



Rock

COLLECTING

for

Kids

An Introduction to Geology

Dan R. Lynch





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Adventure Publications
Cambridge, Minnesota

DEDICATION AND ACKNOWLEDGMENTS

Thank you to my wife, Julie Kirsch, for her unending love, understanding, and support for my books and literally every other aspect of life.

And thank you to Emily Dix, Ron Pomper, and Steve Turnbull for their advice, encouragement, and enthusiasm for this project.

Disclaimer This book is meant as an introduction to the practice of rock collecting in general. It does not guarantee your safety when rock collecting in any way—when rock collecting, you do so at your own risk. Neither Adventure Publications nor Dan Lynch is liable for property loss or damage or personal injury that may result from rock collecting. Before you go rock collecting, be sure you have permission to collect on the location, ensure that an adult or adults are present, and always avoid potentially dangerous locations, such as cliffs, areas with moving/deep water, deserts, or areas where wildlife (bears, snakes, cacti, insects) may be a concern. Some rocks and minerals (such as those containing lead) can also be potentially hazardous, so you should always be able to recognize such specimens before you go into the field. (You'll likely need to refer to other field guides or experts to do so.) Finally, be aware that many national, state, and local parks do not allow rock collecting, so again, only collect where you are allowed to do so.

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All About Geology

If you want to collect rocks, it helps to know a little about geology. **Geology** is the study of the Earth and what it's made of. Geology also explores the Earth's history and how it has changed since it formed long ago.



A scientist who works in geology is called a **geologist**. A geologist studies **rocks** and **minerals** and everything else about the Earth beneath our feet.

Rocks and minerals are very important to understand because they make up the Earth and because we use them every day. We use rocks to build houses and walls, and we use minerals to make many things, like coins, computers, and glass.

But we can also use rocks and minerals to learn amazing things, like the age of the Earth and what kinds of animals lived long ago.

Rocks and minerals are also fun to collect! By picking up rocks and writing down where you found them, you can learn a lot about geology. And you can build your collection every time you visit a new place.

But you're not allowed to collect just anywhere!

Check out page 126 to make sure it's OK to collect where you are. And when in doubt, ask first!



OUR EARTH

The Earth is always changing. The mountains, oceans, and rocks seem like they will be here forever. But they will be gone someday, and something new will be in their place. These changes happen because of the Earth's geology.

The Earth is made up of layers. The outside of the Earth, where all the plants, animals, and people live, is called the **crust**. The crust is like a thin, hard shell of rock on the surface of the planet. It has all the mountains, plains, oceans, and deserts that we see, but the crust is affected by the layers beneath it.

Deeper inside the Earth, there is another layer called the **mantle**. It is very hot and made up of melted rock. It's so far down that we can't dig there. The melted rock in the mantle is called magma. The mantle's heat is like a big oven, and all of that heat causes the crust above it to move around. Sometimes the magma pushes its way up through the crust—we call that a volcano!

Deeper down, there are even hotter layers, and some of those layers are melted and others are solid. At the very center of the Earth is a hot, solid **core** made of metal.

When we study geology, we look at what the Earth is made of and how the inside of the Earth moves and changes. Geology also involves how the weather can change the Earth's surface long-term. Over a long time, wind, rain, and ice can wear down rocks, and even whole mountains can be worn away!

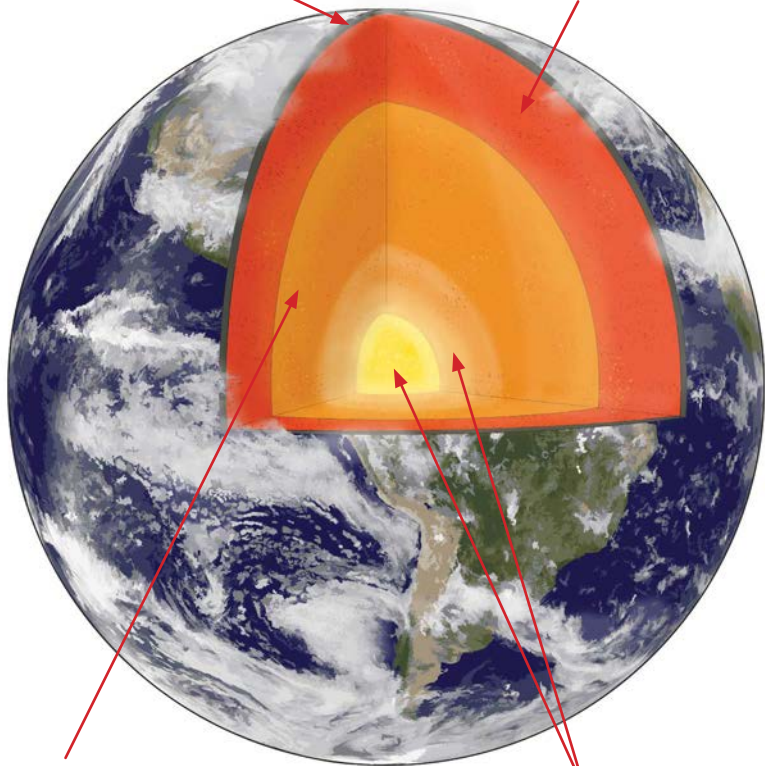
INSIDE THE EARTH

THE CRUST

The ground, mountains, and the ocean are all part of the thin outer crust.

UPPER MANTLE

Located just underneath the crust, the upper mantle is hot and soft because it is made up of melted rock.



LOWER MANTLE

The lower mantle is made of rocks that won't melt because they're buried too deep, even though it is very hot.

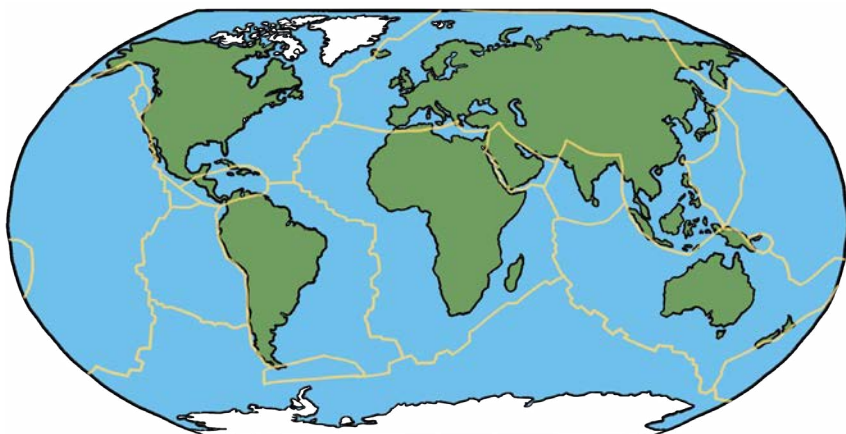
OUTER AND INNER CORE

The outer core is so hot that everything there melts and swirls around the inner core, which is made up of solid metal!

LANDFORMS AND TECTONIC PLATES

Hills, mountains, and canyons are all examples of **landforms**, or features that occur on Earth. But have you ever looked at a mountain or an ocean and wondered how it formed? In most cases, it's because of tectonic plates.

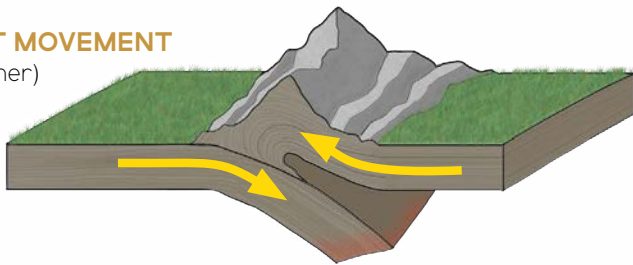
The thin outer crust of the Earth is made of many separate pieces, which are called **tectonic plates**. These plates fit together like giant puzzle pieces. Tectonic plates are always moving because of the hot, melted rock flowing underneath them. Some plates move away from each other, some crash into each other, and some slide past each other. These different actions can make all kinds of landforms, such as mountains, valleys, and even volcanoes! Most of the continents sit on top of their own tectonic plate, while most oceans are on top of more than one. The map below shows all of the Earth's most important plates, which are outlined in yellow.



Let's look at a few ways tectonic plates can move:

CONVERGENT MOVEMENT

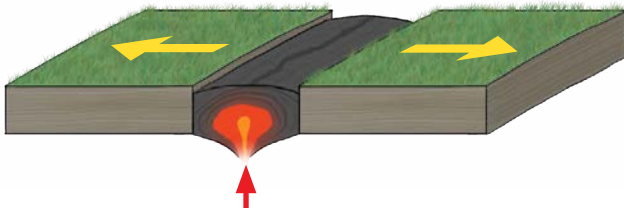
(coming together)



When two plates smash into each other, sometimes one is forced under (where the rock melts) and the other is pushed upward. This can make mountains.

DIVERGENT MOVEMENT

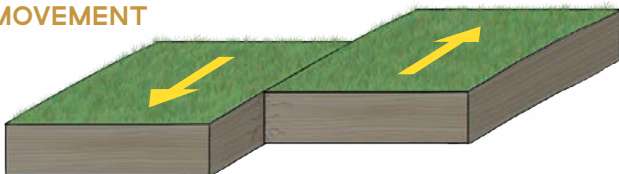
(separating)



At the bottom of the ocean, plates are often pushed apart by rising magma (melted rock). This creates underwater mountain ranges; plates moving apart on land produce valleys that eventually become seas.

TRANSFORM MOVEMENT

(sliding past)



Sometimes two plates just slide past each other. As they grind along, this can cause powerful earthquakes that shake the land. Earthquakes happen every day, but most are too small to feel.



The Grand Canyon is an amazing example of how water alone can cut an enormous path through rock.

WEATHERING

Most rocks seem very hard and solid. But have you ever found a rock that crumbled very easily? Or have you seen a giant rock formation with a hole in it? Those things happened because of weathering. **Weathering** happens when rain, wind, waves, and ice wear down rocks over a long time. Even the round pebbles you find at the beach are weathered—when the strong waves pushed them around, the pebbles tumbled into each other and were worn smooth.

Sometimes weathering can happen to very large rocks or rock formations. Rivers weather rocks when the

movement of water carries away sediment (pieces of the rock). Over time, so much sediment can be carried away that the river gets deeper. Arizona's Grand Canyon was created when a river carved through the rocks for many years.

Wind can weather rocks too. In deserts, the wind can blow sand around very easily. When the little, hard grains of sand hit other rocks, they begin to break them into pieces. The softer areas of rock break down first. Sometimes when the soft areas are surrounded by harder areas, the softer rock can wear away to form a hole or an arch.

Even plants can weather rocks! When trees and other plants get their roots into cracks, they can split the rocks apart as the roots grow bigger. On the sides of mountains or on the edges of cliffs, this can make rocks fall apart and tumble down. When you see a pile of rock at the bottom of a mountain, you know that plants, along with water and ice, got into cracks and broke the rock into pieces.

These rock arches in Wyoming are famous examples of weathering caused by wind.



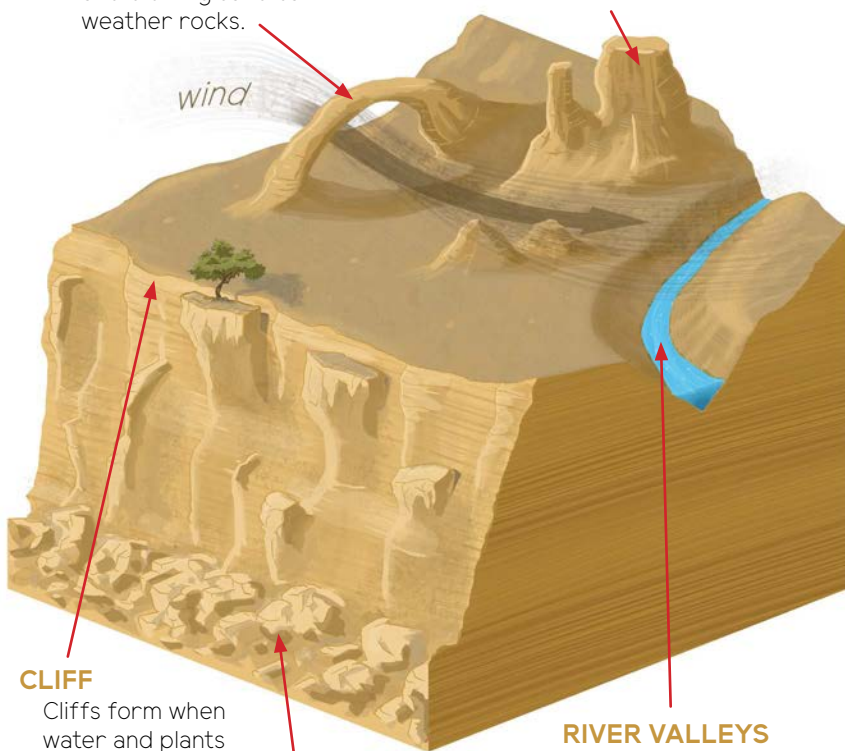
EXAMPLES OF WEATHERING

ARCHES

These are amazing examples of how wind and blowing sand can weather rocks.

PILLARS AND MESAS

Rock pillars and flat-topped mesas are formed by erosion caused by wind and rain.



CLIFF

Cliffs form when water and plants weather rocks and cause them to fall.

SCREE

Scree is the rubble and rock that falls off a mountain or cliff. It often falls into a pile.

RIVER VALLEYS AND CANYONS

These V-shaped canyons are made by rivers that cut down into the rock over time.



Stalactites are amazing hanging rocks that are found in caves. The ones above are from Carlsbad Caverns National Park in New Mexico.

CAVES

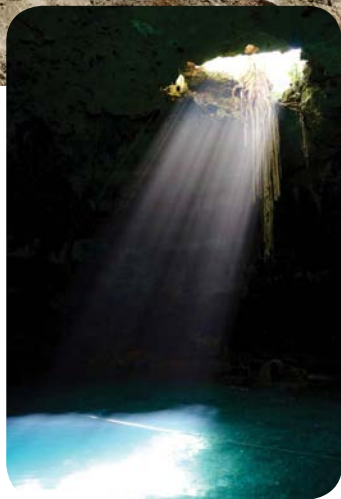
A **cave** is an opening in rock, usually underground. You've probably seen pictures of a dark cave before, but did you know that many caves are formed by weathering?

There is a lot of water underground. It is called **groundwater**. When we dig a well to find drinking water, groundwater is what comes out. But some rocks, especially limestone, can dissolve in groundwater, just like sugar dissolves in water. In time, groundwater can dissolve and wash away rocks, creating openings. Those openings are called caves.



A sinkhole in a desert in Israel.

Sometimes a big cave can weaken the ground above it. If the ground above a cave can't hold itself up anymore, it falls in. This is called a **sinkhole**, and large sinkholes can even make buildings or cars fall into the ground. Thankfully, dangerous sinkholes are very rare. Sinkholes are more common in tropical areas, and in Mexico there are some very big sinkholes called **cenote** (say it, "sih-no-tee"). They are popular places to visit because they have water at the bottom.



The dark insides of a cenote in Mexico.

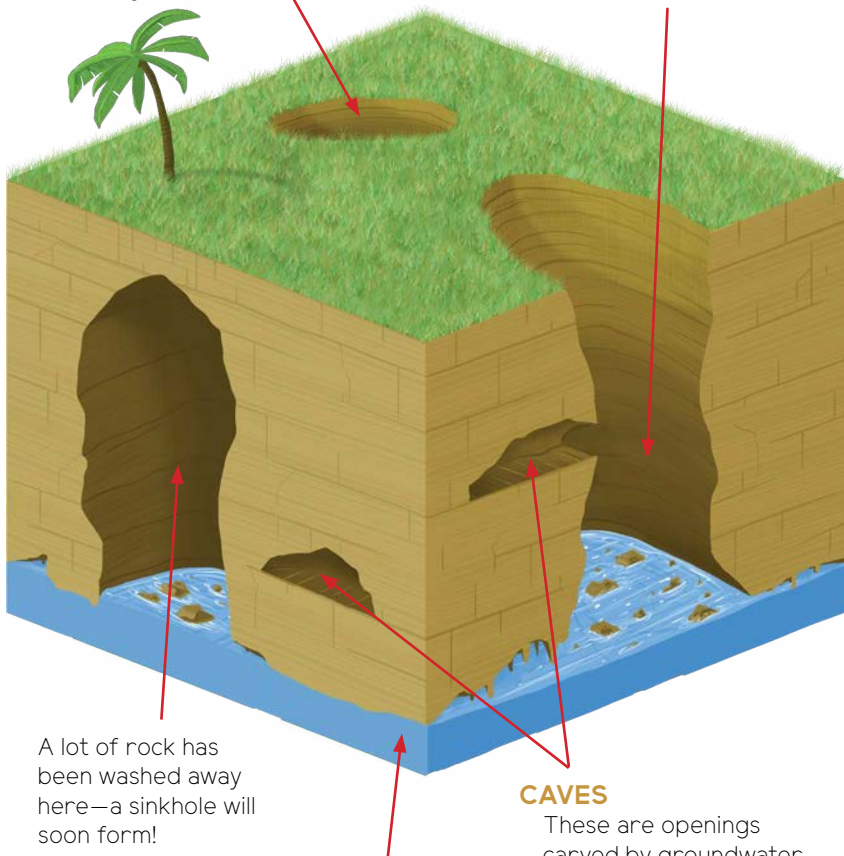
SINKHOLES, CENOTES, AND MORE

SINKHOLES

Sinkholes form when groundwater weakens and washes away underground rock.

CENOTE

This large sinkhole has groundwater at the bottom; it is called a cenote.



A lot of rock has been washed away here—a sinkhole will soon form!

CAVES

These are openings carved by groundwater.

GROUNDWATER

Water that flows through rocks, often deep underground.

GLACIERS

Weathering and erosion from wind and rain can make landforms like canyons and cliffs. But some of the biggest changes to the land happened because of glaciers. During the last **ice age**, when the world was colder, glaciers covered a lot of the northern parts of the world. And when the glaciers disappeared, they left behind lakes, valleys, and rivers. But what is a glacier?

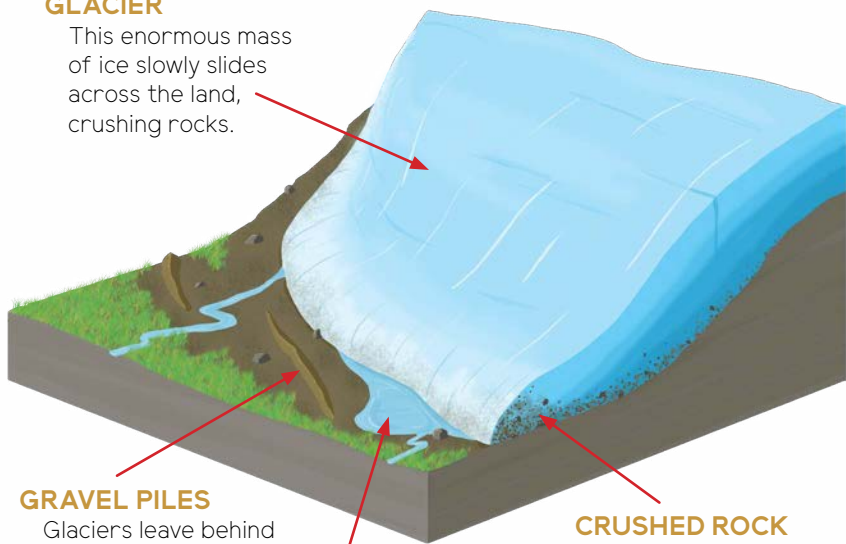
Glaciers are huge masses of ice that form when tons of snow builds up and turns into ice over a long period of time. As a glacier continues to form, it spreads out across the land, moving and flowing almost like a very slow river. Many of the glaciers in the last ice age were thousands of feet thick and many miles wide!

This glacier in Switzerland shows the dirty ice flowing downhill and melting into a lake. Do you see the valley that the glacier has carved?



GLACIER

This enormous mass of ice slowly slides across the land, crushing rocks.



GRAVEL PILES

Glaciers leave behind ridges and piles of gravel and sand.

RIVERS AND LAKES

Many rivers and lakes formed when glaciers melted and left lots of water behind.

CRUSHED ROCK

Glaciers crush rocks into little pieces that become stuck in the ice. All of those rock pieces make the glacier even better at scraping the land!

Glaciers only move a few feet each day, but they weigh so much that they crush the rocks that they move over. Glaciers can even grind down hills, carve valleys into rock, and flatten the entire landscape!

During the ice age, the glaciers formed in cold northern parts of the world and slowly moved south. As the ice of a glacier moved, it picked up lots of broken rock and gravel.



All of these smooth, shiny rocks were worn flat by a glacier that once moved through this valley. Do you see the lines on the rock made by the scraping ice?

But when the glaciers melted, the rock was left behind in piles, which we can see today as hills. All of that melting ice also created lots of rivers, lakes, and other landforms. In some places in the world, you can still find big, smooth rocks with lots of deep scratches in them, which show how the glaciers scraped them as they passed through the area.

ROCK FORMATIONS

All the landforms you see every day, like mountains and lakes, were formed by the Earth's geology. These changes are caused mostly by the moving tectonic plates and by weathering. But some of these landforms often developed in different ways. Knowing how they formed can help you know whether they are good places to look for rocks and minerals.

Mountains and some hills form when rocks are forced upward by tectonic plate movement. Lots of rocks from deep in the Earth can be pushed up to where we can find them. Sometimes you can find gemstones, crystals, and even fossils in the rocks of mountains.

The Matterhorn Mountain in Switzerland is an awesome example of a mountain formed when tectonic plate movement forced rocks upward.





Rivers and lakes usually form due to weathering. Here's how it works:

Wind and rain make a low spot in the Earth where water collects. As

more water collects there,

it forms rivers and lakes,

where water begins to flow and

move. This can move lots of rocks and

even wear them away. When a river carves into rocks

over many years, it can form a canyon. On the shores

of lakes and rivers, you can often find neat rocks

and minerals that have been worn smooth and round by water.

Oceans form when tectonic plates spread apart and leave a gap between them. As the gap gets bigger and bigger, it fills with water. Oceans are so powerful that they can move and weather lots of rocks. On the shores of oceans and seas, you can find many kinds of rocks and minerals, as well as seashells and even fossils.

Deserts are regions that don't get much rain, and they are very dry. Deserts usually form because





This giant gold mine in Australia is an example of mining today. Lots of mining is done by digging enormous pits like this.

they are in a hot part of the world, and often there are mountains that block them from getting rain. There aren't a lot of plants in deserts, so rocks are usually easy to see on the ground. This can make it easy to find neat rocks and minerals.

Mines are places where people dig lots of minerals out of the ground. When people dig into the ground to find valuable metals or gemstones, it's called mining. Sometimes mines are tunnels that go deep underground, and other times mines are giant open pits in the ground. Mines can be found in mountains, hills, deserts, and anywhere in between.

Minerals

Rocks and minerals are two very different things. Rocks are made up of mixtures of lots of different minerals. But minerals are more pure; they are chemicals that have hardened. This means that minerals are always made of the same stuff, but rocks can be a mixture of lots of different things. This makes minerals special because we can use them to figure out what our world is made of. And once you understand minerals and the rocks they formed in, you're one step closer to figuring out where to find crystals and gems to collect!



WHAT MAKES A MINERAL?

Minerals form when specific chemicals join together and harden. For example, table salt is a mineral. It is a combination of two chemical elements: sodium and chlorine. Elements are basically “building blocks,” and each mineral has its own recipe of chemical elements. (This is called the mineral’s chemical formula.) There are thousands of minerals in the world. They can be found as grains in all kinds of rocks, but they also can be found on their own.



HOW MINERALS FORM

Minerals form in many ways. A lot of minerals form when very hot water comes up from the Earth and gets into holes or cracks in rocks and dries up. That hot water often has tiny particles of minerals in it, and when it dries up and cools off, it leaves minerals behind.



You can also test this at home! Put a little salt in some warm water, and stir it up until the salt disappears (dissolves). Then let the water dry up. When it’s dry, you’ll see a crust of tiny salt crystals left over.

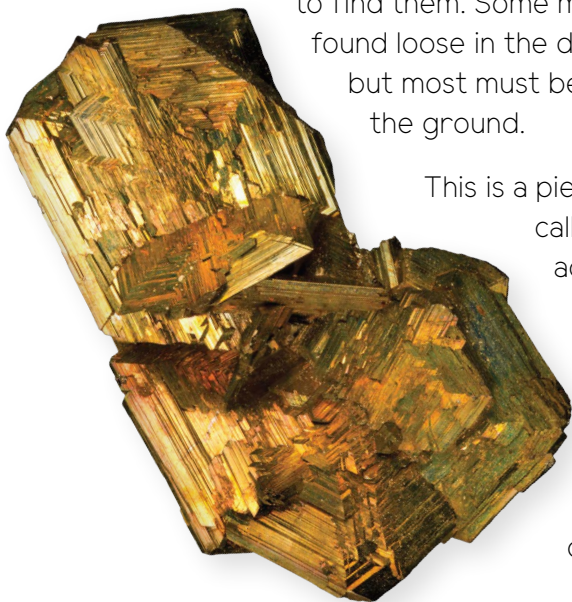
Other minerals form when rocks weather. When rocks are exposed to water, they break down and their ingredients separate, freeing the minerals inside it.

CRYSTALS

If a mineral has enough room when it is forming, it can form a crystal. **Crystals** are hard shapes that are made of a pure mineral. Each mineral has its own crystal shape (or shapes). Some crystals can be pointy, and others can be flat or square. They can also be different colors, some can be see-through, and some are shiny.

Mineral collectors love crystals, which can be hard to find. Most are found inside holes or spaces in rocks. Collectors often break rocks to find them. Some minerals can be found loose in the dirt or on a beach, but most must be dug up out of the ground.

This is a piece of a mineral called marcasite. It's actually a group of marcasite crystals. Look at all the amazing details on the crystals, like the little ridges and different colors!



HOW CRYSTAL FORMATION HAPPENS

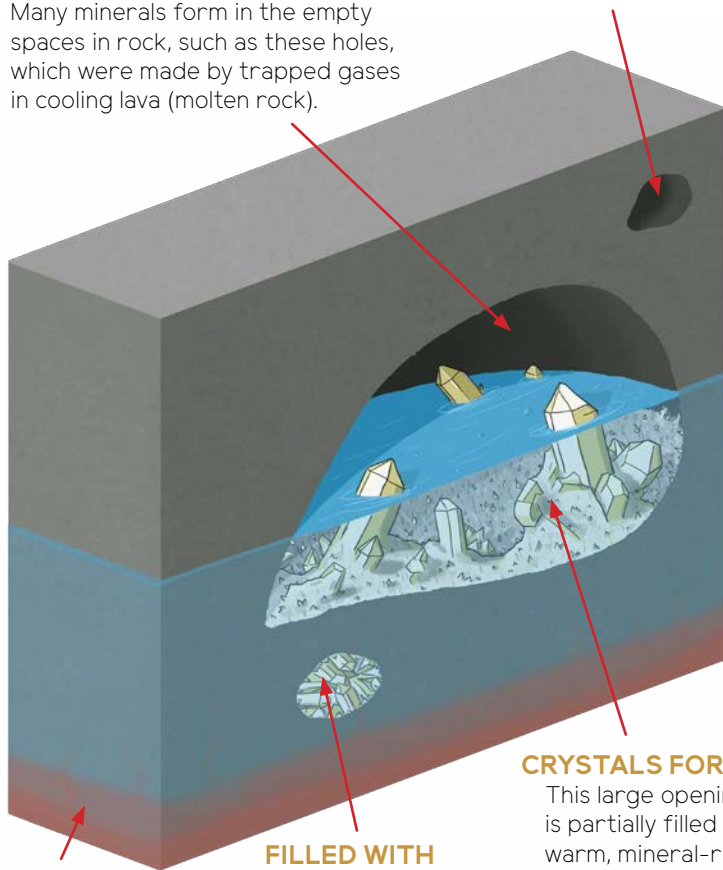
A simplified look at one of the many ways minerals form.

EMPTY SPACES IN ROCK

Many minerals form in the empty spaces in rock, such as these holes, which were made by trapped gases in cooling lava (molten rock).

NO MINERALS

No groundwater with minerals in it has reached this empty space, so no minerals are forming here.



HOT WATER

Heat from deep in the Earth warms up water and adds lots of minerals to it.

FILLED WITH CRYSTALS

This hole was small and is totally filled by mineral crystals.

CRYSTALS FORMING

This large opening is partially filled with warm, mineral-rich groundwater, so big and small crystals are forming inside.

WHAT DO MINERALS LOOK LIKE?



There are thousands of minerals in the world, but minerals are usually only found in three ways: as parts of a rock, as individual crystals, or as loose pebbles.

When you see a speckled rock with lots of different colors, look at it closely. You can see that each colored chunk is a separate grain. Those grains are minerals!

You can also find minerals as crystals. These hard shapes can often be found inside holes in rocks. Next time you find a rock with a hole in it, look inside. If you see little sparkly shapes, those are mineral crystals!



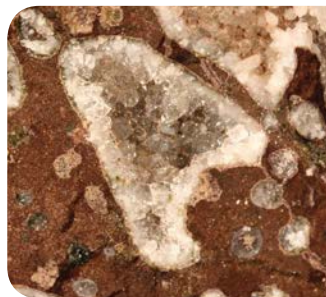
Minerals can also be found as loose pebbles. Have you ever been on a beach or at a river and found a white pebble that lets light shine through it? Or maybe you have found a black pebble that looks shiny, like metal? Those are minerals that water helped free from rock.

THE MANY FORMS A MINERAL CAN TAKE



Quartz is a very common mineral, and it forms in many ways and in many places. It also can look pretty different, depending on how you find it. When it is very well-formed, it looks like big, pointy crystals that are white and see-through.

When quartz forms in tiny openings in rock, it can look like many little, pointy, sparkly crystals all over the inside of the hole.



One of the most common ways to find quartz is as a part of rocks. This speckly, grainy rock is a kind of granite, and most of the white you see is quartz.

Another common way to find quartz is on beaches or rivers as white pebbles. Long ago, these might have been crystals, but because of weathering, this quartz has been rounded and worn down into smooth stone.



CRYSTAL SHAPES

The best way to learn about minerals is to look at their crystals. Many minerals only have one crystal shape, but others can have many different shapes depending on where they formed! Here are just a few examples.

This is calcite, and it can form as sharp, pointy crystals. But it can also form as clusters of block-shaped crystals. Or it can form in cracks in rocks. These are just three ways that calcite can form. It can have hundreds of different crystal shapes!



Glossary

BAND An easy-to-see layer in a rock or mineral.

BRECCIA A rock made up of broken pieces of other rocks that are stuck together.

COARSE Coarse rocks have mineral grains in them that are easy to see.

CONGLOMERATE A rock made up of rounded pebbles that are stuck together.

CRUST The hard, rocky outside of the Earth; the Earth's surface. This is where we live and where we find rocks.

CRYSTAL A solid shape formed when a mineral hardens. Each mineral has a different crystal shape.

CUBE A crystal shape that looks like a square block.

DULL A mineral that is not very shiny.

EARTHY A mineral that is not shiny at all and looks dusty or dirty.

EROSION When rocks or minerals wear (erode) away because of weathering.

ERUPTION When a volcano throws lava, gas, and ash onto the Earth's surface.

FACE A flat side of a crystal. Some crystals have many, many faces, and others only have a few faces, depending on the crystal shape.

FIBROUS A mineral that looks like it's made of fibers or cloth.

FINE Mineral grains that are so tiny you can't easily see them.

FLUORESCENT MINERALS Minerals that glow under a special ultraviolet light.

GEM A mineral specimen that is valuable, often brightly colored and transparent.

GEODE A round rock that is hollow inside, often with a lining of crystals.

GLASSY A mineral that is very shiny, just like glass.

GRANITIC If a type of rock is related to granite, or resembles granite, we call it “granitic.”

GRAIN The little particles of minerals inside rocks. Some can be very big, or coarse, and others can be tiny, or fine.

IGNEOUS ROCK Rocks that form when molten rock cools off and hardens; this can happen deep inside the Earth or on the Earth’s surface.

LAVA Melted rocks that have been pushed onto the Earth’s surface.

LUSTER How shiny a mineral is.

MAGMA Melted rocks that are still deep underground.

METAL Shiny, bendable minerals that form naturally, like copper.

METAMORPHIC ROCK Rocks that form when older rocks are heated up and pressed on by lots of weight; this changes the old rocks into new types.

MINERAL A substance that forms when a pure chemical hardens. Minerals form as crystals inside rocks.

MOLTEN Melted and able to flow, like liquid.

OPAQUE Not see-through; letting no light into it.

ROCK A group of minerals that formed together in a tight mass. Rocks can form inside the Earth or on the Earth's surface. There are three kinds of rock: igneous, sedimentary, and metamorphic, and they all formed in a different way.

SAND Tiny particles of rocks and minerals that have been worn down by weathering.

SEDIMENT Little particles of rocks, minerals, and even plants and animals that have been worn down by weathering. Sediments are things like sand, dust, and mud.

SEDIMENTARY ROCK Rocks that form when sediment sticks together and hardens. This mostly happens in or near water, especially lakes and oceans.

SPECIMEN A collectible piece of a rock or mineral.

TECTONIC PLATE The large sheets of rock that make up the Earth's crust. They move around and bump into each other, which causes earthquakes and volcanoes.

TRANSLUCENT Something that lets a little light through, but you still can't see through it.

TRANSPARENT Something that lets lots of light through; it is clear and see-through.

VEIN A stripe of mineral that formed inside a crack in a rock.

VOLCANO An opening, or vent, in the ground where molten rock and gas is forced upwards onto the Earth's surface.

WAXY A mineral that is a little shiny and reflects light the same way wax does.

WEATHERING When water, wind, ice, and plants break and wear down rocks and minerals.

RECOMMENDED READING FOR KIDS

Tomecek, Steve. *National Geographic Kids: Everything Rocks and Minerals*. National Geographic, 2011.

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Rocks and Mineral Journal

KEEP TRACK OF YOUR FINDS

Date:

Where I Found It:

Is It a Rock or a Mineral?:

What I Think It Is:

Date:

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Is It a Rock or a Mineral?:

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What I Think It Is:

Date:

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Is It a Rock or a Mineral?:

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ABOUT THE AUTHOR



Dan R. Lynch grew up in a rock shop, learning to identify rocks and minerals from a very young age. He has written a number of books on rock and mineral identification, with a special focus on agates from his home region of northern Minnesota and Lake Superior. He has always loved the natural world, especially all of its wonderful little details that many people don't pay any attention to, and he hopes that this book can spark young readers' curiosity about the rocks beneath their feet. Dan currently lives in Madison, Wisconsin, with his lovely wife, Julie Kirsch, and Daisy, their fluffy white cat.



Rock Collecting Is Simple and Fun!

Nature's treasures are just beneath our feet, waiting to be discovered! With this book, you'll experience the excitement of finding, collecting, and identifying rocks and minerals. Dan R. Lynch, author of many field guides, presents an introduction to our amazing Earth with easy-to-understand guidelines for collecting that the whole family will learn from and enjoy.

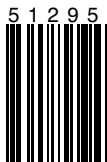
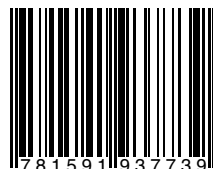
INSIDE YOU'LL FIND

- "How to" section, including details on what to look for and where to look
- Geology basics, such as where rocks come from and how Earth's surface changes over time
- Identification guide to 75 common and collectible rocks & minerals
- Full-color photographs and ID tips



This fun guide is engaging and informative as it starts children on a path toward becoming successful rock collectors!

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