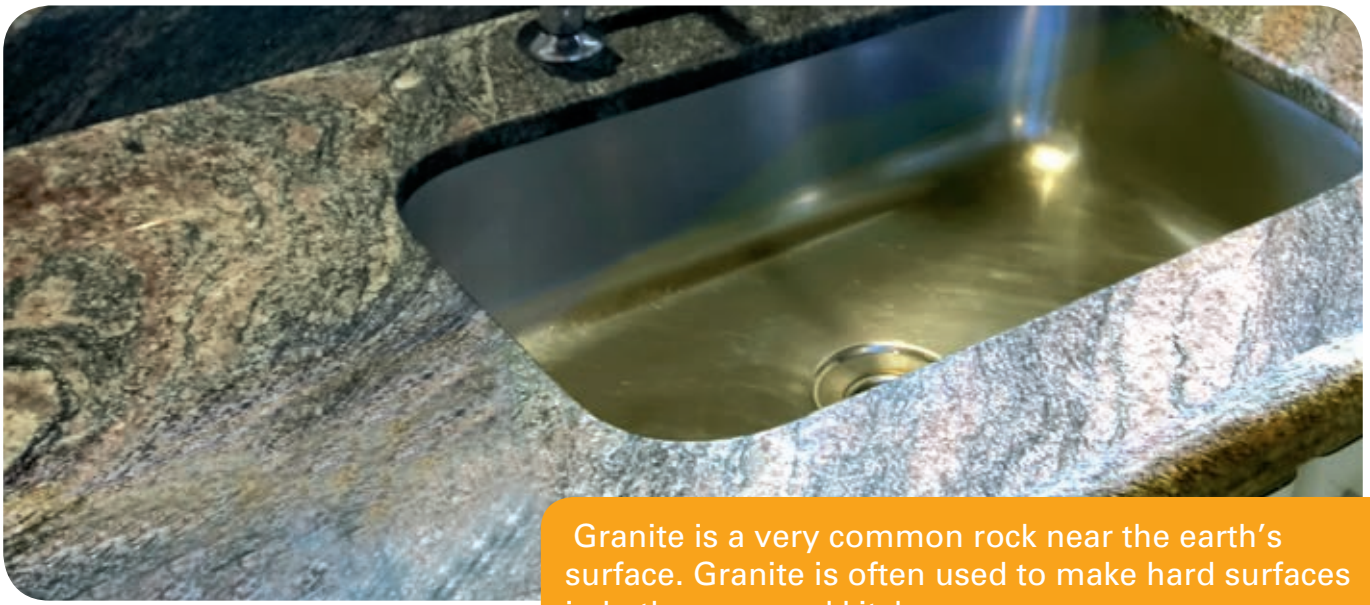
A material from a geological process is formed in nature without any action by people or other organisms. Minerals and rocks are formed by geological processes. The sand on beaches that is used to make glass is of geological origin. Diamonds and mountains are formed by geological processes.

Some animals, such as the Oryx (or gemsbok), have horns that are extremely resistant to impact. They use the horns both for attack and for defense.

Over time, mountains break down and wear away. They very slowly become sand. Sand worn from the tops and sides of mountains moves to lower areas and may end up on a beach. Erosion is a geological process. Erosion of rocks takes place over a very long time. It has been happening since Earth was formed. Mountains, rocks, and minerals are affected by this geological process. Some bathroom and kitchen counters, and some floors are made of natural stone, like marble or granite. Some are made of artificial stone.

Materials of Industrial Origin

A material is made from an industrial process when it is not found that way in nature. People have invented ways to make objects stronger or harder, so they can be used for different purposes. Tiles for roofs, floors, and walls, for example, can be made of clay. The clay is pressed together and heated to a high temperature. This process transforms clay into a waterproof material called ceramic.



Granite is a very common rock near the earth's surface. Granite is often used to make hard surfaces in bathrooms and kitchens.

Learn Even More

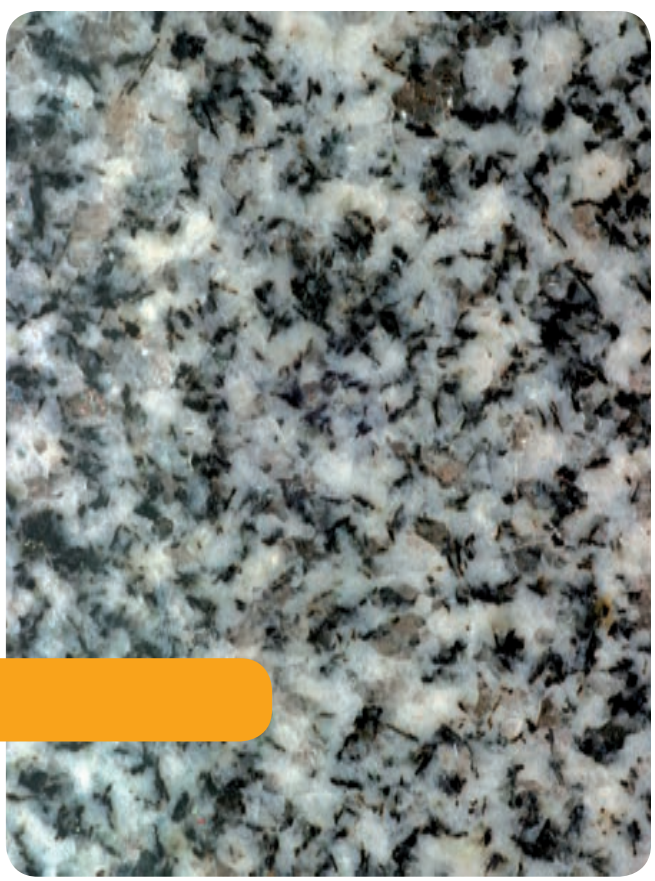
Quartz Crystals

Feldspar

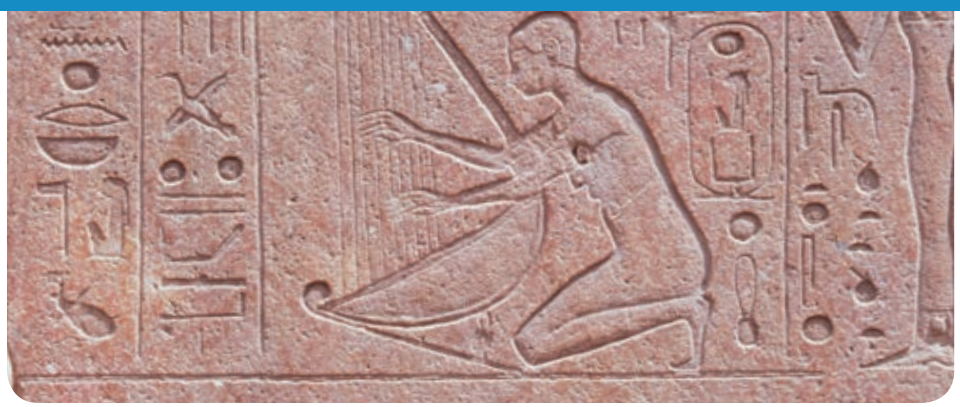
Mica

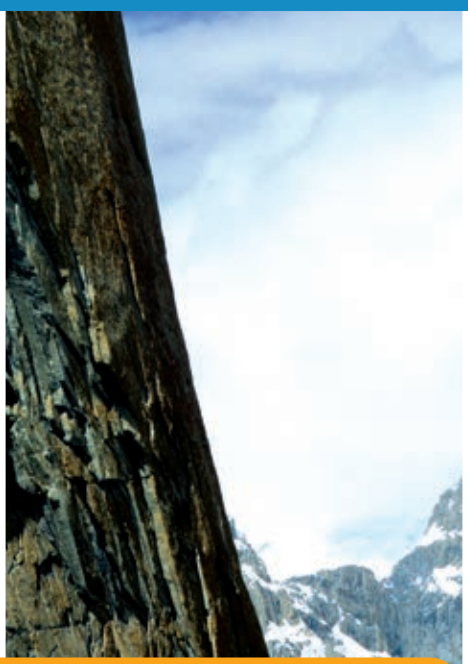
Rocks Are Made of Minerals

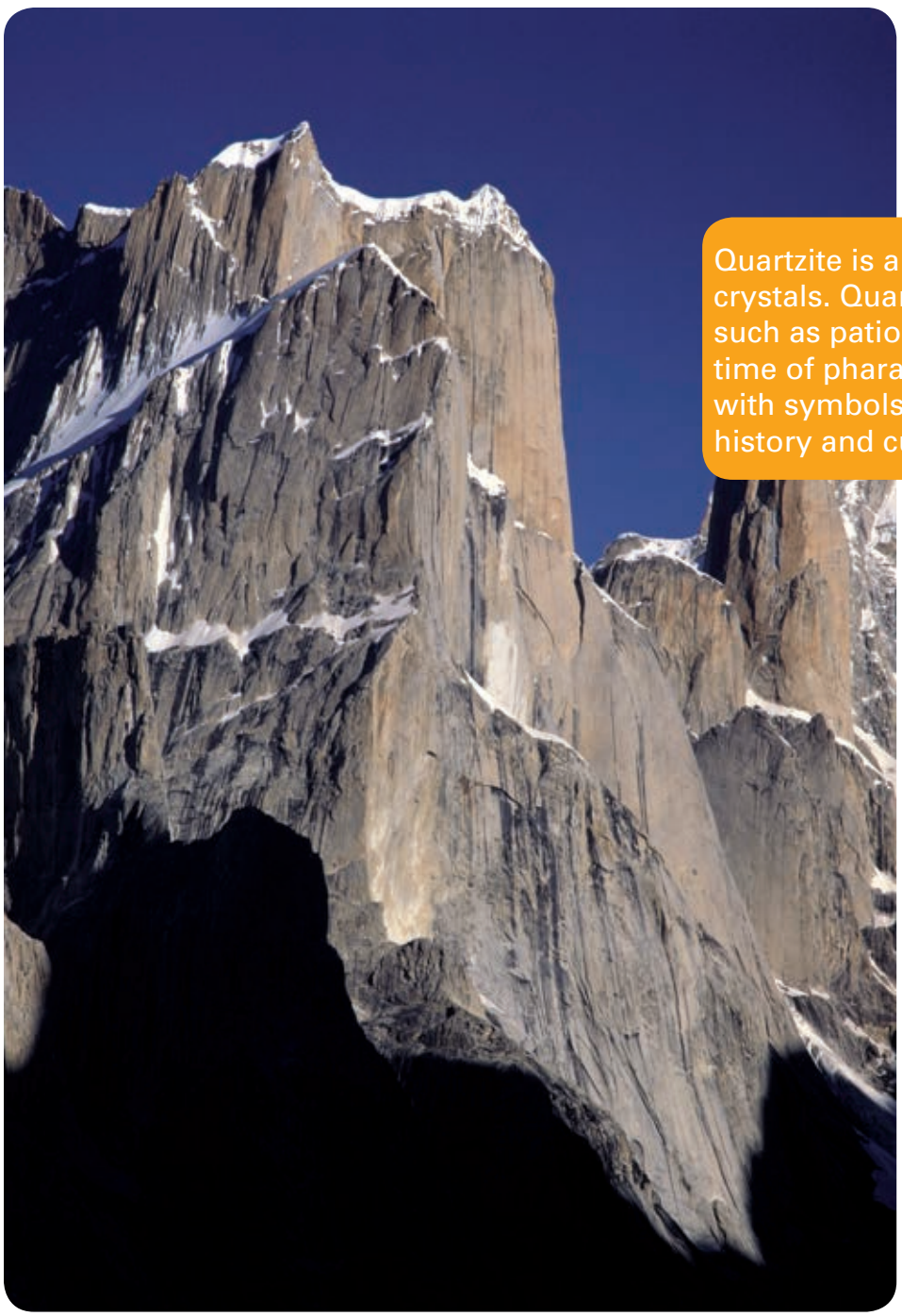
Minerals are substances that rocks are made of. A rock can be made of one, two, three, or many minerals mixed together. Granite is a type of rock formed by three main minerals: quartz, feldspar, and mica.



Granite







Quartzite is a rock made just of quartz crystals. Quartzite is used for many things, such as patio stones. In ancient Egypt, at the time of pharaohs, quartzite often was carved with symbols and images to record the history and culture of the country.

The Highest Cliffs in the World

The Trango Towers are mountains. They are located in Pakistan, a country on the continent of Asia. They are the tallest granite cliffs in the world, rising about 6,286 meters above sea level. Even the best mountain climbers are challenged to get to the top of Trango Towers.

What Is Earth Like Inside?

What can we find at the center of Earth?

Lab Activity

Investigating Earth's Interior

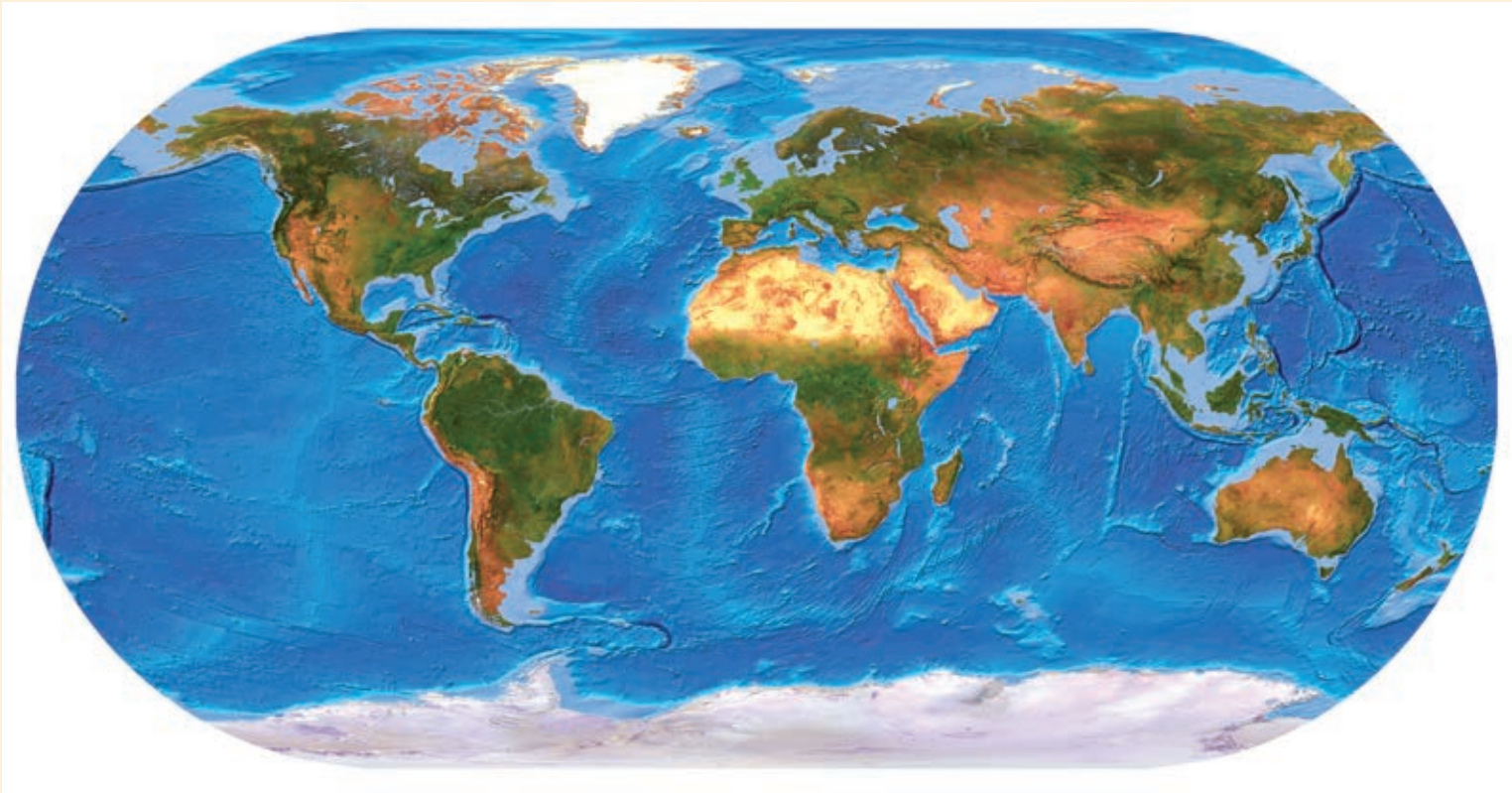
1. This seafloor map shows all seven continents on Earth. You can find a larger map like this in the Appendix at the back of your book. It is probably different from maps you usually see.

2. What do you think you would find if you dug a really deep hole down into the earth? What if you dug all the way to the center of the earth? Write down your ideas in your *Science Notebook*.

3. What are volcanoes? What do you think happens inside a volcano? Discuss your ideas with your teammates.

4. Draw and label Earth's layers in your *Science Notebook*.

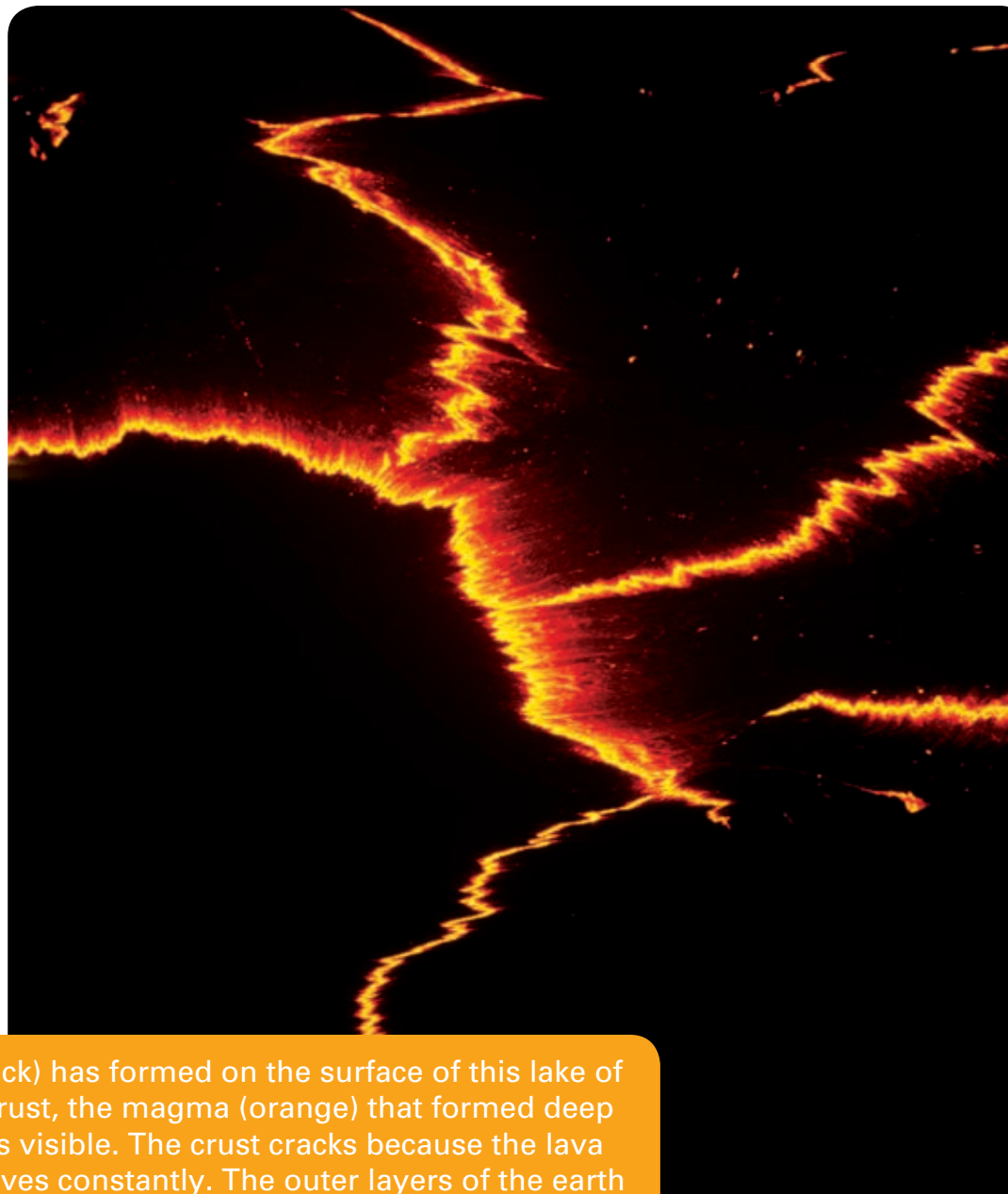
Seafloor Map



Learn More

Forming Earth

Nearly five billion years ago, long before dinosaurs, Earth looked very different. Scientists believe that planet Earth was built by huge rock fragments that collided. Earth was heated by the sun, and the rock became fluid. As that happened, heavier, denser material sank to the core and lighter material floated to the surface. As that material cooled, it became solid, forming the rocks of the mantle and crust. As the outside layers slid over the rock layers under them, geological processes created areas with thicker crust that became the seven continents. Rock plates under the continents are still moving today.

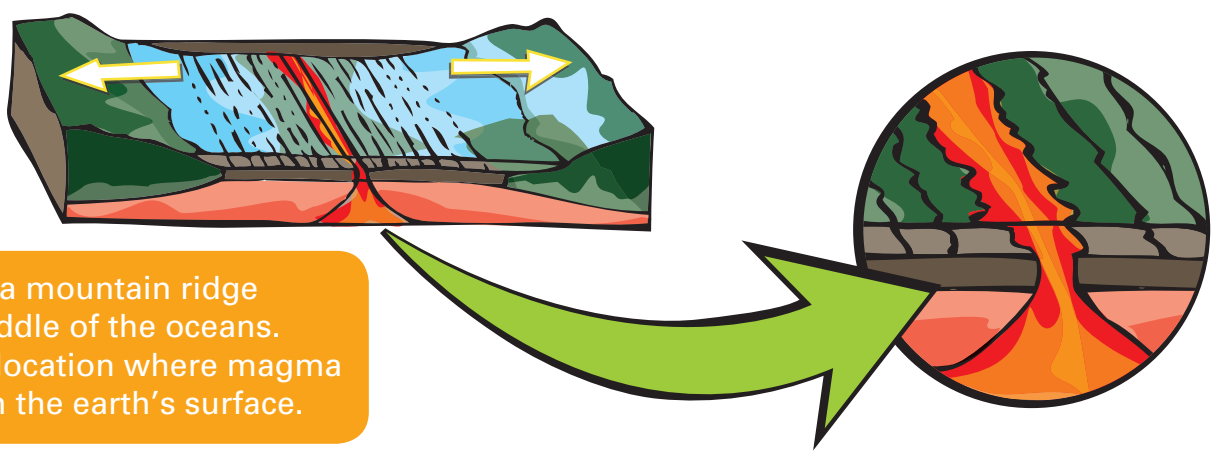


A solid crust (black) has formed on the surface of this lake of lava. Under the crust, the magma (orange) that formed deep within the earth is visible. The crust cracks because the lava underneath it moves constantly. The outer layers of the earth move in a similar manner over the hot rock below them.

What Are Volcanoes?

Volcanoes are openings on the surface of Earth that magma escapes from. Magma is the name for molten rock that forms when rocks melt deep within Earth. Imagine how hot it must be to melt rocks! When magma reaches the surface, it is called *lava*. As lava comes in contact with air or water, it cools quickly. As it cools, it turns into rock again. Volcanoes can be found on land and under oceans.

The volcano in this photo is called Pu'u 'O'o, part of Kilauea on one of the Hawaiian islands. It is the volcano with the biggest lava outpour in the world.



There is a mountain ridge in the middle of the oceans. This is a location where magma can reach the earth's surface.

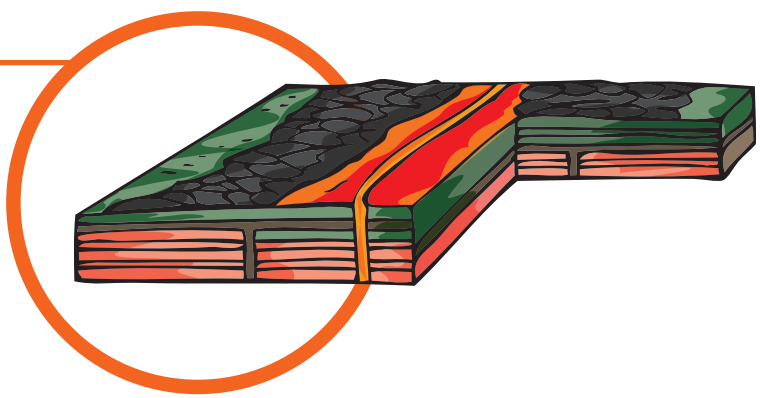
Learn Even More

Hawaiian Eruption

Types of Volcanic Eruptions

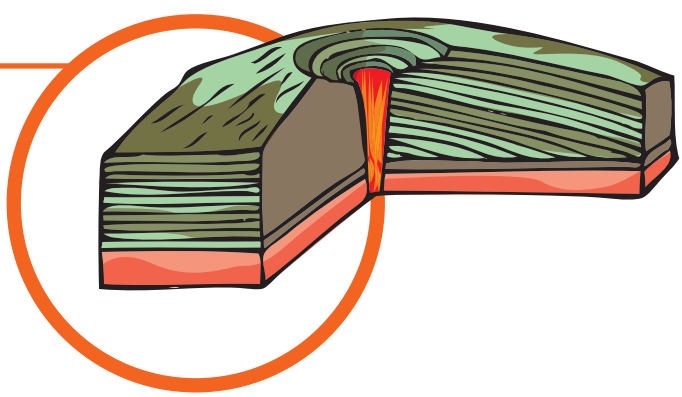
Fissure

Eruptions of this type are less devastating than others. The lava is hot and very fluid. It escapes through a fracture or crack opened at the surface. Fissure eruptions can build up high plateaus of rock. An example is the Columbia plateau of the Pacific Northwest in the United States.



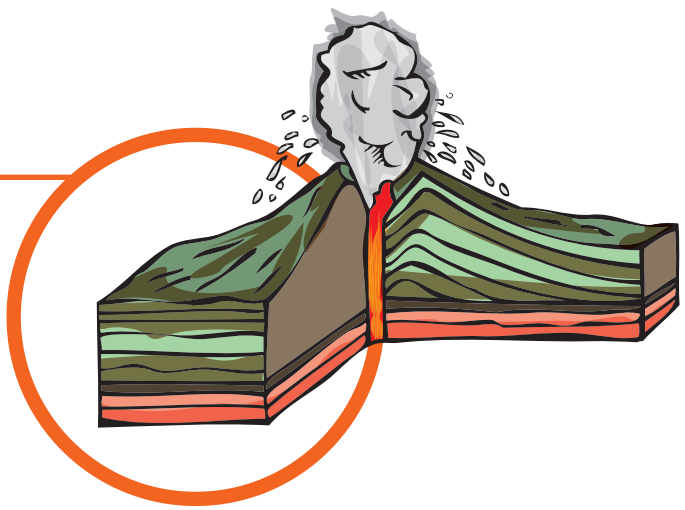
Shield

These eruptions may be accompanied by small explosions and very fluid lava. On Earth's surface, these volcanoes look like a shield that a warrior with a sword uses. Mauna Kea on the Big Island of Hawaii is an example of a shield volcano.



Strombolian

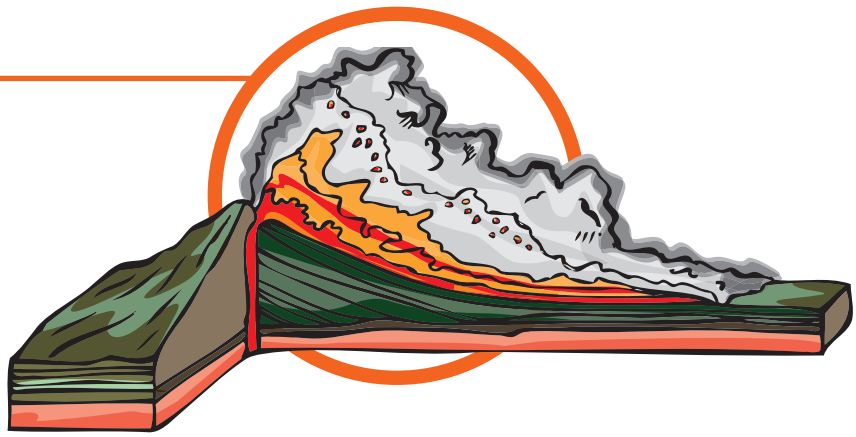
These are long eruptions, during which the volcanoes give off gas and lava bombs in a cyclic, continuous way but without any great disasters occurring. This type was named after the volcano in this photograph: Stromboli, in Italy.



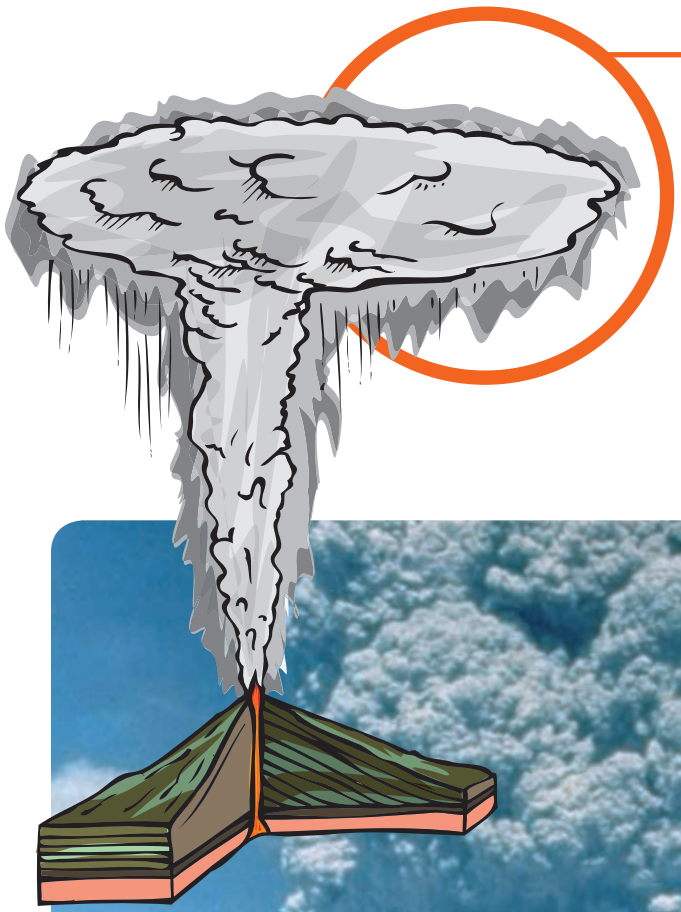
Learn Even More

Pelean

These are destructive eruptions that spit out clouds made of volcanic ash up to an altitude of 8,000 meters. Ejected material, such as ash and chunks of rock mixed with gases, can flow down the volcano's slope at a speed of 150 to 500 kilometers per hour, destroying everything in its way.

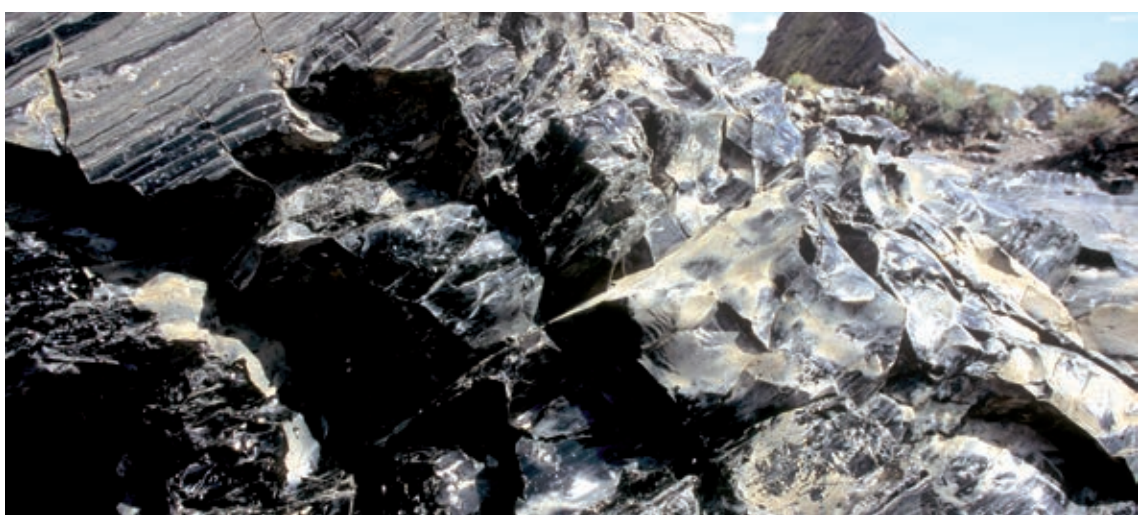


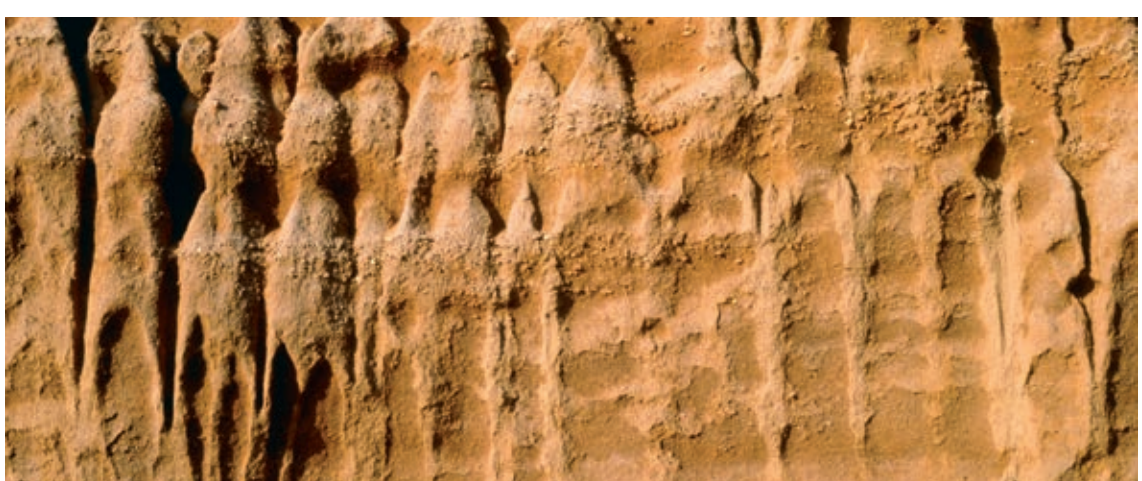
The Soufriere volcano, located on the island of Montserrat in the Caribbean, has eruptions of the Peléan type.



Plinian

These are the most violent eruptions of all. The gases and volcanic material are shot out with such pressure that they may resemble a rocket headed to space. The eruption of the Pinatubo volcano, in the Philippines, formed a cloud more than 10 kilometers in height, reaching to the stratosphere.





How Are Rocks Different?

What colors and shapes do these rocks have?

How can you tell if they were formed at the same time?

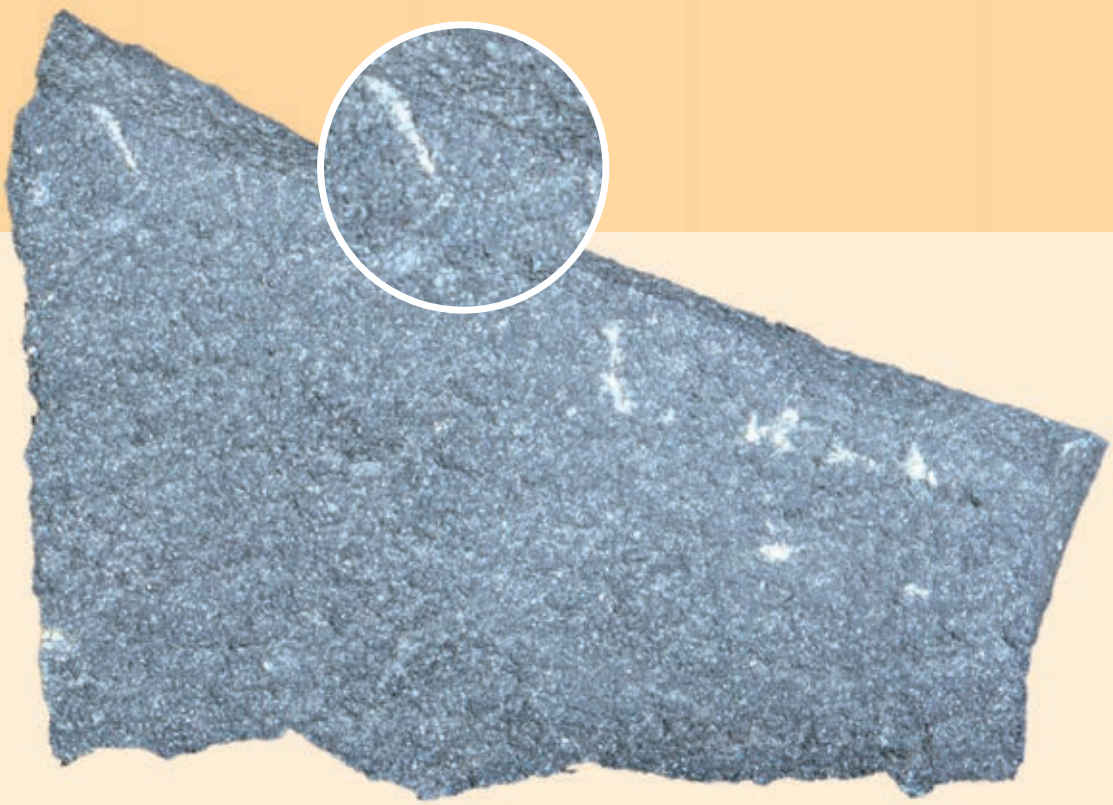
Lab Activity

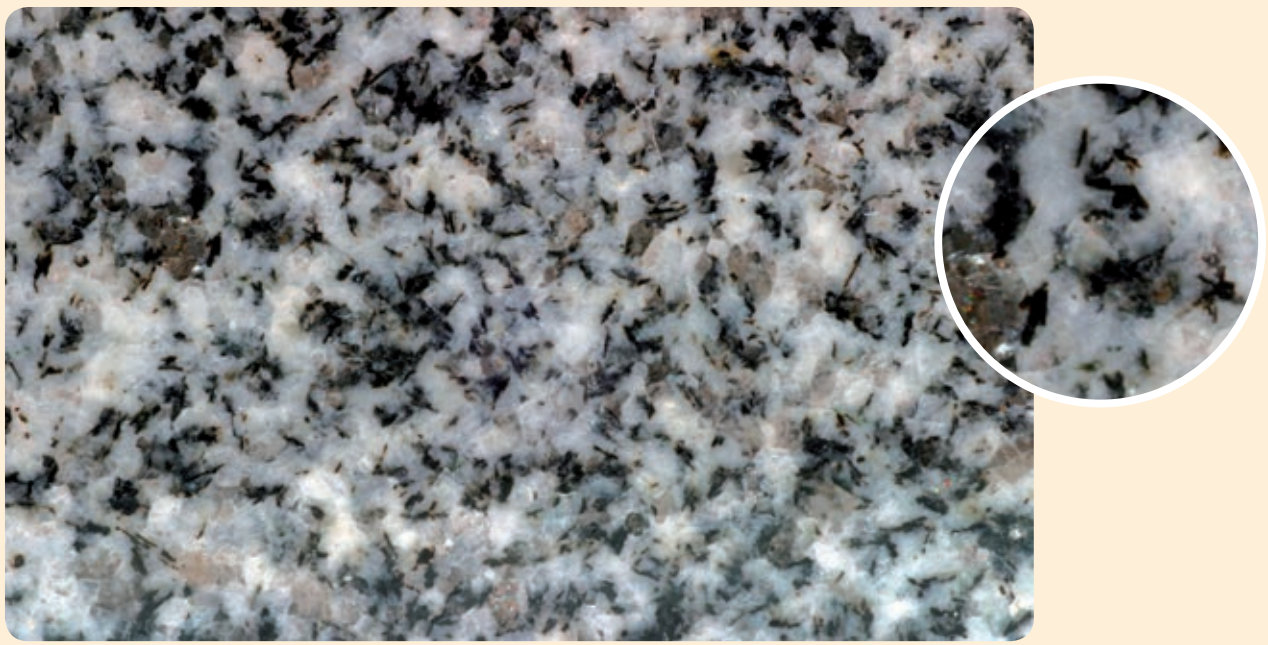
How Are Rocks Different?

1. Many rocks have grains that look like sand. Examine the samples with the magnifying glass. How do the grains of these rocks look alike or different? Notice what size grains the rocks have.
   - How are they arranged?
   - In your *Science Notebook* make a drawing that shows the grains of each sample and how they are arranged.

2. Read the *Learn More* section.

3. Use the information from the reading on rocks to identify the samples you received. Group the rocks according to their appearance. Two of them are igneous rocks, two are sedimentary rocks, and two are metamorphic rocks.





Learn More

Types of Rocks

Rocks are everywhere. Rocks are on the continents, at the bottom of oceans, on the moon, and on other planets. Characteristics of each rock can give some clues about its origin and what processes have shaped it. A geologist looks for these clues when working in the field.

Igneous Rocks

From Liquid to Solid

Water turns into ice when it is put in the freezer. As in the case of water, any substance freezes or melts at some temperature. In the inner part of our planet, temperatures are very high when compared to the surface temperatures. The pressure on the rocks also increases with depth in the earth. Under such conditions of heat and pressure, the rocks may melt to a fluid state. Pressure within Earth may be so great that the crust can break and allow magma to escape to the surface. When it arrives, this magma cools and solidifies to give rise to new rocks—called igneous rocks. Their name comes from the Latin word *ignis*, which means fire.

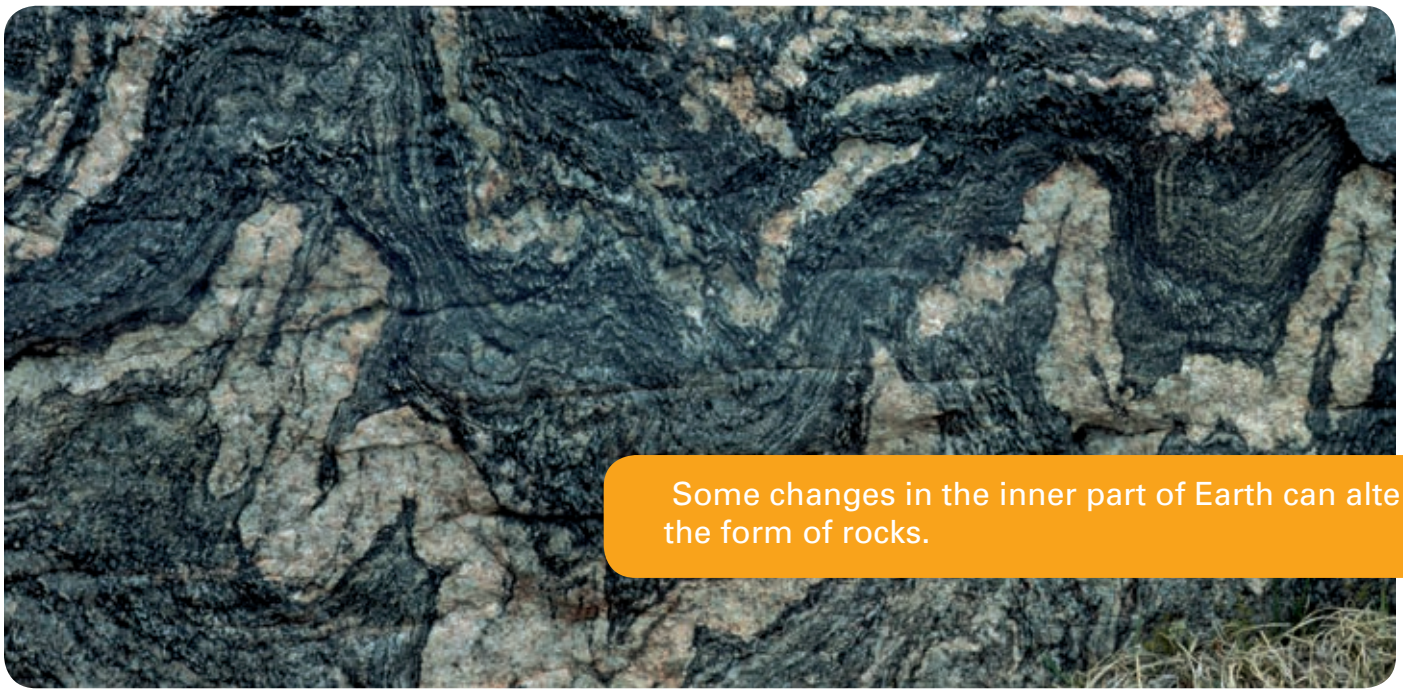
The lava from volcanoes turns into rock when it cools by making contact with air or water.

As in a layer cake, the layers of a sedimentary rock are composed of different materials.

Sedimentary Rocks

Grain by Grain

The sand of beaches and dunes and all the small grains carried by rivers or winds are fragments of other rocks, shells, or corals. When they form, the grains are called sediments. These sediments are carried to lower areas of Earth's surface (often to the sea), where they settle and can accumulate in layers. After thousands or millions of years, the accumulations can become really thick and their weight is so great that the sediments are joined again, creating new rocks. Sediment deposting is very slow. As a result, each layer of sedimentary rocks has a different age. To know the history of our planet, geologists must find out how long ago each layer was formed. Rocks formed from layers of sediments are called sedimentary rocks.



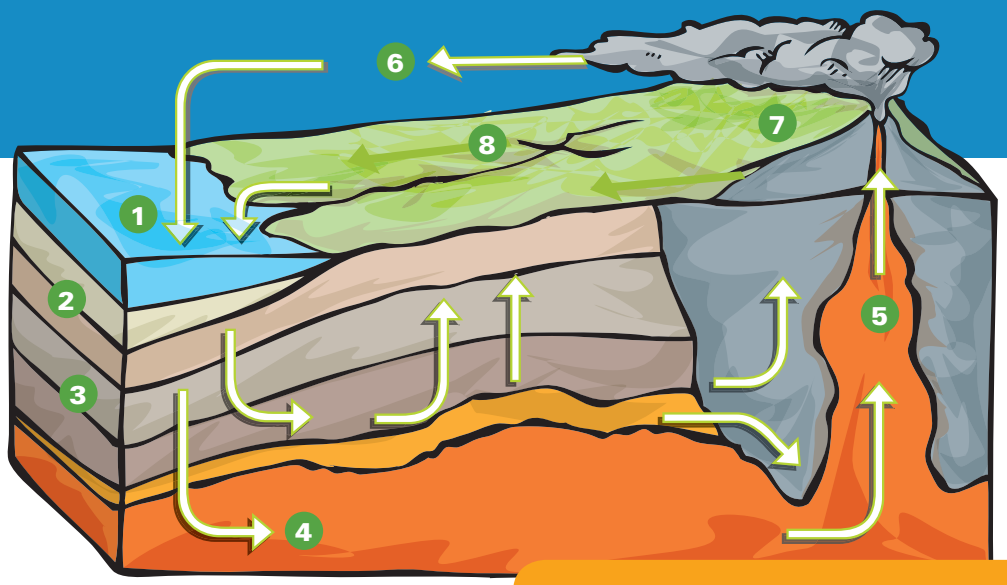
Some changes in the inner part of Earth can alter the form of rocks.

Learn Even More

Metamorphic Rocks

How One Rock Turns into Another

A metamorphosis takes place when caterpillars turn into butterflies. We use the same word with rocks when an increase of temperature and pressure changes their structure or causes new minerals to form from existing ones. A raw carrot tastes different than a cooked one. A rock that comes into contact with the heat of a volcano or one that gets squeezed also can get new physical or chemical characteristics. Rocks formed in this way are called metamorphic rocks.



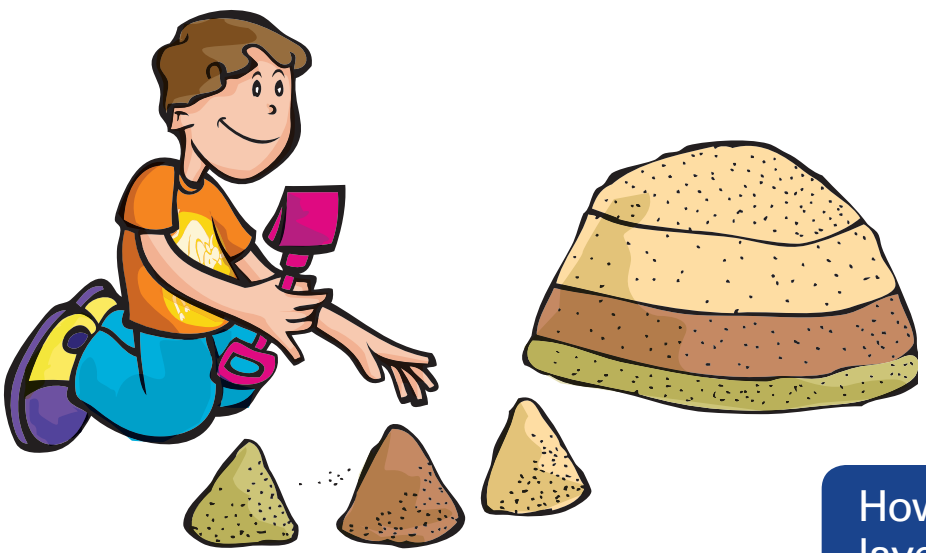
Rocks are always being transformed.

The Rock Cycle

All kinds of minerals and rocks are in constant transformation though the process is extremely slow by human standards. The changes undergone by igneous, sedimentary, and metamorphic rocks with time can be described by the rock cycle. This image shows the relationship these three types of rocks.

1. Worn down fragments of rocks are carried to the sea.
2. These pieces are deposited, forming layers of sediments.
3. After thousands or millions of years, the weight from layers of sediments helps turn them into sedimentary rocks.
4. Some sedimentary rocks are heated deep in the earth.
5. Some sedimentary rocks can become metamorphic rocks that melt. Magma from melting rocks in the mantle can escape to the surface.
6. and 7. On the surface, lava from volcanoes cools to form igneous rocks.
8. All rocks break down over time, becoming sediments.

How Do Rocks Form in Layers?



How would you describe the layers in the image?

What materials might the layers be made of?

Lab Activity

Sedimentary Rock Model

1 Imagine the bed of a river.

- What kind of rock might be formed at the bottom of this river?
- How do you think the rock could form?

Fish in a River

2 To find out how such rocks are formed, you will make a model of sedimentary rock, like in a riverbed.

A. Place a flat layer of gravel at the bottom of the container. Do not try to make it level.

B. Then add a layer of sand. Again, it does not have to be perfectly level.

C. Now place a layer of clay on top of the sand layer.

D. Put a leaf or flower on top of the clay.

E. Place another layer of clay on top of the leaf or flower and then add another layer of sand.

F. Place a final layer of gravel on top.

G. Pour 100-ml of water in the container very carefully, and avoid disturbing the layers already formed.

Lab Activity Continued

3. Make sure each layer is flat. Use your hands to flatten the last layer placed in the container.

4. Make a drawing of this model in your *Science Notebook*.

5. What would happen if you shook a container of water, sand, and clay?
   - What would happen after the container is left to rest?
   - Which substance would be on top?
   - Which substance would be at the bottom?
   - Record your ideas in your *Science Notebook.*

6. Discuss the results after the contents have settled. Compare them to your predictions.

Layer 3 – Period 3 – 70,000 years ago
The sea level lowers again, causing a layer of sand to deposit on top of the shale.

Layer 2 – Period 2 – 80,000 years ago
The sea level rises. A layer of clay is deposited on top of the sand layer (which is now a deeper region in the sea) that was formed before.

Layer 1 – Period 1 – 100,000 years ago
A layer of sand is formed next to the shore.

Learn More

The History of Earth as Told by the Layers

The sediments produced by the wearing down, or erosion, of mountains can make a long journey before being deposited in the lower regions of Earth. This phenomenon has been occurring since the formation of the first mountains. Consequently, there are sedimentary rocks that are more than three billion years old, and new rocks are still being formed at this very moment. Beaches are areas where sediments brought from the continent may accumulate. Over millions of years, more sediment is deposited on top of other, older sediments. As a result, they form huge piles of sediment layers that may then be transformed into sedimentary rocks.

When sand is carried by a river or when sand grains of a dune are carried by the wind, they can make a long journey before they arrive at a lower region. In many cases, these regions are the bottom of oceans.

This cliff made of limestone is the result of the accumulation of sediments at the bottom of the sea over millions of years.

Since newer sediments arrive on top of older ones, the study of rock layers can show geologists a little of Earth's past. When they analyze the characteristics of rock layers shown in a desert, for instance, they might find out that the region was at one time the bottom of a river or was flooded when certain layers were deposited. When sediment is deposited on plants or animals and the layers are transformed into rocks, organisms can be turned into fossils. Scientists can look at fossils and learn how animals and plants looked a long time ago.

What Do Rocks Tell Us about Life on Earth?

What can we learn by studying rocks?

Where are fossils found?

Lab Activity

Examine a Fossil

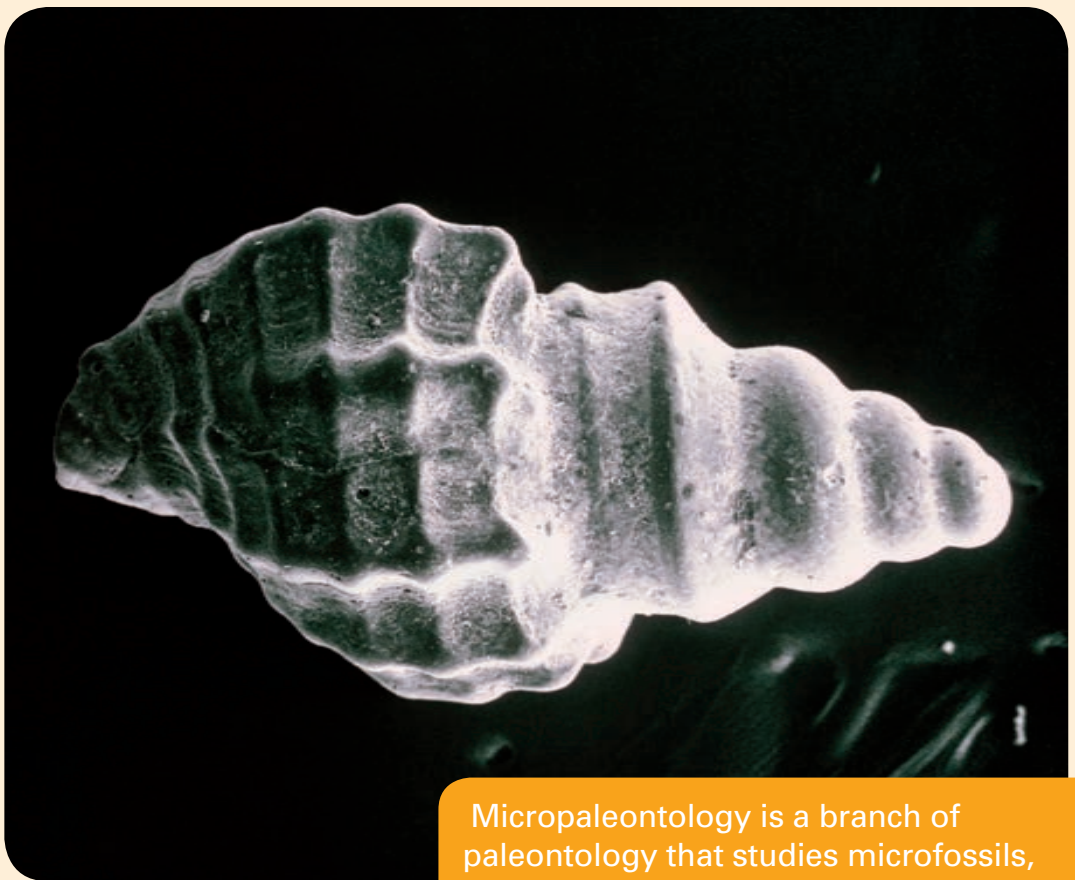
Model of Excavation

1 Discuss what a paleontologist does. What do paleontologists do with the information they uncover? In this activity, you will act like a paleontologist to investigate a fossil within a rock.

- Examine the plaster cast.
- Scrape it carefully, removing the plaster until you find the fossil replica inside.

2 Draw the replica you found and record your observations in your *Science Notebook*.

- How would you describe your fossil?
- From examining your fossil, what organism do you think you have found?
- Where would it have lived?
- What might it have eaten?
- Discuss your ideas with your partner.



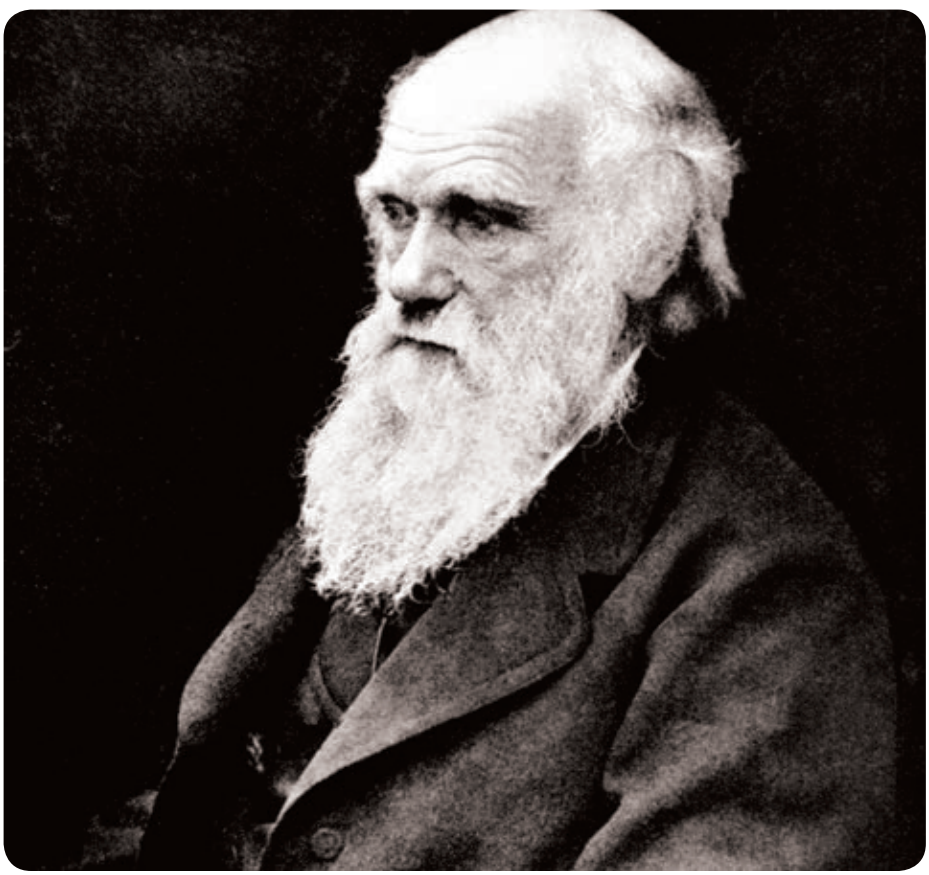
Micropaleontology is a branch of paleontology that studies microfossils, such as pollen from plants and microscopic organisms preserved in sedimentary rocks. Such study allows us to establish the age of rocks and assists in finding oil. This snail microfossil image has been magnified 110 diameters.

Learn More

Fossil Organisms Can Teach Us Something about the Past

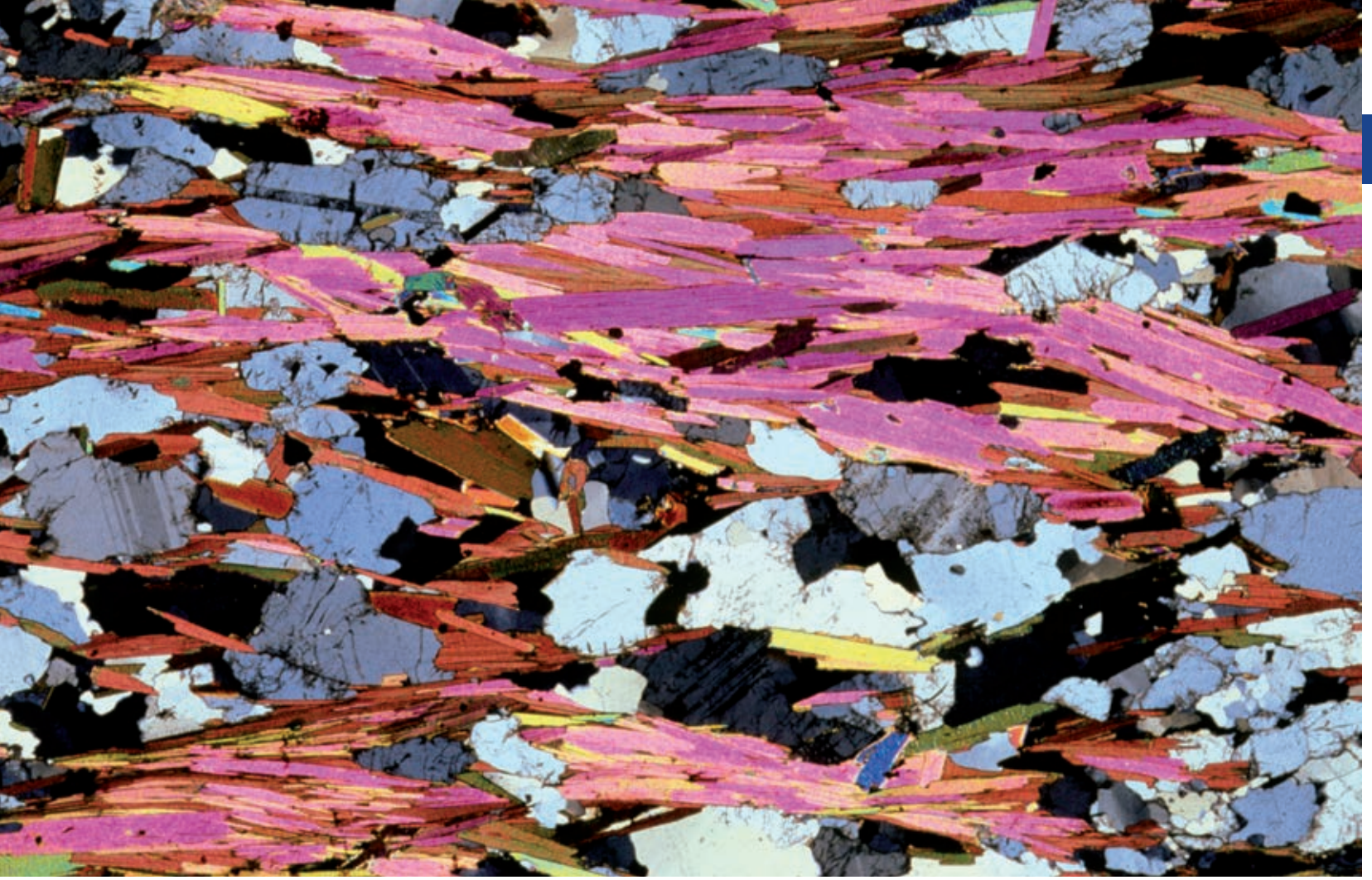
Geologists first determined information about the age of rocks from fossils. Many species found as fossils do not exist anymore. When we study the evolution of species (using fossils), we can determine the age during which each species lived. These findings are vital for us to define geologic time. Geologists divide geologic time into intervals that help tell the history of our planet since its formation. By comparing fossils to modern organisms, famous scientist Charles Darwin developed the idea of evolution through natural selection and in 1859 published his influential book *On the Origin of Species*.

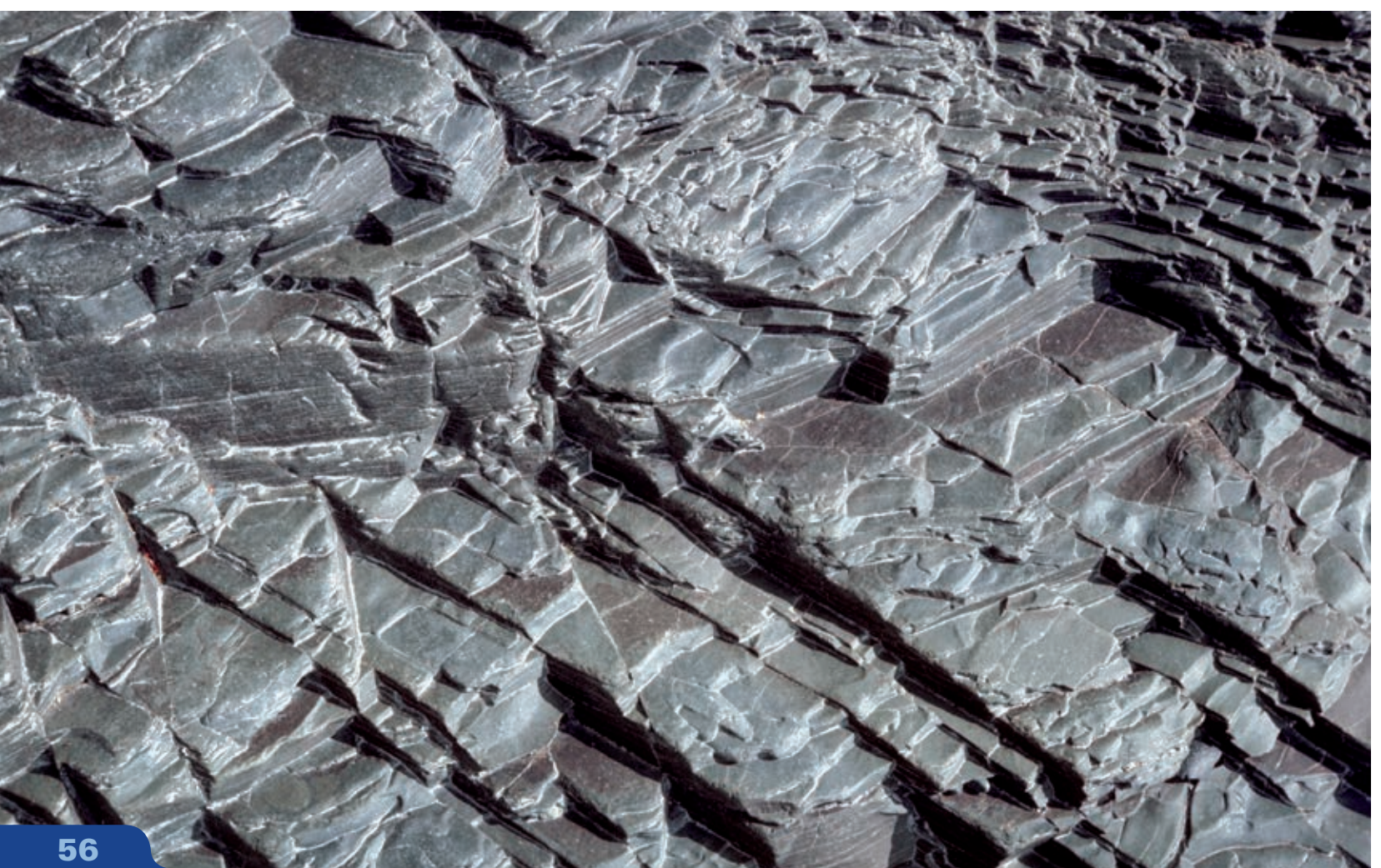
Charles Robert Darwin (1809–1882) made a 5-year trip around the world. His observations of fossils and living organisms were the basis of modern studies about the evolution of species.



Some ammonites were as small as coins, while others were as big as tires.

The group of trilobites is the largest group of extinct animals found to date: more than 15,000 different species have been discovered.





What Are Rocks Made Of?

What are shine spots in a rock?

What makes the colors in the photograph?

Lab Activity

Examining Minerals

1. Observe properties like colors and shape seen in your team's mineral samples. How do they look similar or different? Compare them to other team's minerals.
   - Which ones have small shiny surfaces?
   - What do you think they are?
2. Record the similarities and differences in your *Science Notebook*.
3. Observe the colors of the minerals in the rocks carefully. Which minerals can you find in the samples of granite and gneiss?
4. You already know that rocks are made of minerals. Now observe the photographs and see what minerals can be found in the granite and gneiss.
5. Read aloud the labels on the photographs. Have a discussion with your classmates.
   - Which mineral makes up most of granite?
   - Which mineral is present in the least amount?
   - Which mineral does not appear in gneiss?
   - What about gneiss makes it seem less colorful than granite?


WHAT A FLAKE!
WHERE?
WHAT LUSTER!

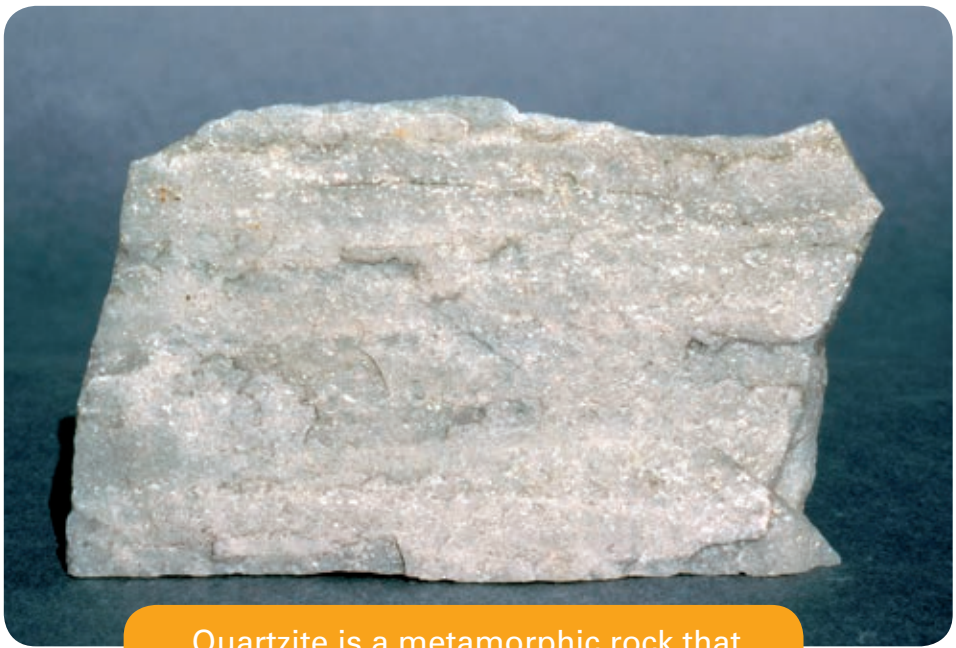

Black Mica Flakes (Biotite)
White Bands of Quartz and Feldspar
Gneiss


Granite
Big, Pink Crystals of Feldspar
Black Mica Flakes (Biotite)
Translucent, White, or Gray Crystals of Quartz

Learn More

Minerals Are Very Different from Each Other

A rock can be composed of one or more minerals. There are minerals, such as quartz, that can be found in all three types of rocks. Quartz is present in granite, a kind of igneous rock, and is also found in some sedimentary and metamorphic rocks.



Quartzite is a metamorphic rock that contains quartz.

Quartz can also be found in conglomerate, which is a type of sedimentary rock.

Small and Big Crystals

There are thousands of different minerals. Minerals are solid materials with the internal structure of a crystal. Sometimes we can see these crystals, but not always. The size and shape of minerals can vary a lot. Minerals may form big crystals, like quartz. Minerals may also form very small crystals, which can only be seen with a microscope. The size of crystals in a mineral is related to the space they had to form in and the time they had to cool down. Such properties can result in beautiful crystals that are the result of a mineral that had plenty of time and space to form. When there is no space, the crystals grow side-by-side and we can hardly distinguish them.

Purple Quartz

Amethyst is the name of a kind of purple quartz. Purple quartz is formed where volcanoes once existed. Gas bubbles were formed in the cooling lava from these volcanoes, then later, quartz had time and space to grow.

The formation of amethyst crystals was slow, within bubbles that existed in the solidified lava from volcanoes.

Can the Shape of a Rock Be Changed?

What happened to these rocks?

How did they get that way?

Lab Activity

How Mountains Form

Look at the following photograph. Try to imagine what happened to bend these rock layers.

What could have caused these mountains to be formed? In this activity you will simulate one type of mountain formation process. In just a few minutes, you will simulate what takes millions of years to happen in nature.

1. Lean the wooden board against one end of the plastic container.

2. Make sure that the board is very close to the container's wall. Now arrange the soil layers.

   A. Place a 2- to 4-cm layer of clay in your container.

   B. Use your hands to make this clay layer as even as possible.

   C. Then place a layer of sand the same thickness on top of the clay.

   D. Draw what you built in your *Science Notebook*.

3 Repeat the same procedure:

A. Make a second layer of clay.

B. Make a second layer of sand.

C. Make a third layer of clay.

D. Draw and label the resulting layers in your *Science Notebook*.

4 Now use the wooden board like a bulldozer. *Slowly* push against all the layers, pushing them toward the middle of the container. Keep pushing until the layers are pressed against the other end of the plastic container.

A. What happens to the sediment layers?

B. Use drawings and captions to record your observations in your *Science Notebook*.

Learn More

Why Do Rocks Have Folds and Faults?

Objects can break for several reasons. They may fall, they may crash into other objects, or they may be crushed or stretched. They break because they cannot stand the fall, crash, or squeezing. Some objects such as chalk or pencil lead break easily, but you cannot break a nail with your hands. When we need a lot of strength to bend or break an object, we say that it is resistant to deformation, because deformation means a change of form or shape. Some malleable materials, such as rubber, can undergo some deformation without breaking. This is known as ductile behavior. There are different types of ductile behavior. When we stop squeezing an eraser, for instance, it returns to its original state. We call this elastic behavior. But what happens to a paper clip? Have you ever seen a paper clip return to the former state on its own after being bent? The paper clip exhibits plastic, but not elastic, behavior.

Elastic behavior: An eraser is an object that bends when it is squeezed because it is made of rubber.

Plastic behavior: A paper clip keeps its new shape after being bent. The same thing happens to rocks.

These rocks were bent by a huge force.

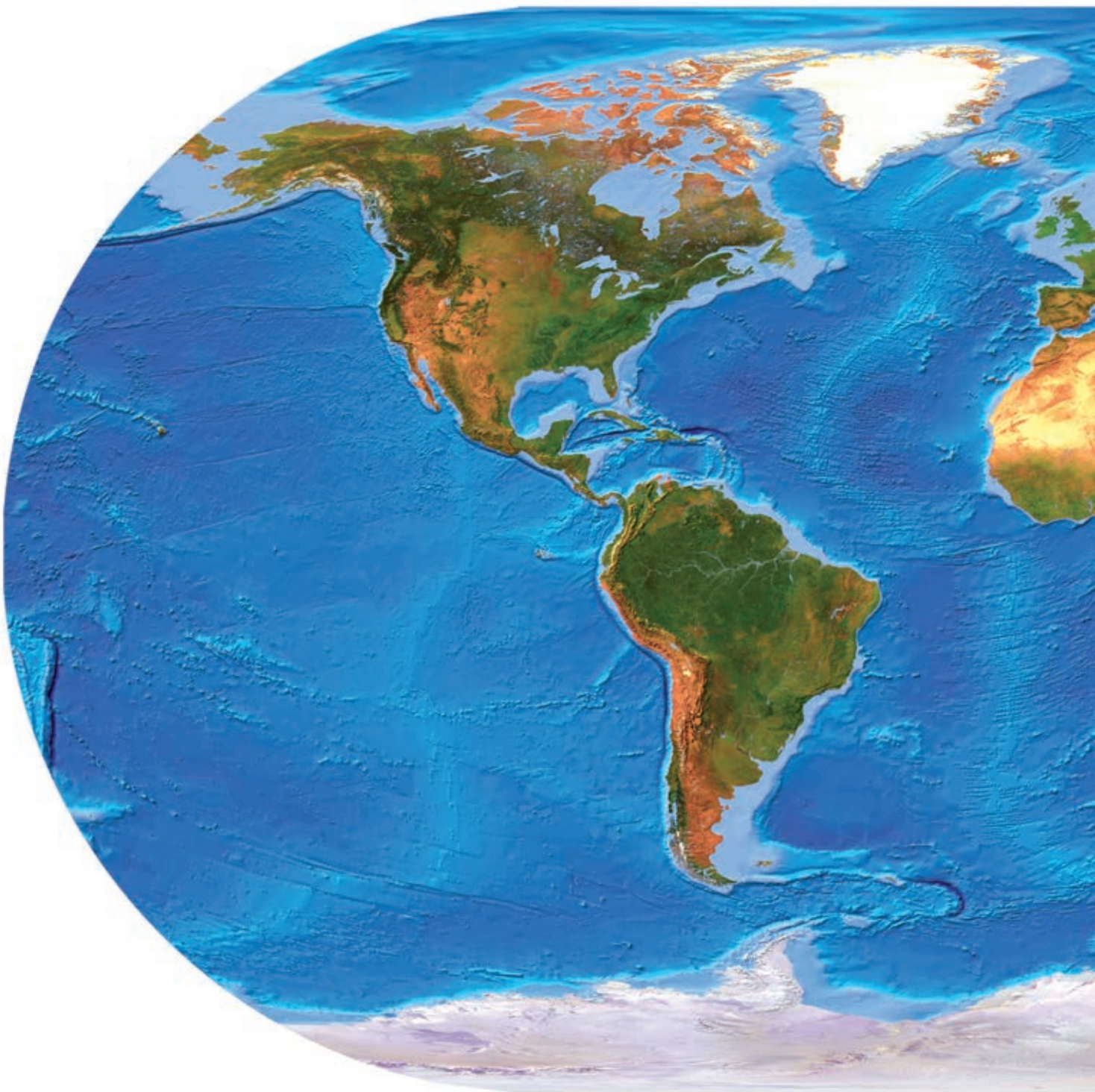
The Himalayan Mountains rise more than 8,000 meters above sea level. They were formed by a collision between the tectonic plate of India and the tectonic plate of Asia.

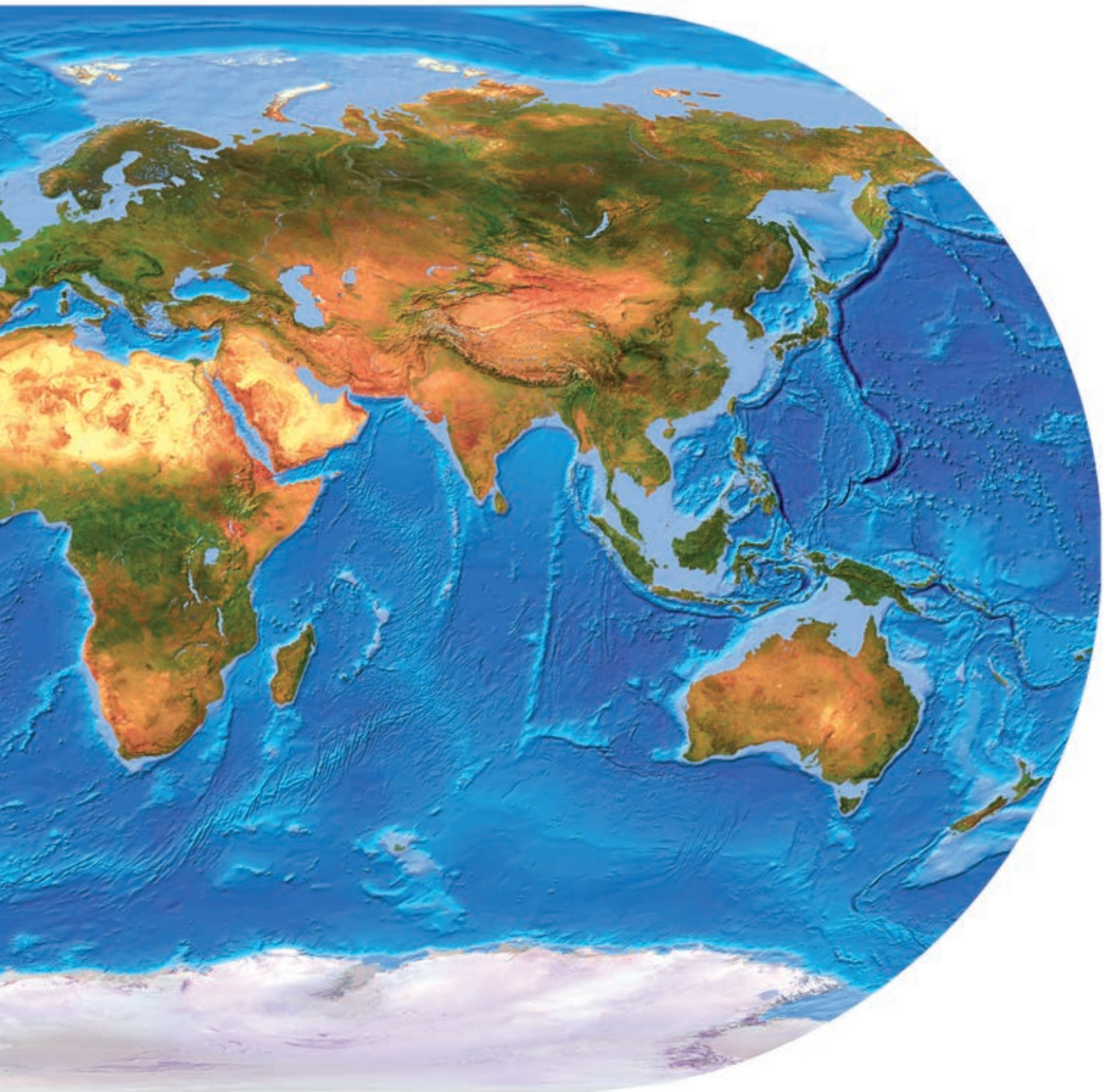
The Force of Tectonic Plates

Just like chalk, erasers, paper clips, or even steel beams, rocks are materials that can break or bend. In geological terms, we say they can develop faults or folds. What actually happens depends on several factors. Mountains are rocks that have been broken or bent by huge forces, such as the motion of tectonic plates. These rocks had been bent by a huge force. The tectonic plates move in different directions with different speeds. When they bump into each other, sediments that have been deposited at their edges for millions of years are compressed and bent. If they are bent enough, they can fold upwards and create mountain ridges. These plates can also slide under one another, usually with one of them being lifted.

When a layer breaks, the plane where the break took place is called a fault.

Seafloor Map





Glossary

attract – to cause to draw near or stick to

biological process – how material is made by a living organism (such as animal bones or wood or shells)

chemical properties – characteristics that only change when a reaction results in a new substance

contour map – a map showing changes in height of the land, like hills, valleys, mountains, and rivers

core – the center of the planet

crust – the layer of solid rocks at the outer surface of Earth

crystal – a solid whose material is arranged in a very regulated structure

crystalline – made of or looking like crystal; clear, transparent

cycle – a series of events that is repeated over time

deformation – a change in form or shape

elastic – capable of returning to its original shape or arrangement after being stretched, compressed, or otherwise deformed

elevation – height of something, like the land, measured as distance above or below the surface

erosion – the process of wearing down rocks and other materials

field – a place where study or observation occurs outside an office, school, factory, or laboratory

fossil – remains or impression of a plant or animal that has been preserved under layers of sediment

fracture – a break or crack

gemologist – a person who studies minerals that have been cut and polished as jewels

geode – a small, hollow, usually rounded rock lined inside with crystals

geologic time – the time of the physical development and formation of Earth; also known as "deep time"

geological process – how material is made or transformed by Earth's natural processes (such as volcanoes or deposits from water)

geologist – a scientist who studies minerals, rocks, and Earth processes

geology – the study of Earth and how it was formed

glistening – shining with a sparkling, reflected light

hardness – the ability of one mineral to scratch another

igneous – formed by the cooling and hardening of magma

industrial process – how material is made or transformed by humans when it is not naturally found in nature (such as metal cans or tile flooring)

landform – the natural features that make up Earth's surface

legend – an information box on a map that has symbols representing things on the map

luster – describes how light reflects off a surface

magma – hot, liquefied rock located deep beneath Earth's surface

magnetism – the ability of some minerals to attract certain metals, such as iron and steel

malleable – easily molded or shaped

mantle – layers of hot magma under Earth's crust

manufacture – the process in which materials, such as minerals, are transformed to create a new product

metamorphic – formed when temperature and pressure cause rock to change or form new minerals

mineral – a pure, inorganic, solid substance that occurs naturally

Mohs Scale – a standard scale of some of the most common minerals, organized from the softest to hardest

natural resource – anything that is provided by nature, including water, minerals, timber, and petroleum

opaque – letting no light pass through a surface

paleontologist – a scientist who studies fossils and ancient forms of life

physical properties – characteristics of something that can be measured or seen without changing its chemical identity

plastic – capable of being shaped or formed

precious stone – a mineral, such as a diamond, emerald, or ruby that is expensive because of its rarity or appearance

properties – characteristics that are used to identify a mineral

relative – considered in comparison with something else, as in comparing the hardness of one rock to another

reliable – able to be counted on; dependable

repel – to drive off, force back, or keep away

resistant – undergoes little or no change as a result of the action of something else

rock – a hard, naturally occurring mixture of minerals

routine – following regular, accepted procedure

sedimentary – formed from layers of mud, sand, stones, and other matter carried and deposited by water, wind, or ice

sediments – small pieces of rock and other materials that have been worn away by erosion

simulation – the demonstration of one process through the use of another

symmetry – an exact matching of form and arrangement of parts on opposite sides of a boundary, such as a line or around a point or axis

tectonic plates – large, moving plates that lie under the oceans and continents

texture – the appearance and feel of a surface

translucent – letting some light pass through a surface but scattering it so that images may be blurred

transparency – the ability of a substance to allow light to pass through it

quartz – a mineral found in many different rock types; can form transparent crystals

Rocks and Minerals

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