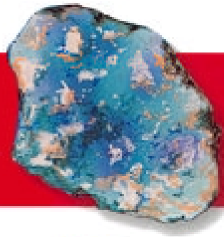
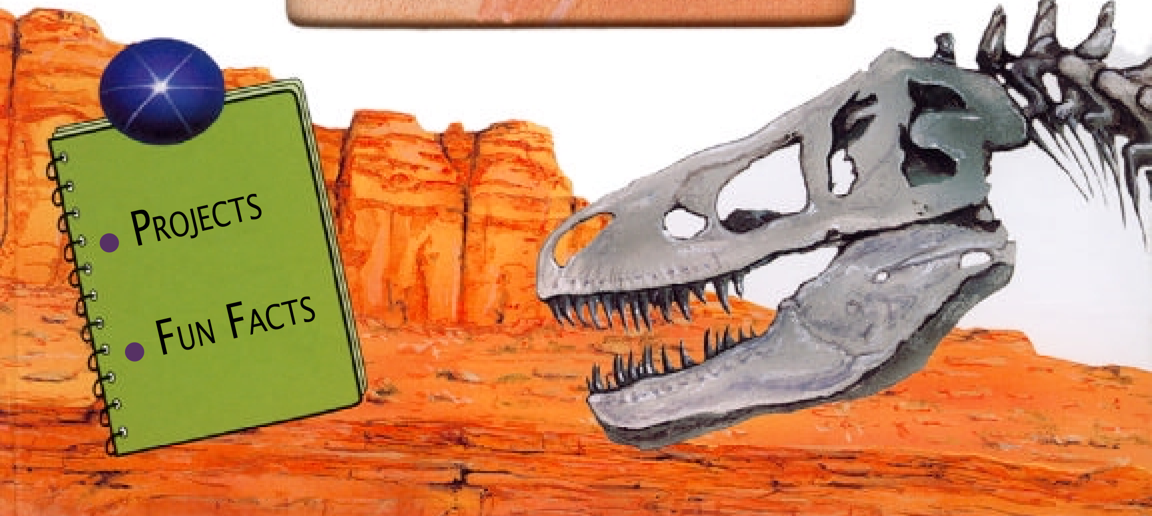


Reader's Digest Explorer Guides

DIG IT!

How to Collect Rocks and Minerals



How to Collect
Rocks and Minerals

Written by Susan Tejada
Illustrated by Steve Seymour and Ed French

DIG IT!
How to Collect Rocks and Minerals

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Contents

Go forth, under the open sky, and list
To Nature's teachings.

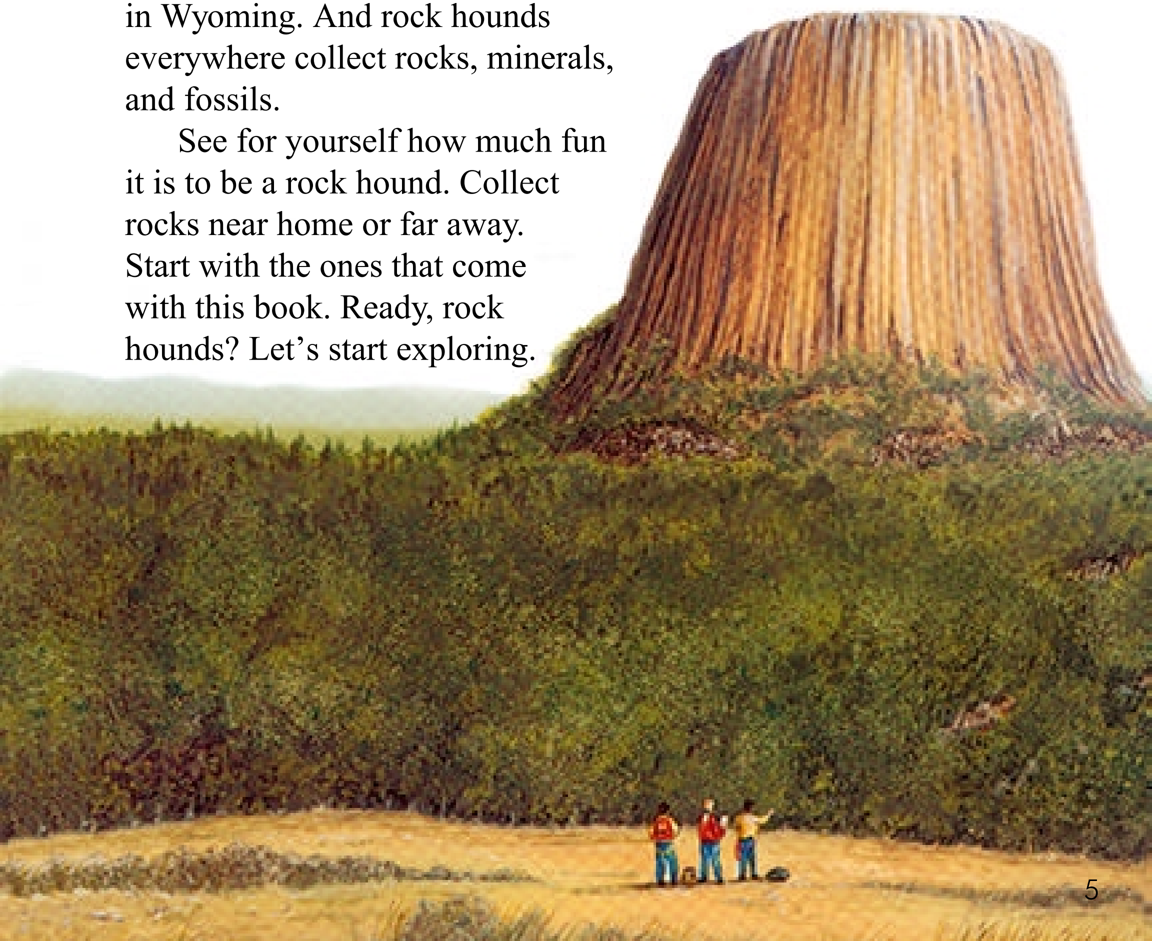
—William Cullen Bryant

Stories in Stone

Read any good rocks lately? Even though rocks don't contain words, they tell amazing stories. Did you know that long ago huge reptiles swam in a sea that covered Kansas? Or that feathered dinosaurs roamed a lakeshore in China? The Sahara Desert was once underwater. Tropical forests grew in Antarctica. How do we know? By reading rocks.

Today, people travel hundreds of miles to see beautiful rocks shaped like arches, towers, and domes. Rock climbers scramble up tall rocks like Devils Tower in Wyoming. And rock hounds everywhere collect rocks, minerals, and fossils.

See for yourself how much fun it is to be a rock hound. Collect rocks near home or far away. Start with the ones that come with this book. Ready, rock hounds? Let's start exploring.

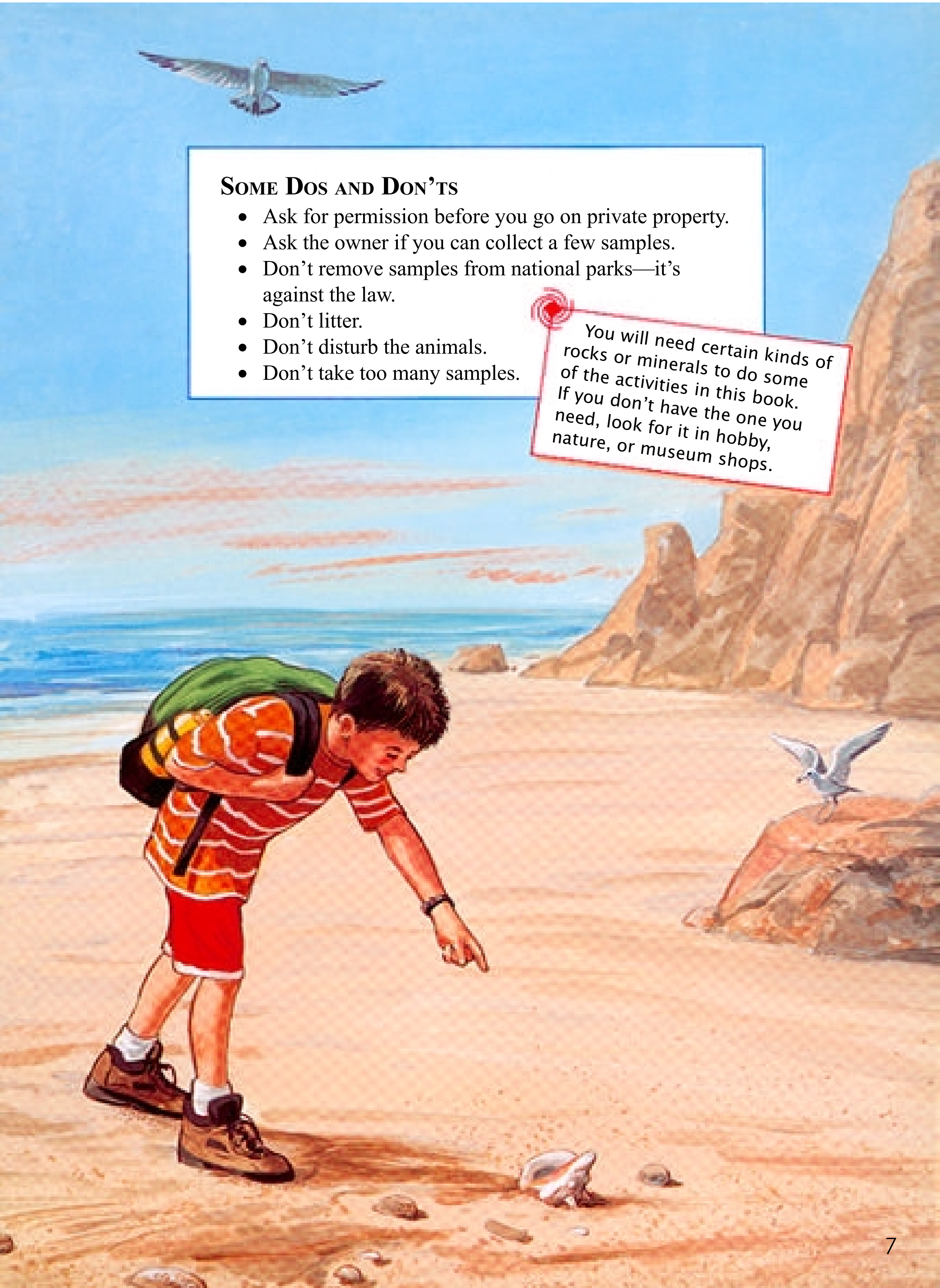


Good Places to Collect

There are lots of good places to look for rocks, minerals, or fossils. Some of the best ones are:

- The beach at low tide
- At the bottom of steep hills or cliffs
- Along rivers and streams
- Quarries
- Outcrops (bare rock sticking up out of the ground)
- Road cuts (where roads were blasted through rock)

One great way to find out about good collecting spots is to join a club for rock hounds. Ask a science teacher, librarian, or someone who works in a natural history museum for information about clubs.



Some Dos and Don'ts

- Ask for permission before you go on private property.
- Ask the owner if you can collect a few samples.
- Don't remove samples from national parks—it's against the law.
- Don't litter.
- Don't disturb the animals.
- Don't take too many samples.

You will need certain kinds of rocks or minerals to do some of the activities in this book. If you don't have the one you need, look for it in hobby, nature, or museum shops.

Gearing Up

You don't need tools to gather loose rocks. To collect pieces of larger rocks, you can use a hammer and chisel to break off samples. Carry your samples in a strong bag, such as a backpack. To protect them, wrap each one in newspaper, napkins, or paper towels. Store small samples in empty egg cartons or small boxes. You can find most of these things around your house—but always ask permission before taking or using them.

Use your brush to clean your samples. Paint a white spot on each one and write a number on it in permanent marker, then seal with clear nail polish. In a notebook, write down the number, then describe your sample.

As your rock collection grows, you'll be able to remember where and when you found each one.

You may also want to use:

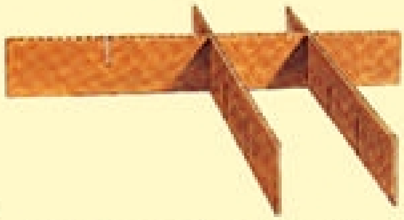
- A field guide and magnifying glass to identify samples
- A map and compass to guide you on a collecting trip
- A sieve or strainer to sift out small samples

Hold Everything

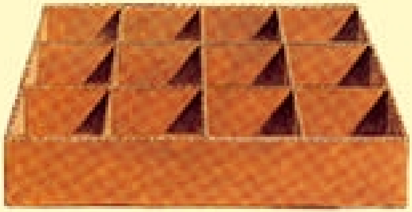
Rock collectors need a place to keep their samples and show them off. The easiest display box to make is from an egg carton lined with cotton wool (see page 8). Here's an idea for something a little fancier.

What You'll Need

A cardboard box, any size
Sheets of cardboard
Scissors
Cotton wool



What to Do



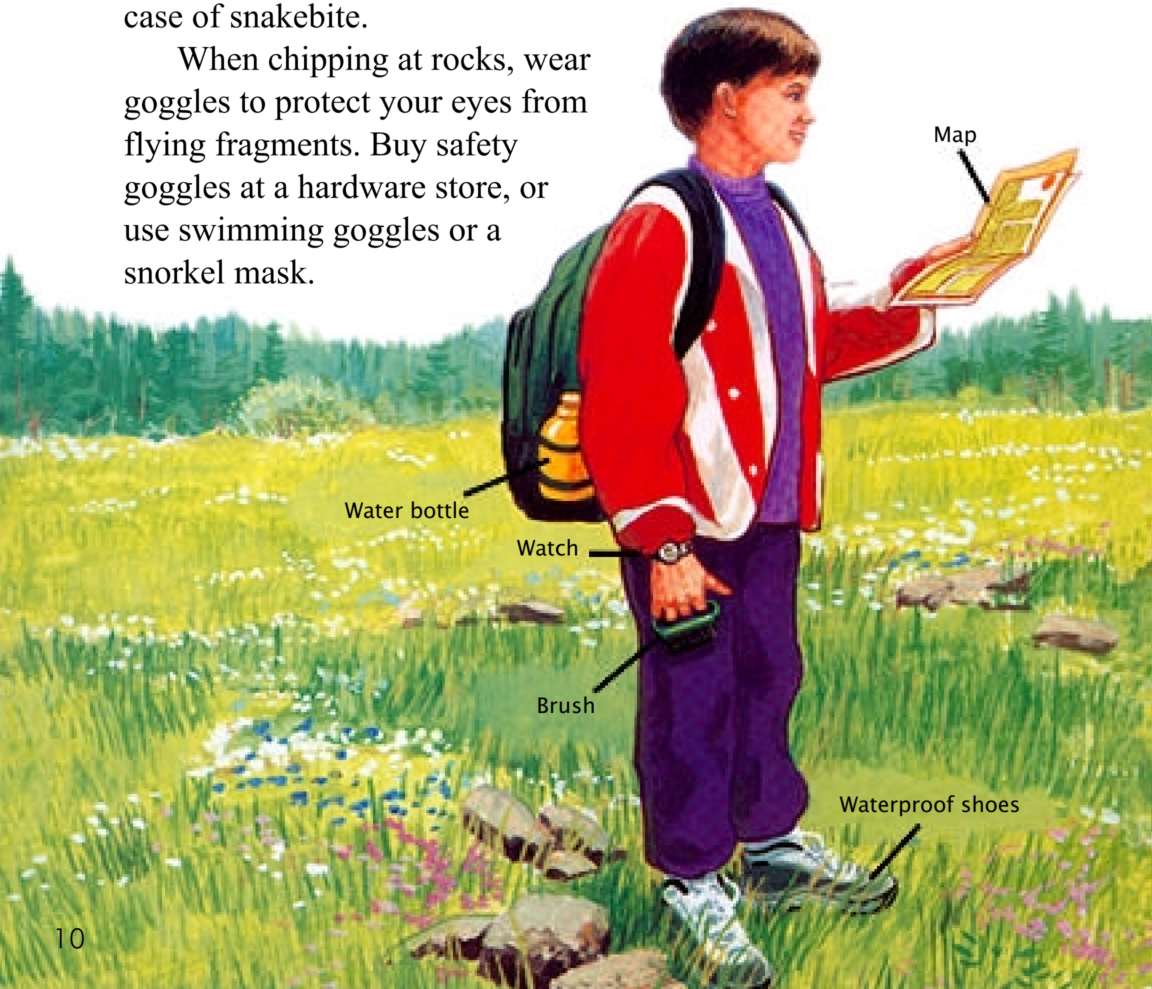
1. If the box is deep, cut it down to make it more shallow (ask for adult help).
2. Cut strips of cardboard the same depth and length as the box. Cut more strips of cardboard the same depth and width as the box.
3. Cut vertical slits along one edge of each strip, two to three inches apart.
4. Fit the strips together in a grid pattern, using the slits as notches.
5. Line the box with cotton wool, then place the cardboard grid inside, on top of the cotton.
6. Add samples!

Stay Safe

You won't be attacked by dinosaurs on a rock-collecting trip, but you might meet up with other dangers. Follow these tips for safe searching.

Don't go exploring alone. Take a grownup and a friend or two along. Tell someone else where you are going and when you expect to return. If poisonous snakes live in the area, make sure someone with you knows what to do in case of snakebite.

When chipping at rocks, wear goggles to protect your eyes from flying fragments. Buy safety goggles at a hardware store, or use swimming goggles or a snorkel mask.



Protect your head when you are working near cliffs or steep hills. Wear a hard hat such as a bike helmet. Protect your hands with sturdy work gloves and your feet with waterproof boots or shoes. Wear long sleeves and pants to protect your arms and legs from scrapes, scratches, and bug bites.

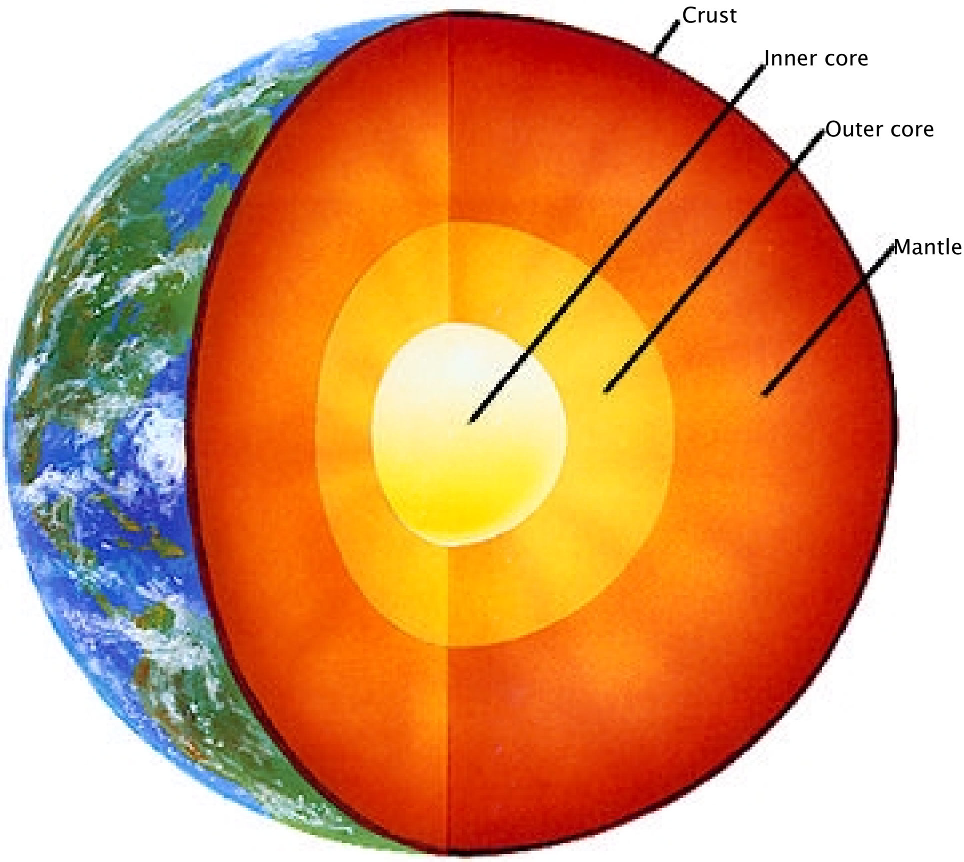
Take along water and a snack. Rock hounds need their energy! Wear a watch to keep track of the time. You will want to return before it gets dark.

LOOK OUT FOR:

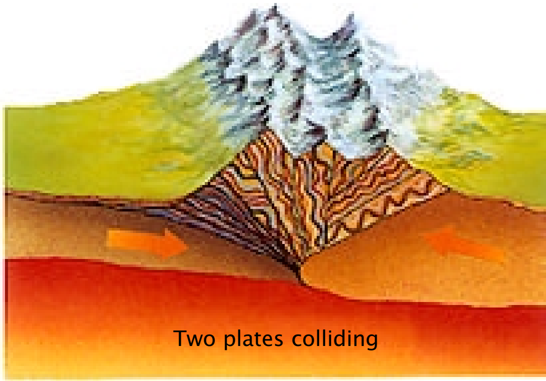
- Falling rocks! And don't climb on cliffs.
- Snakes! They often hide under or around rocks. Instead of lifting a loose rock straight up, pull it toward you with your hammer, keeping the rock between you and any snake.
- Cars! Be EXTREMELY careful if you're collecting along the side of a road.
- Deep, dark places! Don't go into caves or down old mine shafts.

Earth, from the Inside Out

If you think the ground under your feet is rock-solid, think again. At the very center of Earth lies the core. The superheated metal of the inner core is squeezed solid. But the hot metal of the outer core is liquid. The inner mantle surrounding Earth's core is solid rock. The outer mantle has a layer of partly melted rock. The thin, rocky layer that covers the mantle is Earth's crust. This is the ground we walk on as well as the ocean floor.

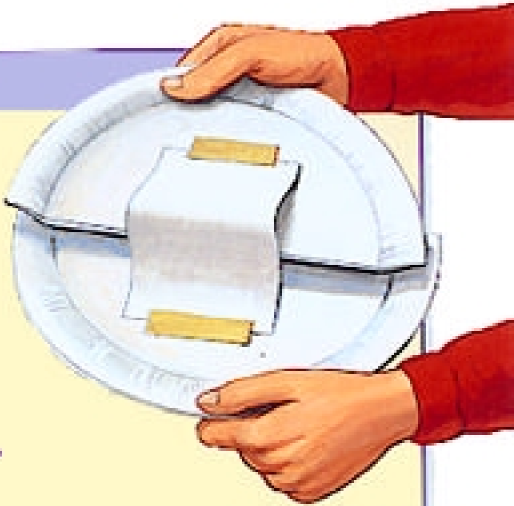


The crust is split up into huge pieces, like the pieces of a giant jigsaw puzzle. These pieces, called plates, can move up to a few inches a year. Sometimes the plates bump into each other, and one plate may slip underneath the other. Sometimes a plate cracks and produces a new ocean. Over millions of years, the movements of the plates change Earth's appearance. Land rises and mountains form. Land sinks and valleys appear. Volcanoes erupt and lava hardens, building up new land.


Two plates colliding

Making Mountains

When Earth's continents collide, pressure pushes up the land at the edges of the plates. Over millions of years, mountains form. See how this works.



What You'll Need

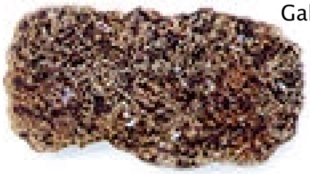
A paper plate
A piece of paper
Adhesive tape
Scissors

What to Do

1. Cut the plate in half. Each half represents one of Earth's plates.
2. Tape the short ends of the paper to each plate half. The paper is Earth's crust.
3. Now push the plate halves together, sliding one half under the other.
4. What happens? Like the piece of paper, land is pushed up into mountains, but over very long periods of time.

Dig Those Rocks

Some rocks are smooth and bright.



Some rocks are rough and speckled.

Some rocks are shiny and hard.

Some rocks are dull and fibrous.

Hundreds of different kinds of rocks exist, and they're everywhere. In fact, rocks make up Earth itself.

But what makes up rocks? Minerals. Some rocks are made up of just one mineral. Marble, for example, has only the mineral calcite in it. Usually, though, rocks contain several minerals. The rock called granite holds the minerals quartz, mica, and feldspar.

It's a Gas!

Limestone contains the mineral calcite. Find out what happens when limestone comes into contact with an acid.

What You'll Need

Glass jar
4 tablespoons of white vinegar
Small piece of limestone

What to Do

1. Pour the vinegar into the jar.
2. Drop in the limestone.
3. What happens? Why does the limestone start to bubble? Vinegar, an acid, dissolves the calcite. This releases carbon dioxide gas—the same gas that puts the "pop" in soda pop.
4. Try this activity outdoors. Carry some vinegar in a plastic bottle and dribble a few drops on different rocks. If they contain calcite, they'll start to fizz. Then use a field guide to find out what kind of rocks they are—limestone, chalk, or marble.

Rock Hall of Fame

Biggest single rock: Uluru (Ayers Rock), in Australia, is more than 1,000 feet (345 m) tall and 5½ miles (9 km) around.

Biggest rock construction: The Great Wall of China is 1,500 miles (2,400 km) long.

Longest cave system: Mammoth Cave, in Kentucky, is about 300 miles (480 km) long.

Don’t MIS This!

That’s not a MIStake. “MIS” is a code to help you remember the three kinds of rocks: **m**etamorphic, **i**gneous, and **s**edimentary. These words describe how rocks form. Geologists (people who study Earth and its rocks and minerals) use them to identify all the rocks in the world.

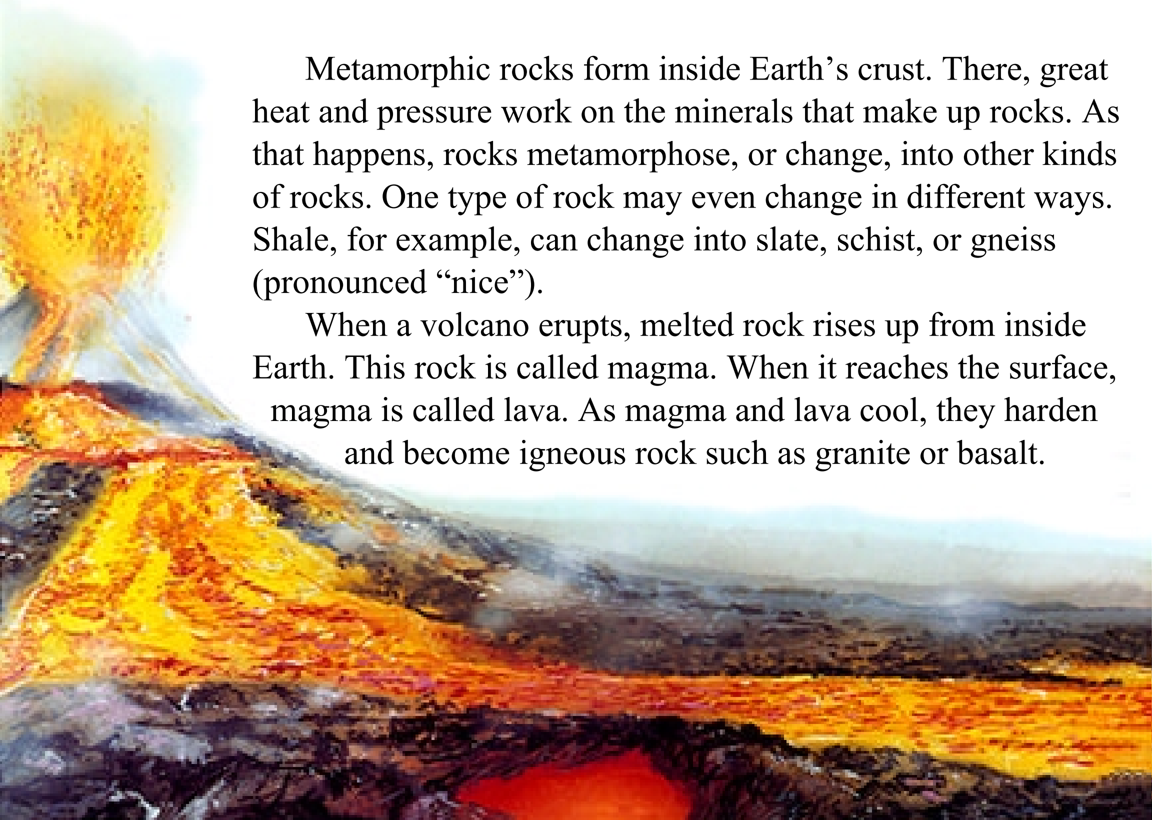

Metamorphic


Igneous


Sedimentary

Metamorphic rocks form inside Earth’s crust. There, great heat and pressure work on the minerals that make up rocks. As that happens, rocks metamorphose, or change, into other kinds of rocks. One type of rock may even change in different ways. Shale, for example, can change into slate, schist, or gneiss (pronounced “nice”).

When a volcano erupts, melted rock rises up from inside Earth. This rock is called magma. When it reaches the surface, magma is called lava. As magma and lava cool, they harden and become igneous rock such as granite or basalt.



Layered Look

When pieces of rock fall into water, the largest ones reach the bottom first. Try this activity and see for yourself!

What You'll Need

1 small scoop of soil
1 small scoop of gravel
Clear jar with a lid
Water

What to Do

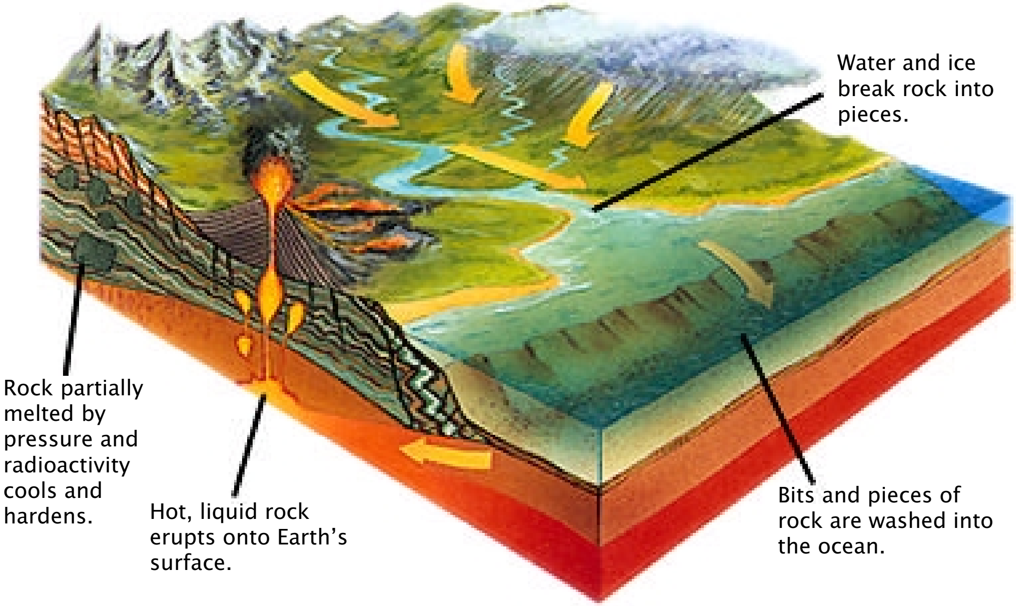
1. Put the soil and gravel in the jar and cover them with water.
2. Screw the lid on tightly and shake the jar to mix the contents.
3. Set the jar on a shelf for a day or two.
4. What happens? The largest, heaviest pieces will be at the bottom. The smallest, lightest pieces will be at the top.

Weather and water break up the rocks on Earth's surface. Streams and rivers carry the pieces into lakes and seas. There, they settle to the bottom. Over millions of years, pieces harden into rock layers. When the water level drops, the layers become dry land. This kind of rock is called sedimentary rock. Sandstone, shale, and limestone are different types of sedimentary rocks.

The Rock Cycle

The rock cycle takes millions of years. It has been going on since Earth began. And it is going on now, while you are reading this book.

Melted rock from deep inside Earth comes to the surface. It cools and hardens, becoming igneous rock. Rock falls, water, ice, and changes in temperature slowly break the rock into smaller and smaller pieces. Water, glaciers, and wind carry the pieces from one place to another. Slowly, these pieces of rock build up into layers of sedimentary rock.



Over time, the sedimentary rock gets deeply buried in Earth's crust. There, heat and pressure turn it into metamorphic rock. The metamorphic rock melts and the entire cycle begins again.

Losing Your Marbles

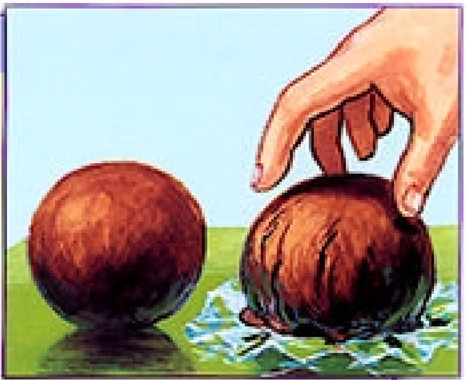
Artists like to make statues out of marble. Why? Because it's beautiful and strong. But when the statues are outside, rain—which contains some acid—slowly wears away the marble. Acid rain, a kind of pollution, has even more acid in it. Take a look at the marble statues in your town. Do they have worn-down noses, ears, or fingers? These are signs of acid damage.

Breaking Up

The cycle of freezing and thawing can break up even solid things as tough as rock. Try this project to see how it works.

What You'll Need

Modeling clay
Plastic wrap
Bowl of water



What to Do

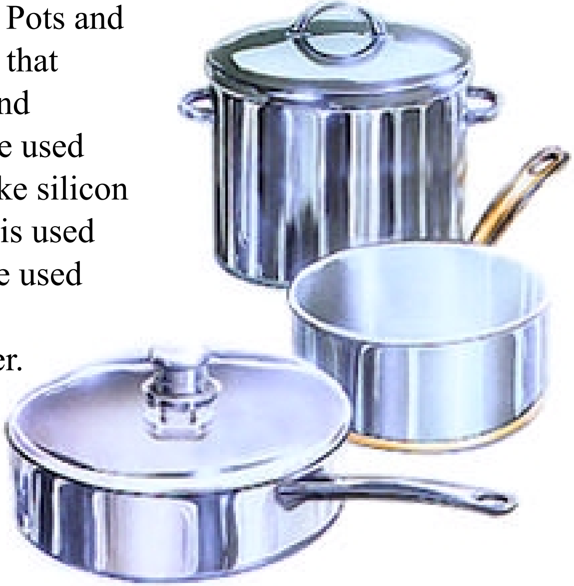
1. Divide the clay into two equal pieces.
2. Dip each piece in the water, then shape it into a ball.
3. Wrap each clay ball in the plastic wrap. Put one in the freezer and the other in the refrigerator. Leave overnight.
4. The next day, unwrap the balls. How are they different? Does the frozen one have cracks in it? If not, wet it and freeze it again.

Note: In the mountains, rock can freeze and thaw every day. Why? Because even in warm weather, the temperature can drop below freezing at night. Over thousands of years, this cycle can completely change the way the land looks.

Life with Rocks

In ancient times, people used flint (a kind of quartz) to make life easier. They shaped pieces of flint into sharp-edged axes, arrowheads, and other tools. They used rocks to make digging sticks, grindstones, and battle-axes.

Of course you don't live in ancient times. You live right here and now. But people still use rocks and minerals every day. Tall buildings are made of steel, concrete, and glass—all materials that come from rocks. Steel is made from iron, coke (a kind of coal), and limestone. Concrete is made with limestone, sand or gravel, and water. Glass is made from sand.



Look around your house. Pots and pans are made from minerals that contain metals such as iron and aluminum. Quartz crystals are used in TV transmitters and to make silicon chips for computers. Copper is used for wires. Zinc and galena are used in batteries. Sulfur is used in fertilizers, plastics, and rubber. The list of ways we use rocks and minerals is endless!

Old Paint

Long ago, people made paint from crushed rock mixed with liquid. You can do it, too.

What You'll Need

- Cardboard
- Pebbles (small rocks)
- Thin rag or old dish towel
- Hammer
- Goggles
- Small bowl
- Water
- Soap flakes (or you can use cornstarch or corn syrup)

What to Do

1. Put a piece of cardboard on the sidewalk.
2. Put the pebbles on the cardboard. Cover them with the rag to keep them from flying up.
3. Carefully hammer the pebbles to powder. Wear your goggles while doing this.
4. Put the powder in a small bowl. Add just enough water and soap to make a thin paste. Presto—paint!
5. Use your paint to color a design on a rock.

Try using different pebbles to make different colors of paint.

Space Rocks

On a clear night, you may see shooting stars in the sky. But they're not really stars, and they don't all stay in the sky. Shooting stars are really meteors. Most of them are caused by parts of an asteroid—chunks of rock that circle the sun just like the planets do. Millions of meteors are seen in Earth's atmosphere every day. But don't worry! Most of these space chunks are small and quickly burn up in the air. Only a few actually land on Earth. Then they are called meteorites.

Almost all meteorites are made of rock. Most look very much like Earth rocks. This makes them hard to find unless you see them fall. Other meteorites are made of iron, including all the giant meteorites people have ever found.

Deep Impact

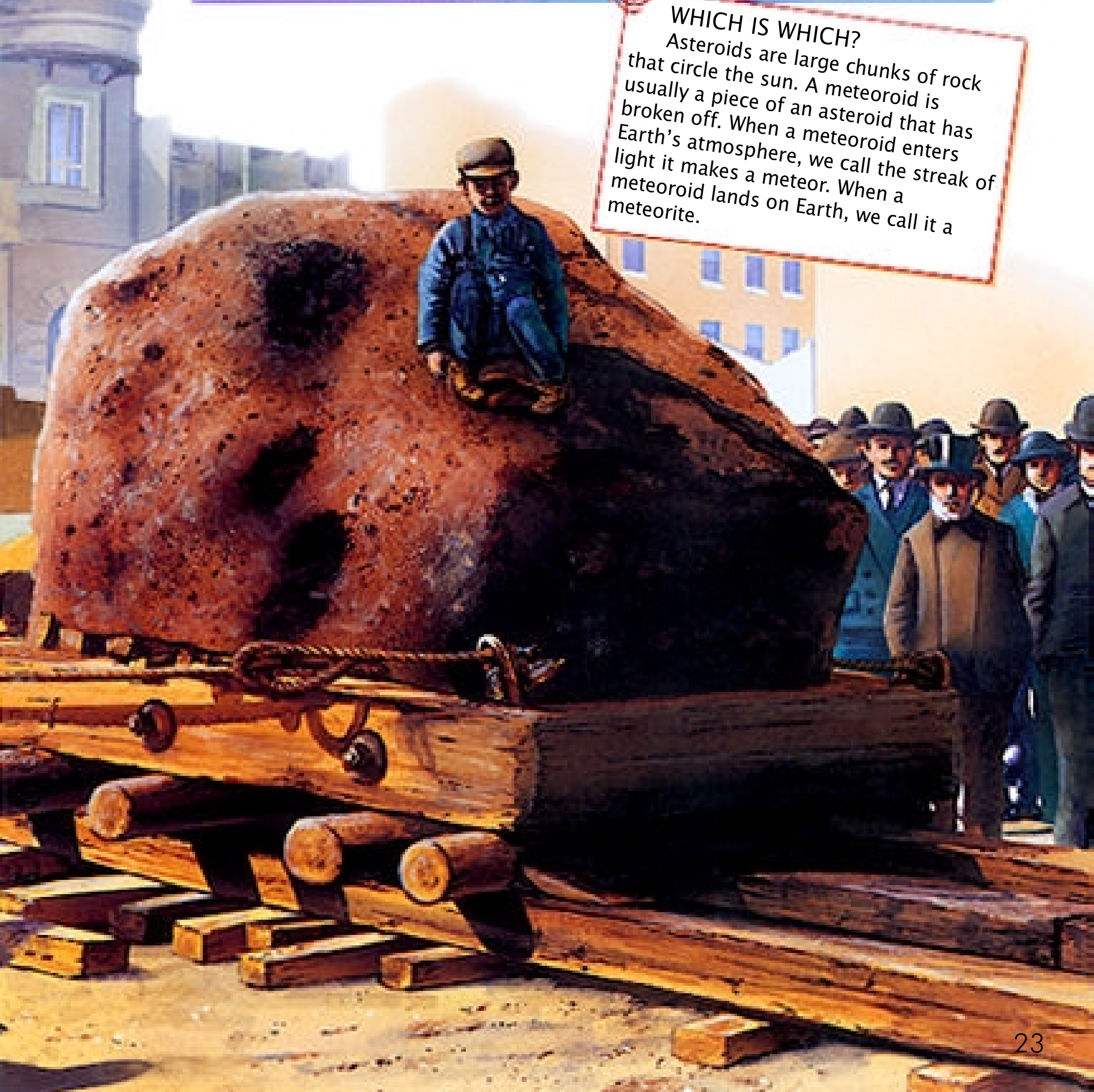
In Arizona, there's a crater that's 4,000 feet (about 1,200 m) wide and 600 feet (about 183 m) deep. How did it get there? It may have been a huge meteorite that crashed into Earth 20,000 years ago. How huge? Scientists now think it weighed about 63,000 tons (about 57,000 metric tons)—heavier than 11,000 African elephants.

Heavy Metal

Where did an isolated tribe of 19th century Eskimos get metal for toolmaking? This puzzled experts for years, but explorer Robert Peary finally found the answer in 1894—meteorites. A local guide helped him find three of these large space rocks in northwest Greenland. It took Peary years to dig out the largest meteorite, and when he finally got the rock to New York City, it took a team of 28 horses to pull it from the dock to the American Museum of Natural History! You can see it there today.

WHICH IS WHICH?

Asteroids are large chunks of rock that circle the sun. A meteoroid is usually a piece of an asteroid that has broken off. When a meteoroid enters Earth's atmosphere, we call the streak of light it makes a meteor. When a meteoroid lands on Earth, we call it a meteorite.

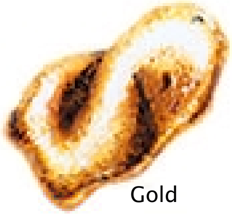


Dig Those Minerals

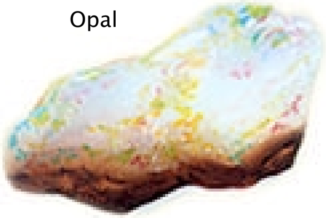
As Detective Sherlock Stones might have said, “It’s elementary, my dear rock hound.” Just as minerals make up rocks, elements make up minerals. An element is a substance made of only one kind of atom. Everything on Earth is made of elements.

Some elements, such as copper and gold, have been used for thousands of years. Other elements have been recently. Scientists have identified more than 100 chemical elements.


Copper

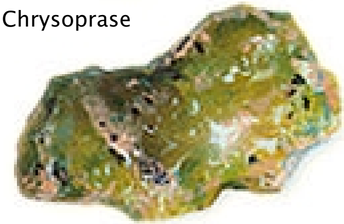

Gold

There are more than 2,500 kinds of minerals. Some have only one element. But most minerals are made up of two or more. These minerals are called compounds. The elements in compounds cannot easily be separated.

Opal


Celestite


Brazilianite


Chrysoprase


Grow Your Own Crystals

One grain, or piece, of a mineral is called a crystal. Crystals often have flat sides and a regular shape, such as a cube or a pyramid. The shape of a crystal is called its habit. A mineral may have crystals of different sizes. They usually form in one or two different shapes, but some form lots of shapes. You might even call them habit-forming!

Once you have a few starter crystals, it's easy to grow more of your own. Try this.

What You'll Need

½ cup of very hot water
Shallow bowl
2 tablespoons of salt

What to Do

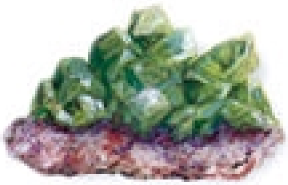
1. Put the water in the bowl.
2. Add the salt, stirring well after each tablespoon. Most of the crystals should dissolve.
3. Let the bowl sit for a while. Crystals will start to form as the water cools. Some will be visible later that day. Crystals will continue to form as the water evaporates over time.

Wulfenite

Crocoite

Almandine

Apophyllite

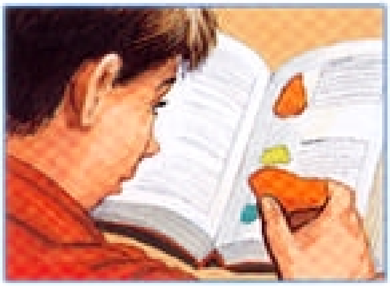


Apatite

Search for Identity

With thousands of minerals around, how can you possibly identify your samples?

Try comparing your rock samples to pictures in field guides. The same mineral can look different in different rocks. But field guides give you lots of information to help you figure out what your rock is. Here are some clues.



If you scrape your sample across an unglazed porcelain tile, what color streak does it leave? Can you scratch a piece of glass with your sample? Does your sample attract a magnet? Is it shiny? Can you see through it? Is it light or heavy? Does it break unevenly? Does it flake? The answers to questions like these will help you identify samples. And the more you identify, the better you'll get at it.

All That Glitters

Fool's gold, or pyrite, is a good mineral for streak testing. Even though the outside looks like gold, it leaves a black mark when streaked—the color of the crushed mineral. Try it yourself and see. Take a piece of pyrite and rub it across an unglazed white porcelain tile. Real gold leaves a yellow streak.

Tough Stuff

In 1824, a scientist named Friedrich Mohs invented a way to help identify minerals. It's called the Mohs Scale of Hardness. Any mineral will scratch a softer mineral. Mohs gave a number to each of 10 minerals. The higher the number, the harder the mineral. The hardest—a diamond—is a 10.

Hardness	Test mineral	Object roughly as hard as test mineral
1 (softest)	talc	lead of soft pencil (graphite)
2	gypsum	fingernail
3	calcite	copper coin
4	fluorite	iron nail
5	apatite	glass
6	orthoclase	steel file
7	quartz	sandpaper
8	topaz	emery paper
9	corundum	no household equivalent
10 (hardest)	diamond	no household equivalent

Use this scale to test your own samples for hardness. Try scratching the bottom of one of your samples with sandpaper. If it leaves a mark, your rock is softer than sandpaper and probably softer than quartz.

Razzle-Dazzle

If someone says, “You’re a gem,” it means you have wonderful qualities—just like a gemstone! Out of all the minerals on Earth, only about 70 are gemstones.

Diamonds, pearls, and emeralds are three kinds of gems. Jewelers use gems in necklaces, bracelets, and other ornaments. Kings and queens wear them in crowns. Why are gemstones so popular? Because they are beautiful and rare.

The more rare a gem is, the more it’s worth. Rubies and sapphires are the same mineral. In rubies, this mineral is mixed with some chromium, which makes the crystals red. There are not as many rubies as there are sapphires, so rubies are usually worth more.

More common gemstones are also prized for their beauty. But because they are not as rare, they are less valuable. These are called semiprecious gems. Garnet, tiger’s eye, agate, and jasper are just a few of the semiprecious gems.

Happy Birthday!

Birthstones were born in the 1700s. That's when people in Poland started to wear gems that were "matched" to their birthdays. The birthstones we use today were chosen by a group of American jewelers in 1912.

Treasure Hunt

Some rock mines are open to the public. For a fee, you can search for gemstones—either in the mines or in buckets of stones that have been collected from the mines. Here are a few you may be able to visit one day.

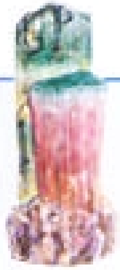
- For diamonds: Crater of Diamonds State Park, Murfreesboro, Arkansas
- For rubies: Jacobs Ruby Mine, Franklin, North Carolina
- For topaz: Topaz Gem Mine, Colorado Springs, Colorado
- For garnets: Red Rock Mine, Alder, Montana

Ask a science teacher or someone who works at a natural history museum if there are any others near you.

Living Gems

Most gemstones are minerals. But some gems are made by plants and animals. These are called organic gemstones.

In the movie *Jurassic Park*, a piece of amber holds the key to bringing back the dinosaurs. Amber is an organic gemstone. It begins to form when sap oozes out of a tree. Over millions of years, the sap hardens into stone. How do we know what prehistoric plants and insects looked like? They may be perfectly preserved in a piece of clear golden amber.

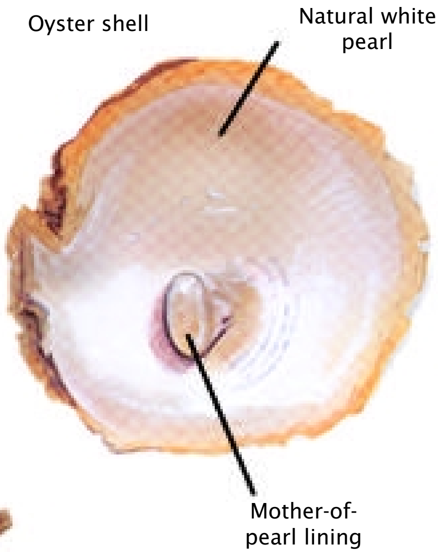


Mineral Hall of Fame

- Most common mineral: quartz
- Hardest mineral: diamond
- Mineral with greatest color range: tourmaline

Animals make gemstones, too. Oysters and other shellfish make pearls. When a grain of sand gets inside an oyster's shell, it may cover it with nacre (pronounced "NAY-ker"). Over time, the nacre will build up and into a pearl. Coral is made from the skeletons of tiny sea animals called coral polyps.

Red coral



Strange and Unusual Minerals

What could be strange and unusual about minerals? Plenty! Azurite, for instance, looks like a bunch of grapes. Stibnite forms spiky crystals. Geodes are plain-looking balls of rock with a surprise inside. Crack one open and you might find quartz crystals surrounded by layers of agate. And at room temperature, mercury isn't even solid—it's a liquid! Some minerals can take different shapes at different times. Take staurolite. This mineral is also called fairy stone when it comes in the shape of a cross. Why? Legend has it that fairies wept when they heard of Christ's death, and their tears turned into crosses. In fact, heat and pressure cause the crystals to grow at right angles to each other.

You're not seeing through this ulexite. Its fibers work like a little TV monitor, sending the image to its surface.

Azurite comes in many shapes, but it's always a deep blue (azure) in color.

Mercury (the silvery balls) is used in thermometers. It expands even when there's a slight increase in temperature.

Attractive Minerals

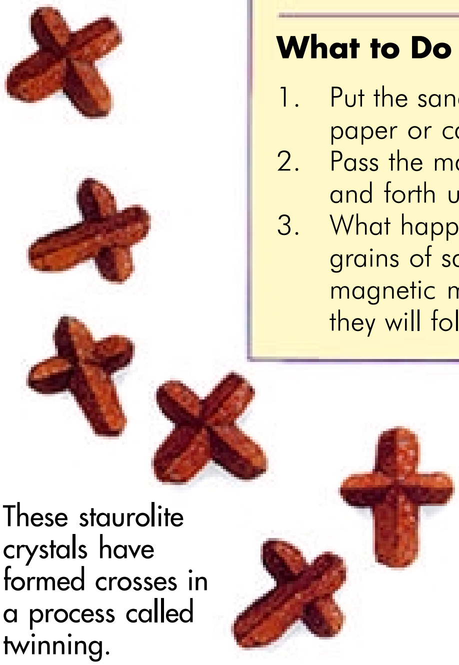
Some minerals, such as magnetite and pyrrhotite, are magnetic. This means they have iron in them and will stick to magnets. Try this activity and see if you can find some magnetic minerals.

What You'll Need

About 2 tablespoons of sand
A piece of thick paper or cardboard
A magnet

What to Do

1. Put the sand on the paper or cardboard.
2. Pass the magnet back and forth underneath.
3. What happens? If any grains of sand contain magnetic minerals, they will follow the magnet.



These staurolite crystals have formed crosses in a process called twinning.

Spiky stibnite is an ore of the metal antimony. This sample has a needlelike habit.

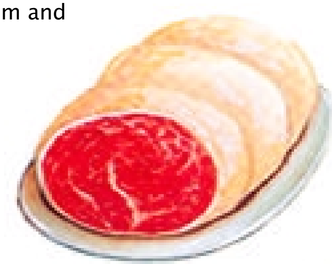
Geodes form in igneous or sedimentary rock. Water seeps inside hollows left by gas bubbles. Minerals in the water then form layers of crystals on the walls.

Eat Your Minerals!

Minerals are found in more places than rocks. Your teeth are made of the mineral apatite. Your body stores minerals too. You get the minerals you need from the food you eat. Milk and cheese contain calcium, which hardens your teeth and bones. Meat and some vegetables contain iron, which helps your blood cells make hemoglobin, a substance needed to carry oxygen to other cells. Your nerves need sodium to do their job. You can get it from salt. You also need potassium, iodine, and zinc to help keep you healthy.

Hot chocolate has calcium and iron.

Beef is high in iron.



Bananas have a high potassium content.

Salt is the common name for sodium chloride.

Fish is a good source of iodine.

Milk and cheese contain calcium.

Your bones store a reserve supply of minerals. If you could not get the food you need, parts of your body, such as your nerves and blood, would use the minerals stored in your bones. But once the minerals were used up, you would need to get more from food.

PUTTING SALT ON THE TABLE
Your saltshaker holds one of the world's most prized minerals: salt, or sodium chloride. Salt helps our bodies stay healthy, tastes good, and keeps food from spoiling. People value salt. In fact, they value it so much, they have even used it for money.

You need only a tiny amount of these minerals every day. But without that small amount, your body wouldn't work the way it should.

Bone-Bender

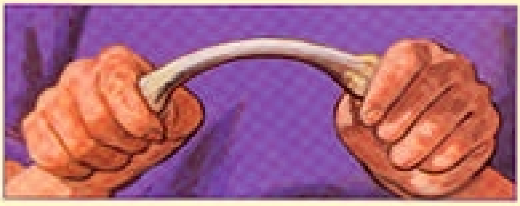
Bones get their hardness and strength from a mineral called calcium. What happens when the calcium is changed? Try this and see.

What You'll Need

The leg bone from a chicken
A glass or jar
White vinegar

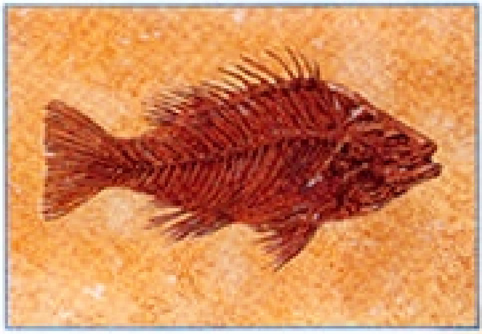
What to Do

1. Remove as much meat as you can from the bone.
2. Put the bone in the jar and cover it with vinegar.
3. Replace the old vinegar every few days with new vinegar.



4. After one or two weeks, remove the bone. Try bending it. What happens? You should be able to bend the bone without breaking it, because the vinegar changed the calcium so that it no longer makes the bone stiff.

Dig Those Fossils



One day millions of years ago, an animal died. Today, you find a fossil of that animal. How did this happen? And what is a fossil, anyway?

After it died, the animal may have been washed into a sea, lake, or river, and covered over by mud. The soft parts of its body decayed, but the skeleton remained. Over a very long time, layers of mud piled up, packed together, and turned into rock. As the skeleton fell apart, it left its imprint in the rock. In other cases, a mineral-rich liquid seeped into the animal's skeleton, turning the bones into rock. Both the imprint and the skeleton-turned-rock are fossils. Imprints of ancient animal tracks and plants are fossils, too.

How did these fossils get from under all that rock to the ground beneath your feet? When Earth's crust shifted, the fossils were pushed up to the surface. Over time, wind and water wore away the rock around them. At last the fossils lay exposed—ready for you to discover them.

Most plants and animals of long ago decayed and disappeared completely. Only a few survived as fossils. Without them, scientists would have little idea of what Earth was like before we were around to observe it.

Press Time

Some fossils formed when living things left an imprint in ancient mud. You can see how it works for yourself.

What You'll Need

Clay that air-dries
A shell or leaf
Paintbrush
Brown shoe polish
Acrylic spray

What to Do

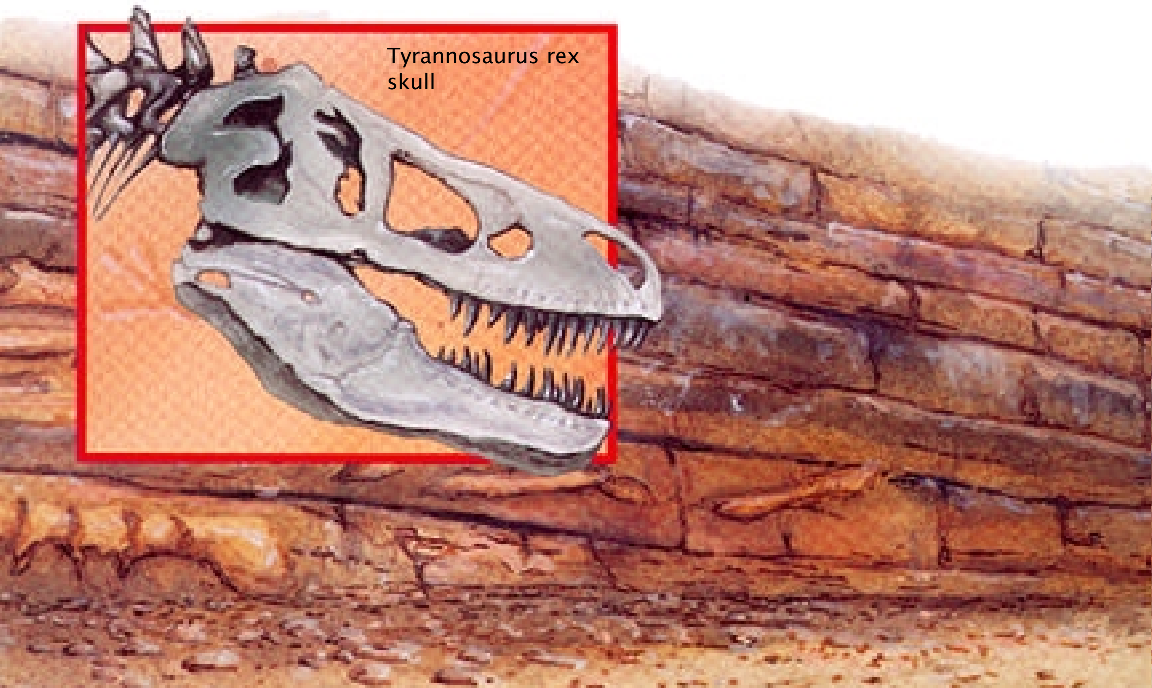
1. Press a piece of clay until it's flat.
2. Press the shell or leaf into the clay, then remove it. (If you prefer, press your hand or your foot into the clay instead.) The imprint you make is like a mold of a fossil.
3. Let your "fossil" dry.
4. Brush it with brown shoe polish.
5. When the shoe polish dries, spray your fossil with clear acrylic for a protective finish.

As Old As the Hills

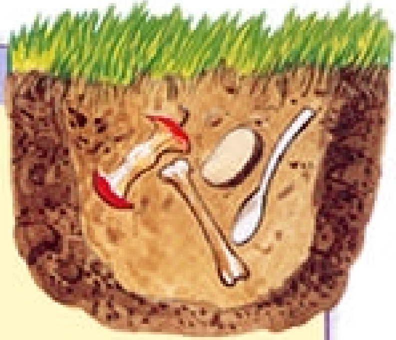
Fossils tell us about early life on Earth. They also tell us about the Earth itself. In most sedimentary rock, the lower the layer, the older the rock—and the older the fossils inside it. Scientists can tell how old the rock is by studying the fossils.

Some fossils are found in many layers of rocks. This shows that the kind of plant or animal that made the fossils lived for a very long period of time—time enough for all the layers of rock to build up.

Some fossils appear in only a few layers of rock. This kind of plant or animal lived only as long as it took for those layers to form. These fossils are called index fossils. When an index fossil appears in rock layers far away from each other, it means that those rocks are the same age.



Falling Apart



Some parts of plants and animals take longer to decay than others. You can see for yourself by trying the activity below.

What You'll Need

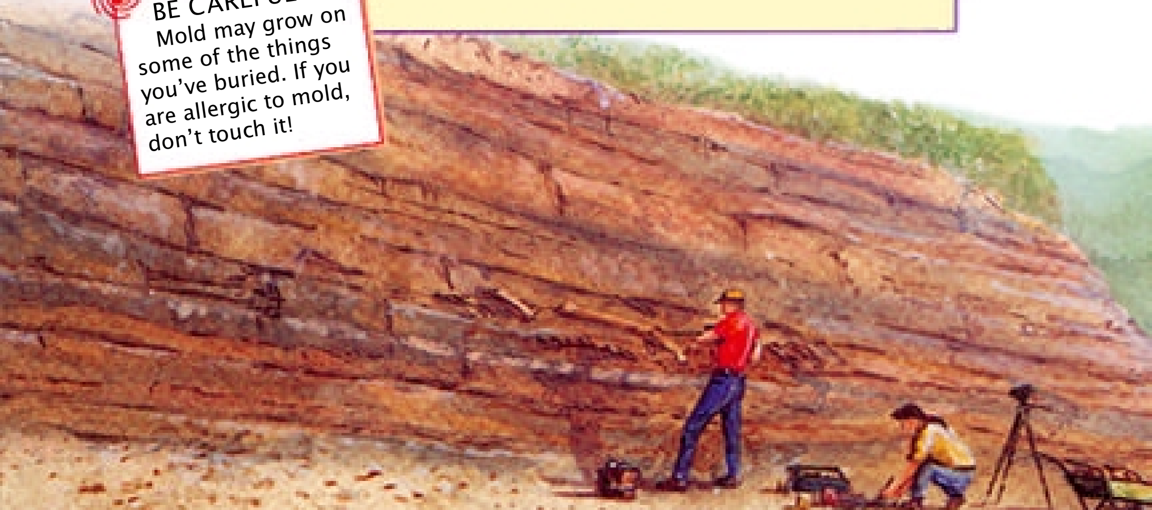
A small shovel
A piece of fruit or vegetable
(try an apple core or a thin slice of potato)
A leftover chicken bone with some meat still on it
A small plastic fork or spoon

What to Do

1. Dig a shallow hole (about 6 inches/15 cm deep) in a sunny place outside.
2. Bury the fruit or vegetable, bone, and plastic in the hole. Keep the soil slightly damp.
3. Check the things you have buried once a week for two to three weeks.
4. What happens? Like a dead animal's soft tissue, the meat and fruit or vegetable will start to decay. Like a dead animal's hard parts (teeth, bone, shell), the plastic and bone will last for a longer time.

Note: If you don't have anyplace to do this activity outside, you can do it indoors. Just use potting soil and a large container, such as a plastic milk jug. Ask an adult to cut off the top part of the jug.

BE CAREFUL
Mold may grow on some of the things you've buried. If you are allergic to mold, don't touch it!



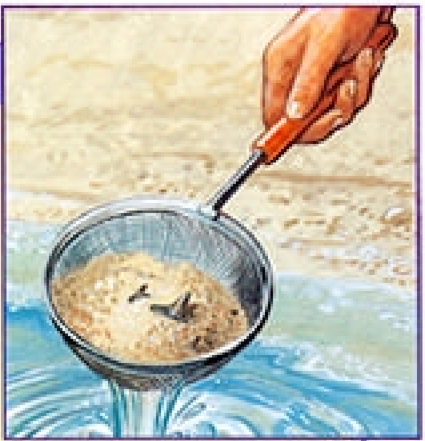
A Fossil in a Haystack

Finding a fossil may seem as hard as finding a needle in a haystack. But rock hounds do find them. Here are some hints for getting started. (See pages 6–7 for more tips.)

- Try looking around sedimentary rock, like limestone, chalk, sandstone, and shale.
- Look for outcrops—bare rock you can see though it's still in the ground.
- Try to spot fossils that are not the same color as the surrounding rock, or that stick out from the ground a bit. Feel the surface. Many fossils are a different color and texture than the rock around them.
- Some sedimentary rocks contain hard rounded lumps called nodules. Crack a nodule against a rock to open it or use your hammer. But be careful! It may have a fossil shell inside.
- Look for things such as shell ridges that identify a fossil.

The most common fossils are of small shellfish—snails, scallops, clams, and trilobites. If you're lucky and find a big dinosaur footprint or a whale jawbone, call the natural history museum near you.

Fossil Teeth



Most sharks grow and shed thousands of teeth during their lives. This means that fossilized shark teeth are fairly common. Look for small, triangular fossil shark teeth in places near the ocean. Dip a sieve, screen, or strainer into the water. Let the sand filter through the screen, then pick carefully through what's left. Here are a few good places to look for ancient shark teeth:

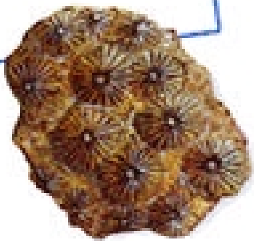
California:	San Pedro Sands in San Pedro, and Topanga Canyon in Topanga
Florida:	Venice Beach in Venice
Maryland:	Calvert Cliffs State Park and Flag Ponds Nature Park in Lusby
New Jersey:	Shark River Park in Neptune and Holmdel Park in Holmdel
South Carolina:	Edisto Beach State Park in Edisto

Fossil Hall of Fame

Largest fossil shark teeth: About 7 inches long, from Carcharocles megalodon, found in South Carolina

Longest complete dinosaur skeleton: 87.5 feet long, from Diplodocus carnegii, found in Wyoming

Dinosaur footprints



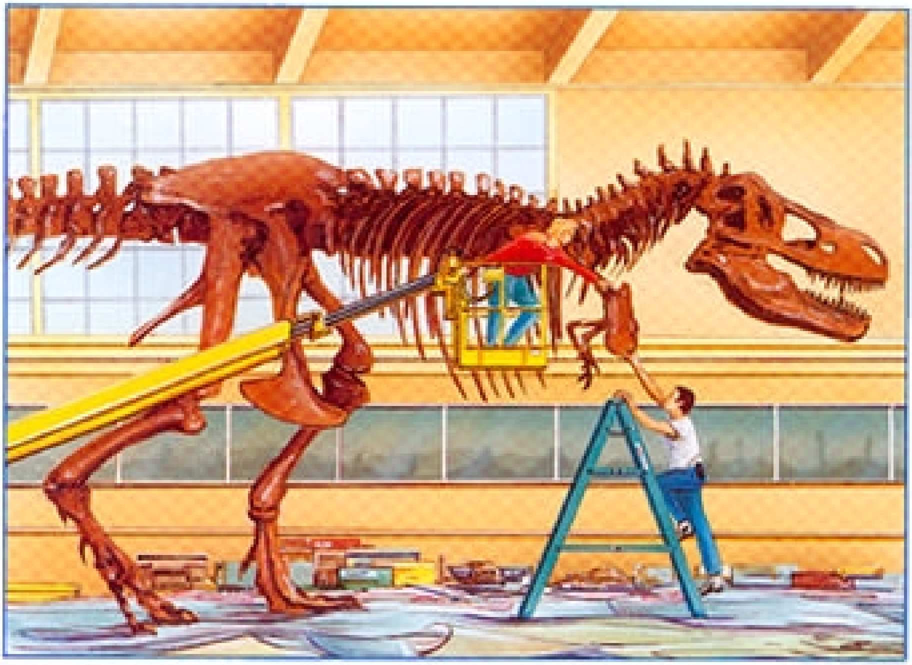
Coral

Trilobite

Whale jaw

A Piece of the Rock

Someday you may find a large or unusual fossil. If you find such a fossil, don't try to dig it out. Leave it as you found it. If you can, take a photograph of it. Then call a natural history museum. Tell a paleontologist (a person who studies fossils) about your find. Send the photograph.



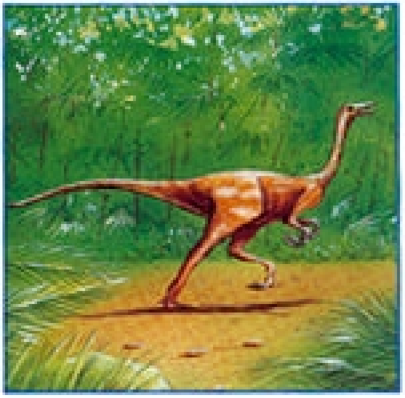
Digging out large or unusual fossils is a job best done by experts. They have the tools and the skill to do it without harming the fossil. First, they will partially expose the fossil from the rock. Next, they will make a map showing the place of each bone. Then they may cover the fossil and the rock with plaster. This will help protect it while they move it to a laboratory.

There, scientists will carefully remove any remaining rock. To do this, they may use chemicals, dentists' drills, or even small paintbrushes. They may use special glue or plastics to make sure the fossil bones don't crumble. Last, they will try to put the bones back together just the way they were when the animal was alive. Now the fossil is ready for further study.

IN LIVING COLOR

Were dinosaurs electric blue? Did they have spots? Did they have stripes? No one knows for sure. Fossils of dinosaur skin show that it was scaly and, in some cases, armor-plated. But the fossils don't show what the skin color was. Scientists can only guess.

Rock Stars



Name: Mary Anning
Home: England
Claim to fame: In 1811, when she was 12 years old, Mary Anning made an amazing discovery. She found the first whole fossil of an icthyosaur (a sea reptile) on the south coast of England. She also found fossils of a pterosaur (a flying reptile). Some of her finds are on display at The British Museum (Natural History) in London.

Name: Stephen Hews
Home: Canada
Claim to fame: In 1995, when he was eight, Stephen Hews found fossilized dinosaur footprints. There were seven of them near a river in Alberta, Canada. The footprints belonged to an ornithomimid (an ostrich-like dinosaur). You can see a model of part of the trackway at Alberta's Royal Tyrrell Museum of Paleontology.

Downtown Fossils

Fossils can show up where you least expect them—in office buildings!

Limestone is a sedimentary rock mostly made of calcite. This is the same mineral found in the shells of sea animals. In fact, limestone often contains the fossils of sea animals. What does this have to do with office buildings? Limestone is often used to build offices, banks, and other public buildings. Next time you're in the library, check out the walls and floors. You just might see a fossil!

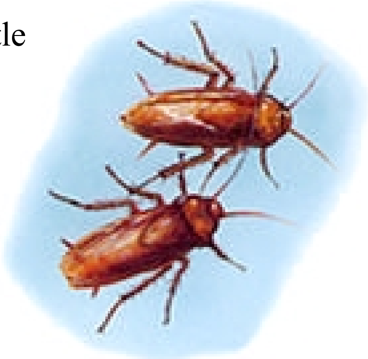
Don't Forget Your Rubbings!

You can collect "downtown fossils" by making rubbings of them. It's easy! Peel the paper off a dark-colored wax crayon. Hold a piece of thin paper over the fossil. Rub the side of the crayon back and forth over the paper in one direction until you see the outline of the fossil. Write the date and place of each rubbing on the paper.

More Great Places to See Fossils

	MUSEUMS
California:	Los Angeles Museum of Natural History George C. Page Museum, Los Angeles
Colorado:	Denver Museum of Natural History, Denver
Illinois:	Field Museum of Natural History, Chicago
Massachusetts:	Harvard Museum of Comparative Zoology, Cambridge
New York:	American Museum of Natural History, New York City
Pennsylvania:	Carnegie Museum of Natural History, Pittsburgh
South Dakota:	The Mammoth Site, Hot Springs
Utah:	Utah Museum of Natural History, Salt Lake City
South Carolina:	Bob Campbell Geology Museum, Clemson
Washington, D.C.:	Smithsonian Institution, National Museum of Natural History
	PARKS
Arizona:	Petrified Forest National Park, Holbrook
Colorado:	Dinosaur National Monument, Dinosaur Florissant Fossil Beds National Monument, Florissant
Connecticut:	Dinosaur State Park, Rocky Hill
Oregon:	John Day Fossil Beds National Monument, units near Mitchell, Clarno, and Dayville
South Dakota:	Badlands National Park, Fossil Exhibit Trail, Interior
Wyoming:	Fossil Butte National Monument, Kemmerer

Old-Timers

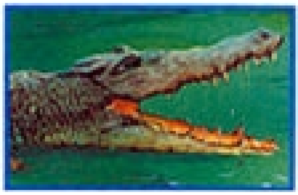


What do you think when you see a cockroach? Would you think such a little insect could outlive the dinosaurs? Dinosaurs ruled the Earth for about 160 million years. But they all died out 65 million years ago. The cockroach, however, was around when the first dinosaur showed up. And when the last one died. In fact, cockroaches have been running around on Earth for more than 320 million years—and they're still going strong! The cockroach has survived for so long, it's called a living fossil. It even looks about the same now as it did millions of years ago.

Here are some other living fossils to look for.

Ginkgo trees
(200 million years)

Turtles
(220 million years)



Crocodiles
(220 million years)

Horseshoe Crabs
(250 million years)

Dragonflies
(300 million years)

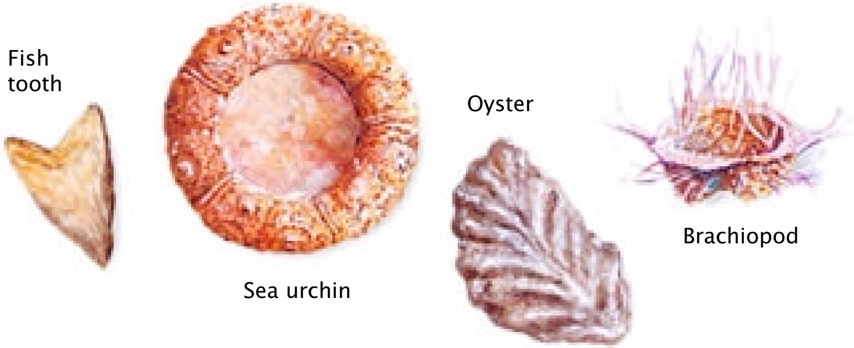
Watch the Birdie!

Are birds living fossils? Some scientists think so. In 1861, a fossil of the oldest known bird was first found in Germany. It lived 155 million years ago. *Archaeopteryx* (pronounced "ar-kee-OP-ter-ix") had feathers and a wishbone. But it also had teeth, claws, and a tail like a reptile. In the late 1990s, two new kinds of dinosaur were discovered in China. And they both had feathers. Both lived more than 120 million years ago. One of them could probably fly. What does this mean? It means the dinosaurs may still be alive today—in the form of birds.

Amazing Fossils

Before people knew what fossils were, they had some strange ideas about them.

- Fish teeth fossils were called toadstones because people thought they came from the heads of toads.
- Sea urchin fossils were thought to come from the sky. Called thunderstones, they were thought to keep milk from turning sour.
- Brachiopod fossils, ground and baked, were said to cure stomach and eye problems.
- Oyster fossils were thought to be the devil's toenails!



Glossary

compound: A molecule or chemical made up of more than one element.

crust: Earth's thin, rocky outer layer. It includes the ground you walk on and the ocean floor.

crystal: One grain of a mineral that may have a regular shape and smooth sides.

element: A substance made of only one kind of atom.

field guide: A book with facts and pictures that is used to identify different kinds of animals, plants, rocks, shells, and other things in nature.

fossil: Imprints made by ancient plants or animals, or preserved parts of plants and animals. An index fossil appears in only a few layers of rock. These help scientists figure out the age of similar rock layers far away.

geology: The study of Earth. A person who studies geology is a geologist.

habit: The shape of a crystal or a group of crystals.

igneous rocks: Rocks that form when lava or magma cools and hardens.

inner core: The solid metal center of Earth.

lava: Magma that has broken through (erupted) onto Earth's surface.

magma: Hot liquid rock that is located beneath Earth's surface.

magnet: An object that attracts iron-bearing objects.

mantle: The layer of Earth between the core and the crust.

metamorphic rocks: Rocks that are changed by intense heat and/or pressure.

meteor: A streak of light caused by a lump of space rock entering Earth’s atmosphere. The rock itself is known as a meteoroid. When it lands on Earth’s surface, it is called a meteorite.

mineral: A natural substance that is not a plant nor an animal.

Mohs Scale: A list of 10 minerals ranked in order of hardness. The higher the number, the harder the mineral. Testing the hardness of a mineral helps to identify it.

ore: A rock or mineral that contains enough metal to be worth mining.

outcrop: The part of a rock formation that sticks up out of the ground so it is easy to see.

outer core: The hot, liquid metal layer of Earth surrounding the inner core.

paleontology: The study of ancient plant and animal life. Someone who studies paleontology is a paleontologist.

plate: A piece of Earth’s crust attached to the hard outer part of the mantle.

road cut: Places where roads have been blasted through rock.

rock: A natural solid made of minerals or rock fragments.

rock cycle: The constant recycling of Earth materials that causes metamorphic, sedimentary, and igneous rocks to form.

sedimentary rocks: Rocks that form when bits and pieces, or sediments, from other rocks or mineral solids build up and harden over many years. Sedimentary rocks may contain plant or animal fossils.

streak test: A test that involves scraping a mineral across an unglazed porcelain tile. The color of the mark it leaves can help identify the mineral.

volcano: An opening in Earth’s crust through which lava erupts.

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