The Mammoth Site
Division of Education

Rocks, Minerals, and Fossils

OH MY!

ACTIVITY BOOK

The Mammoth Site of Hot Springs

Mission Statement

Our mission is the preservation, research, and interpretation of The Mammoth Site of Hot Springs, South Dakota, and development of a broad understanding of the Late Ice Age record across a global framework.

Vision

The Mammoth Site is at the forefront of Quaternary research, with a strong emphasis on the study of mammoths and their relatives. Additionally, we aspire to be a leader in scientific education and outreach, with a strong emphasis on educational and public programming, exhibits, and publications. We foster global scientific collaboration through on-site and related field research, and peer-reviewed scientific publications. To continue to be a primary leader in the scientific community, the long-term preservation and curation of The Mammoth Site is essential.

Purpose

- To provide comprehensive educational and public education concerning the Quaternary (Ice Age) record, with an emphasis on The Mammoth Site and surrounding northern Great Plains; and other locales around the globe
- To serve as a world-class center specializing in mammoth and Quaternary research;
- To investigate and interpret The Mammoth Site of Hot Springs, South Dakota;
- To protect, preserve, and manage collections housed at The Mammoth Site of Hot Springs, South Dakota;
- To foster global cooperative efforts in Quaternary research.

Rocks, Minerals, and Fossils OH MY!

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2019

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Activity 1

Digging In!

Have you ever wondered what the earth is made of? Do you want to know why rocks have assorted colors, textures, and sizes? Sometimes the best way to understand something is to just “dig in.”

Keep safety in mind. Always ask an adult to join you when you rock hunt.

Learning Outcomes
Project skill: Collecting rocks
Life skill: Keeping records
Educational standard: NGSS 2-ESS1-1: Use information from several sources to provide evidence that Earth events can occur quickly or slowly.
Success indicator: Find and log in at least eight rock and five mineral samples in field journal.

What To Do

Explore the area around where you live and collect at least eight rocks, and five minerals. Find rocks that are different from each other. Always ask for permission to hunt for rocks and minerals on private property and public lands.

Keep the following tools handy when you collect rocks. Use a backpack or tote bag to carry them. You might want to take photos of a rock sample's original setting, or other sites to review later so bring a camera or smartphone.

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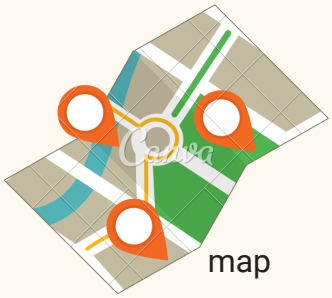
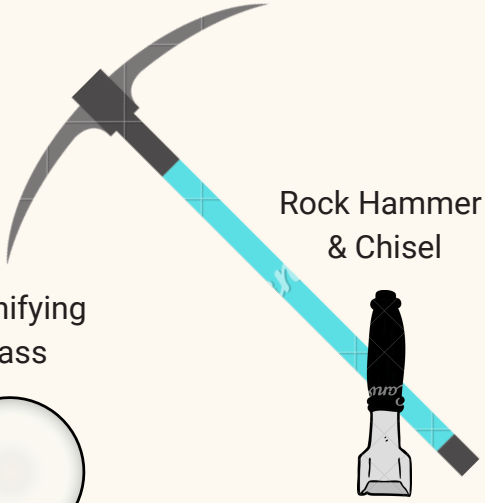


map


Rock Hammer & Chisel

Adventure Log

Magnifying Glass

Safety Glasses

Record the rocks you find in the table below.

Sample	Name	Date	Location	Description

*Use the internet or a reference book to identify your samples. The author's favorites are listed under Resources below.

Finally, use the information in the table as your starting point in your own adventure log. It can be whatever you like—a spiral notebook or a binder, a bound journal, or note cards on a ring. Just be sure to include all the important details.

Did You Know?

According to the National Snow and Ice Data Center, the polar caps hold the highest amount of fresh water on the planet. The next largest supply is the five Great Lakes, which hold about 20 percent. The Great Lakes were formed over thousands of years of glaciers coming and going across the area.

Background

Geology is the study of Earth's materials and history. Throughout time, people of all ages have been fascinated with uncovering Earth's secrets. Geologists travel all around the world to get their hands dirty and answer important research questions. They study many topics of interest, but they all share something in common: their interest in rocks, minerals, and fossils.

Rocks are made of one or more minerals. Rocks and minerals can form through many different processes. The way they form affects their texture, weight, size, and color. Minerals are inorganic materials that occur naturally. They are pure substances, meaning they are made of a single type of material. Fossils are remains or impressions of a prehistoric organism, such as an animal or a plant, usually within a rock. Do you think geology rocks or what?!

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Resources

A good rock and mineral guide or two is helpful as you start your geology adventure. You can borrow them from a library or you might want to purchase them. Here are some of the author's favorites:

- Dig into Rocks, Minerals & Crystals by Beverly Wilson and Shore Wilson Rundell (1999)
- Handbook of Rocks, Minerals, and Gemstones by Walter Schumann (1993)
- Rock and Gem By Ronald Louis Bonewitz (2005)
- Rocks and Fossils by Martin Bramwell (1973)

Activity 2

Rock and Roll!

Rocks are the most common naturally occurring material on the earth and can be found anywhere and everywhere. Do you wonder where rocks come from and how they formed?

For starters, it takes massive amounts of time, heat, and force.

Learning Outcomes
Project skill: Gather supplies to demonstrate the rock cycle
Life skill: Understanding systems
Educational standard: NGSS MS-ESS2-1: Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.
Success indicator: Recreate the rock cycle using household items

What To Do

See the rock cycle in action by creating one with this clever experiment! Be sure to ask an adult to help you. Keep your field journal nearby so you can make notes about what happens.

1. Let's start with sedimentary rocks. Use the scissors to cut the candy into pieces.
2. Press the small pieces of candy, or "sediment," together to make a sedimentary rock.
3. Take your new sedimentary rock and warm it to a smooth surface by holding it in your hand or blowing on it. The heat causes the sedimentary rock to transform into metamorphic rock.
4. Place your metamorphic rock on a paper plate and ask an adult to help heat it in the microwave until melted and bubbly. The candy will be very hot. Do not touch it until it cools! This melted bubbly stage represents lava, which hardens into igneous rock, the third rock group.
5. Note what you observed in your adventure log.

Materials


Starburst Candies

Paper Bowl



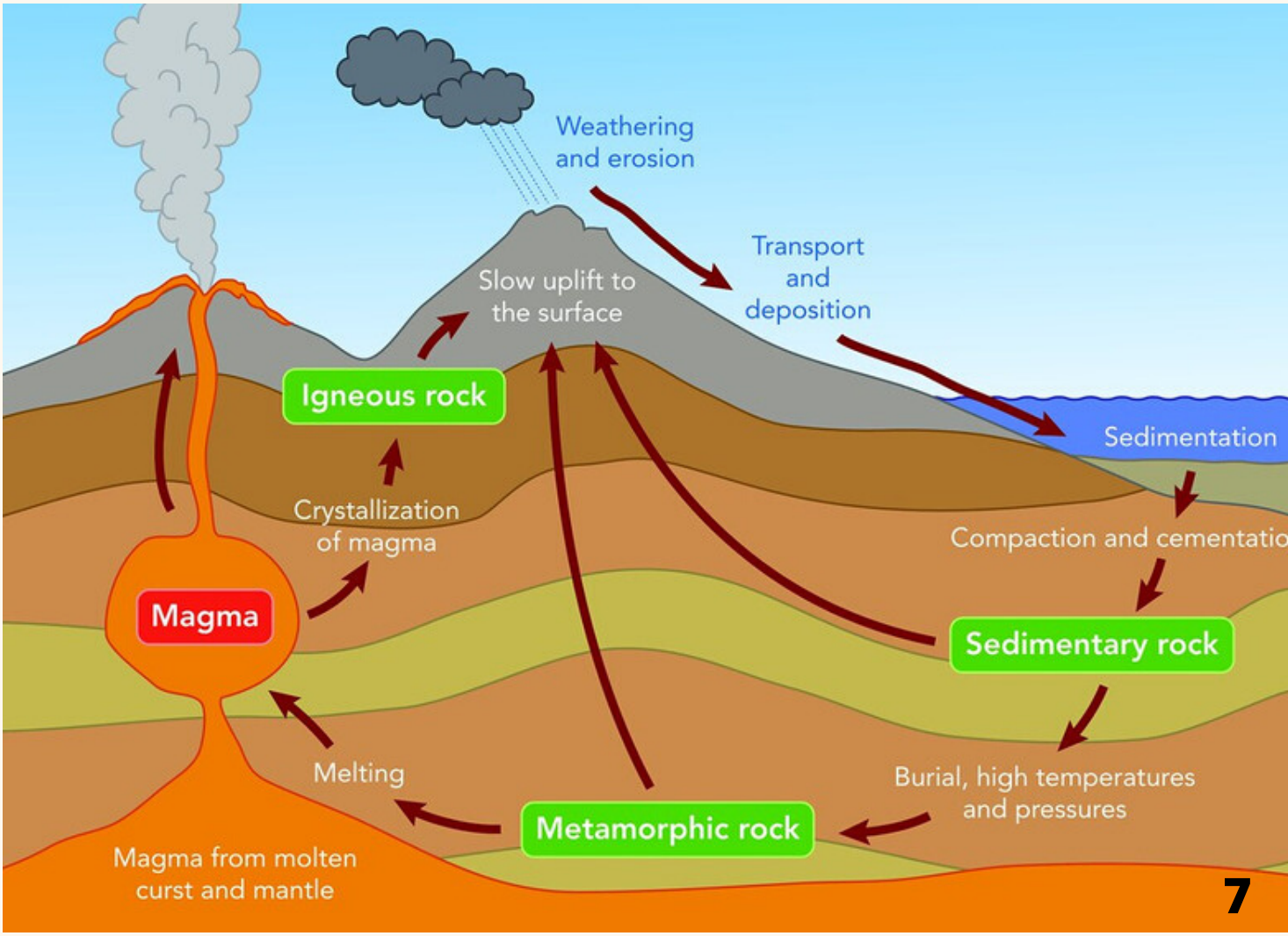
Scissors

Adventure Log


Background

Rocks fit into one of three groups based on how they form: sedimentary, metamorphic, and igneous. Each group has rock types that differ in shape and arrangement of minerals. Common sedimentary rocks include limestone, sandstone, and dolomite. Examples of metamorphic rocks are schist, soapstone, and slate. Pumice, granite, and obsidian are varieties of igneous rocks.

The rock cycle illustration shows how Earth's processes change a rock from one type to another, and how the three groups relate to each other. The cycle starts with soil, small rocks, and pieces of sediment. Wind, water, and gravity move the sediment over time and create sedimentary rock. When sedimentary rock is exposed to heat and pressure, the process is called metamorphism. This turns rock into a metamorphic rock.



Background

The next step of the cycle is when metamorphic rock is heated by magma and then erupted out of a volcano as lava. The cooled lava becomes igneous rocks. Finally, the cycle starts all over again when the igneous rocks break down from erosion.

This rock cycle is an example of what can happen to rock material. A rock can turn into any other kind of rock and keep cycling through the process. It also can stay in one area and not move further in the cycle.

Did You Know?

Some rocks can float. One example is pumice, an igneous rock. This rock begins life as a gassy magma during a volcanic eruption. The many tiny holes in the rock were once gas bubbles when it was flowing and hot.

Featured Career

Geologists work to understand the history of our planet. The better they can understand Earth's history, the better they can foresee how events and processes of the past might influence the future. To learn more check out; https://geology.com/articles/what-is-geology.shtml

Talking It Over

SHARE: How did using the Starburst candy help you understand the rock cycle? If you repeat this project, describe your method.

_____

_____

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REFLECT: If you could travel anywhere in the world to study geology next year, where would you go?

_____

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GENERALIZE: What important points did you learn this year about the rock cycle?

_____

_____

_____

APPLY: Wjhen you become interested in a new subject, how do you learn more about it?

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Activity 3

Beautiful Birthstones

Were you born a sapphire or an emerald? In ancient times each month was said to have a special gem. A symbol of the people who were born during that month. For example, the stone for May is emerald, a green gem. People born in May wore jewelry made of emerald.

These special stones became known as birthstones and many people still wear their birthstones.

Learning Outcomes

Project skill: Explore uses of minerals in our everyday lives
Life skill: Making models
Educational standard: NGSS MS-ESS3-1: Construct a scientific explanation based on evidence
Success indicator: Identify your birthstone and create an accurate model

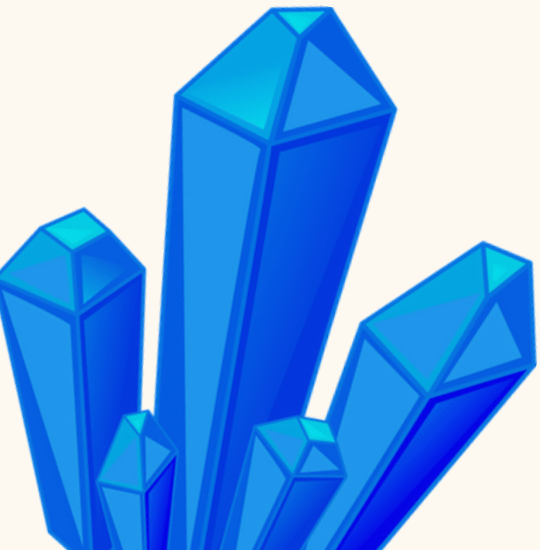
What To Do

Once you learn about your birthstone grab a friend and create your own! You will need a rock and mineral identifying book, clay, needle, paint, paintbrush, and string.

1. Use colored air-dry clay to create beads that resemble gems. Be sure to include all the different faces or cuts you found in your reference book. Use the needle to make a large hole to string the beads.

2. Let the beads dry overnight, then paint the bead the color of your birthstone. Do you need to mix colors together to get the right color?

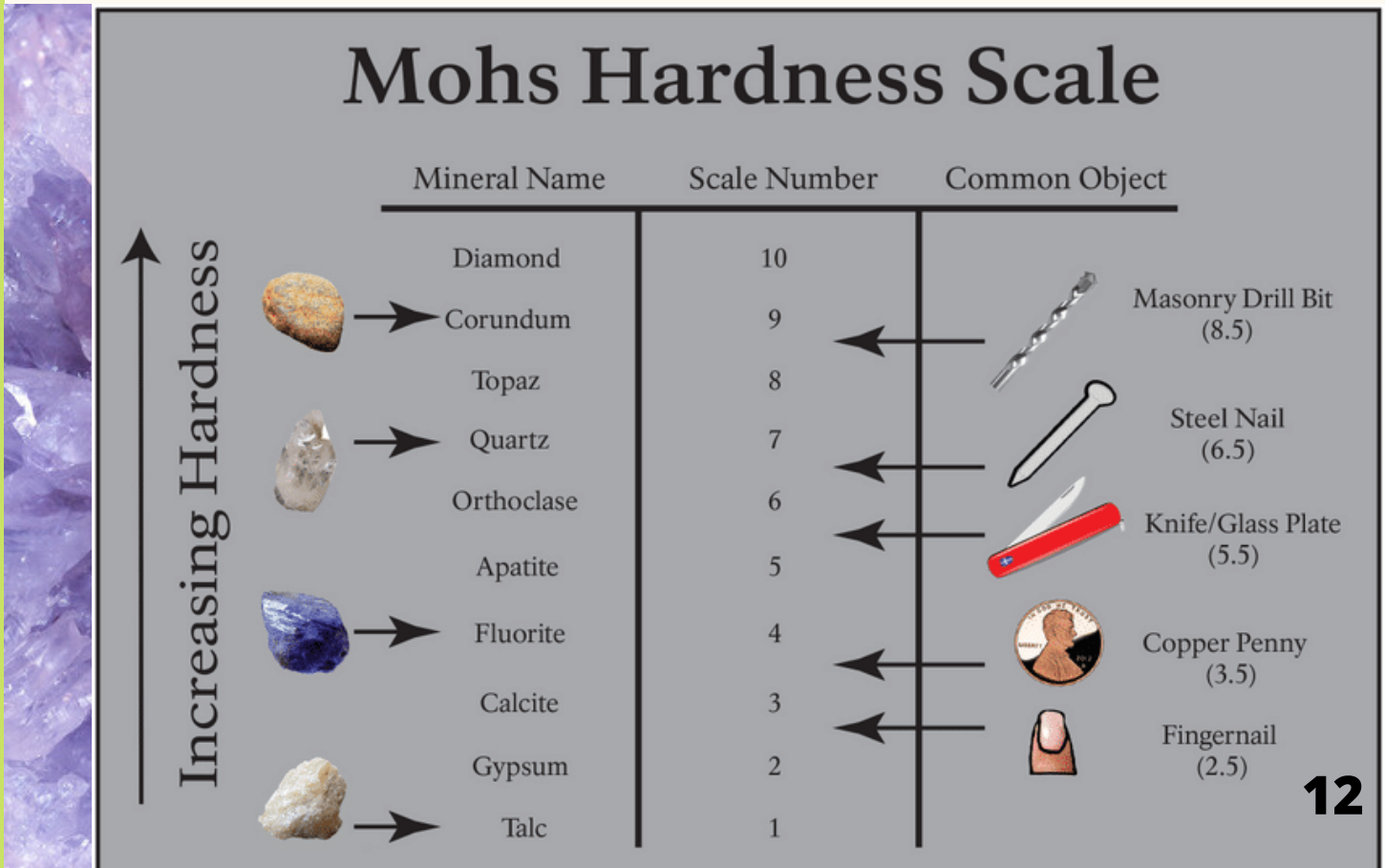
3. After the paint has dried thread the beads on a short piece of string to make a bracelet or a long piece to make a necklace. Happy Creating!



Background

Rocks and minerals are sometimes lumped into the same category. However, rocks are recycled minerals. Every rock is made of minerals. Just as different cookies have different ingredients, so do rocks. If you know the ingredients of a rock, you can figure out what kind of rock you have. Every rock has one or more minerals, which makes each rock different. Minerals give rocks their texture and color. The earth's crust contains more than 3,000 minerals. Most are rare. Only 100 or so are commonly found. The rarest are mostly referred to as gems. Scientists identify minerals by noting qualities such as color, luster, density, fracture ability, and hardness. The hardness is measured using the Mohs Hardness Scale. German geologist Friedrich Mohs developed this scale in 1812.

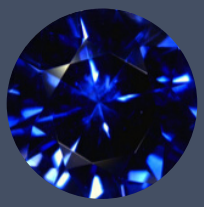
The minerals on the left are examples that range from soft, at the bottom, to hard, at the top.The common items on the right show what it would take to make a mark on the mineral.



Featured Career

Mineralogists study the physical and chemical properties of minerals. Some mineralogists research how to remove minerals from their natural settings. For more details about this fascinating career, check out environmentalscience.org/career/mineralogist.

Did You Know?

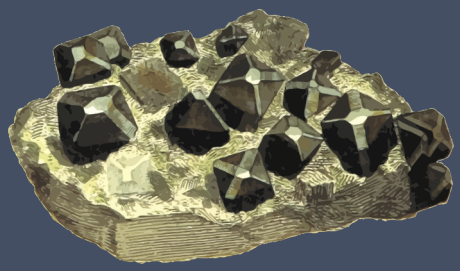


Each state has its own gemstone, rock or fossil you can find yours at https://statesymbolsusa.org/us/symbols/state

Resources

For more information and beautiful photos about dozens of minerals, visit;

- minerals.net.
- https://geology.com/minerals/
- https://www.mindat.org/directory.php



Talking It Over

SHARE: What was the most challenging part of this activity about minerals?

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REFLECT: Copper is used in the wiring of cell phones. What would happen if we had no more copper left on Earth?

_____

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GENERALIZE: How does keeping an adventure log help you to better understand geology?.

_____

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APPLY: Give at least one reason why it is helpful to know which materials are used to produce household items?

_____

_____

_____

Activity 4

Step Into The Past

Humans have always been interested in the history of our world. Do you know the best clues for finding the age of our planet come from rocks? Scientists called paleontologists (PAY-lay-on-TAH-lo-jists), study these ancient rocks, which often include fossils. Fossils are the remains of ancient animals or plants left behind in the rock. Let's look at four clues and learn how to identify fossils.

Fossil-tastic!

Learning Outcomes
Project skill: Learn the different types of fossils
Life skill: Processing information
Educational standard: NGSS MS-ESS2-3: Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions.
Success indicator: Match each fossil to its type

What To Do

Fossils were created in four different ways. Look at the pictures on the next page and fill in the blanks with the correct fossil type for each. Use the chart below for clues!

Trace Fossils	These fossils do not contain the organism itself, only some sign or evidence of it. Examples include nests, droppings, and tooth marks.
Body Fossils	Sometimes scientists are very lucky and find all or part of an organism that was preserved in sedimentary rock. Bones were replaced with sediment and became fossils over time.
Mold Fossils	Molds are created when an animal or plant leaves an imprint of itself in a rock or sediment. Mold fossils can include skin, footprints, teeth, but not the organism itself.
Resin Fossils	Many pine trees produce a gummy material. It can be the color of honey or darker. Sometimes tiny animals are trapped in resin, which preserves them perfectly.

What To Do

A _____

B _____

C _____

D _____

Background

Since 570 B.C, scientists all over the world have looked to fossils for clues about previous life. Fossils are on every country and continent. A fossil is the actual remains or the impression of a prehistoric organism (an animal or a plant). These remains are preserved in petrified form in sedimentary rock or resin.

The fossilization process begins when an organism dies. The remains of an animal or plant are replaced with minerals leaving behind a rock version of the original shape. Four of the most common types of fossils are trace, resin, mold, and body.

Trace fossils come in the form as bite marks, footprints, or animal waste. Studying trace fossils helps us learn how animals lived and what they ate. Example B is a trace fossil, showing feces if an animal.

Mold fossils are created when an animal or plant dies and the sediment around it hardens, leaving a mold of its shape. Example C shows a mold fossil.

Sometimes a small animal or plant became trapped in tree resin. It later hardened into amber, which is petrified resin. This process perfectly preserves the organic material. The resin fossil is in example D.

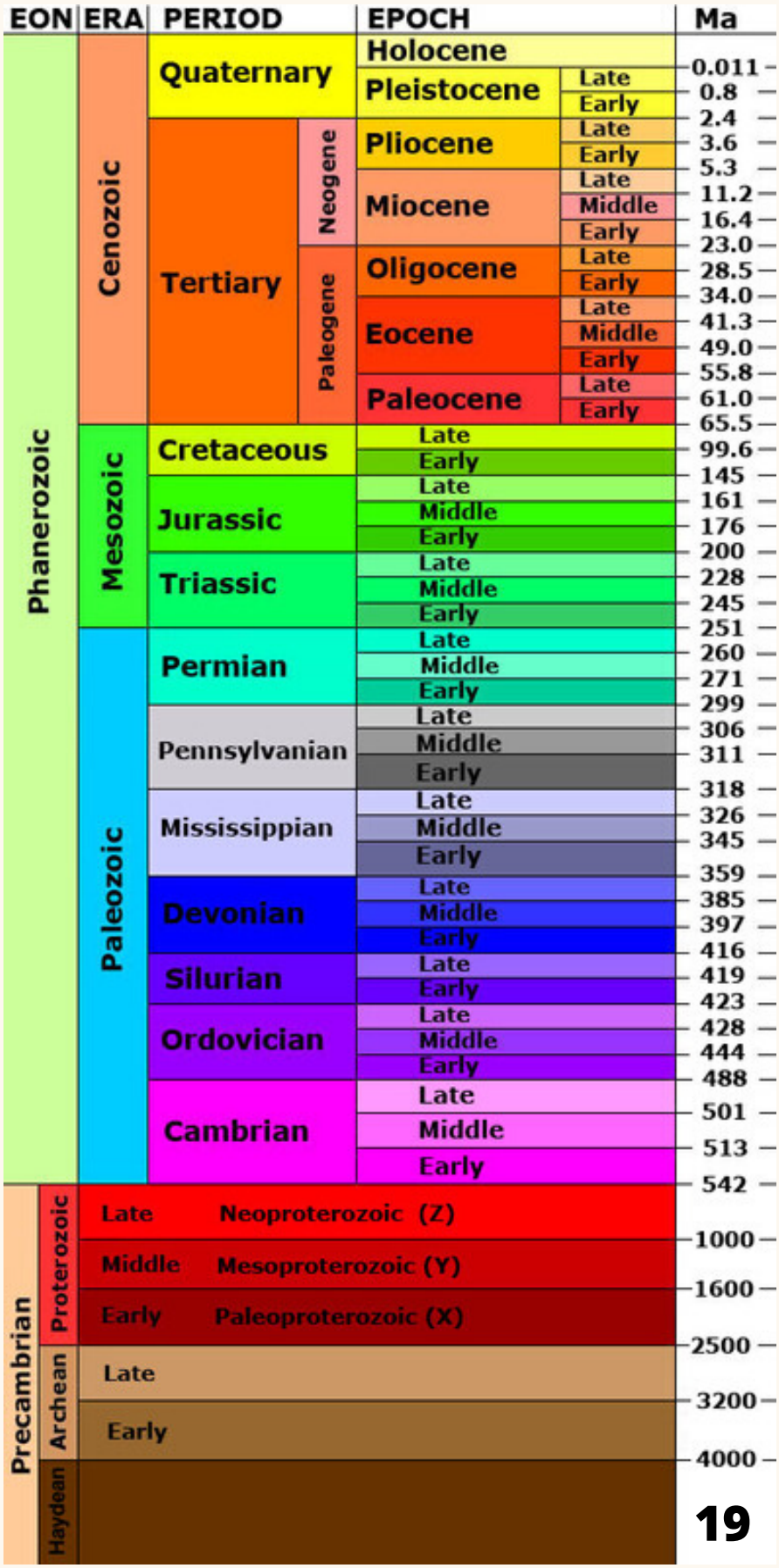
Body fossils are teeth and bones that have turned into stone when the animal dies. Body fossils become famous because they are rare and valuable to understanding Earth's history. They help scientists learn what dinosaurs and other large animals looked like millions of years ago. The picture labeled A is a body fossil.

Featured Career

"Paleontologist" comes from Greek and means: ancient (paleo), being (onto), and study (-logy)—the study of ancient beings. These scientists learn about animals and plants from geologic time by studying fossils. Learn more at kidsdinos.com/paleontology.

Background

Scientists gathered information from fossils and the order of rock layers to create the Geological Time Scale, pictured beside. This represents the history of our planet, divided into long time periods. Most Time Scales start 544 million years ago with the Cambrian Period. Later periods are based on evidence of plant and animal life, starting with very early life forms. You may have heard of the Jurassic Period because of the popular movie, Jurassic Park. This period is known for dinosaurs, which were the dominant animal at the time. It is believed that Pangea was starting to split into two landmasses just before this period.



Activity 5

Walk with the Ancients

Now that you are more familiar with fossils, it's time to go into the field, study like paleontologists, and walk with the ancients.

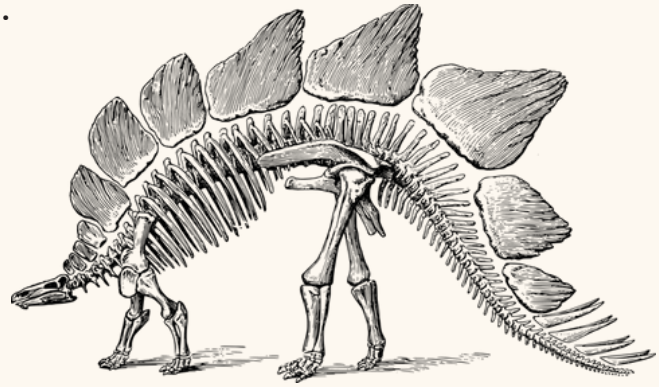
Fossil-tastic!

Learning Outcomes
Project skill: Collect at least five fossils
Life skill: Keeping records
Educational standard: NGSS MS-ESS2-3: Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions.
Success indicator: Find and log in at least five fossil samples in adventure log
Project skill: Collect at least five fossils

What To Do

Now you are going to collect at least five fossils samples for your collection. Search online for some great fossil sites in your state. If you look beyond your own property or on public lands, be sure to ask for permission ahead of time. Check for fossils in sedimentary rocks. Use a chisel to take home the fossil and leave the larger rock behind. If you cannot find five fossils, visit a rock and mineral shop and purchase some for your collection. Log each new fossil in your field journal with its name, location, description, and the date.

Want an extra challenge? Visit a stone quarry, or nature preserve with permission and fill a bucket with small rocks, and sediment. Take the bucket back home with you. Find a strainer with very small holes. Fill your strainer with the sediment and gently put into water. Gently screen through the sediment and look for microfossils such as clams, gastropods, or snails. This is called screen-washing and scientists use it to search for microfossils which are important to understanding ancient climate and ecosystems.

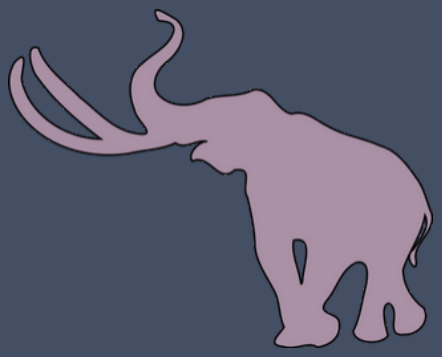


Background

Fossils exist wherever plants and animals lived in ancient times. Fossils are mostly found in sedimentary rocks like limestone.

Here are some tips for fossil hunting.
1. Go online to research well-known fossil hunting spots.
2. Look for imprints in rocks that look like plant and animal parts.
3. Take the appropriate equipment: bags or buckets for your samples, a hammer and chisel, safety glasses, a map, your field journal, and a pen.
4. Log any discoveries in your adventure log.Happy Hunting!

Did You Know?



The Mammoth Site of Hot Springs South Dakota has the largest concentration of Columbian mammoth remains ever found!

Resources

Check out these great videos on fossils.

- youtube.com/watch?v=9f5HehQovx8
- youtube.com/watch?v=oTqWjPWeyN4
- youtube.com/watch?v=TVwPLWOo9TE

Talking It Over

SHARE: Where did you go this year to find fossils?

_____

_____

_____

REFLECT: Of the fossils you collected, which is your favorite?

_____

_____

GENERALIZE: Do you have other collections? If so, how does adding items to a collection differ from collecting items for this project? If not, what would you like to collect next?

_____

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_____

APPLY: Collecting fossils helps us understand the past. What are some other ways to learn about the past?

_____

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_____

Activity 6

Some Assembly Required

"Everybody needs a rock. I'm sorry for kids who don't have a rock for a friend." —Byrd Baylor, American novelist and children's author

Rock collections are fun and exciting! Learning about the earth can help you connect to the past and enjoy what you find in the present. Rock, mineral, and fossil specimens allow geologists and students like you to educate others about the beauty and interesting history of rocks.

Learning Outcomes
Project skill: Research ideas for displaying rock collections
Life skill: Practicing creativity
Educational standard: NGSS 5-ESS1-2: Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.
Success indicator: Create an attractive display for a rock collection

What To Do

Find a container to hold your collection. Use a tray with sides and dividers, a box lid, or even an empty box of candy with a molded plastic insert or paper cups to hold your samples. Be sure to label each specimen. Go online for lots of great ideas! Consider sorting your collection by type (rocks, minerals, and fossils), by geologic time period, or any other method that makes sense to you. After you label each specimen make a catalog in your field notebook such as the one below. Keeping records is very important for junior scientists to do.

Background

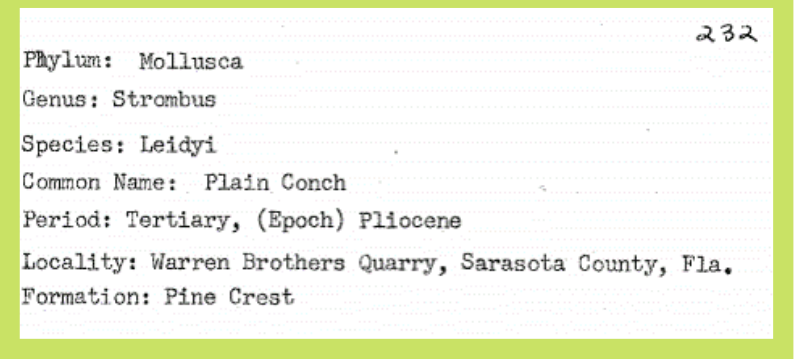
Collecting can be a great hobby! People collect different objects for different reasons.

Here are a few benefits of collecting:

- Collections tell stories. Every object has a story, and when you collect, you help to share its story!
- Collecting teaches many things including historical events, the way people and animals lived, or how something is made.
- Collecting can advance science and research. Scientists collect many items to study and often share their observations with the public.
- Collecting allows you to share your knowledge with others. When you show your collection to your club, friends, or family, you have the power to teach them new and interesting things!
- Collecting can surround you with beautiful objects. By collecting rocks, minerals, and fossils of various colors, you surround yourself with natural beauty and you can enjoy looking at them every day.

How To Maintain Your Collection

- To clean your specimens, soak them in cold, soapy water and lightly scrub with a toothbrush.
- Store your collection in a box, an egg carton, or an even a glass jar. You can organize the collection in any way: by color, by rock or mineral type, or by where you found it.
- Create labels for each of your rocks, minerals, and fossils.



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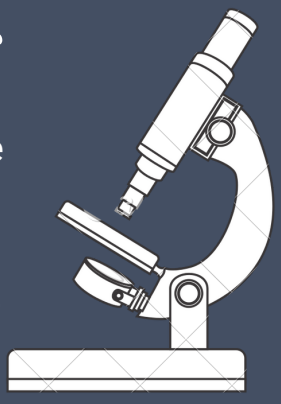
Phylum: Mollusca
Genus: Strombus
Species: Leidyi
Common Name: Plain Conch
Period: Tertiary, (Epoch) Pliocene
Locality: Warren Brothers Quarry, Sarasota County, Fla.
Formation: Pine Crest

Did You Know?

With over 4,600,000 specimens the Smithsonian Institute holds the largest rock mineral and fossil collection in the United States

Featured Career

Museum Curator is the head scientist of a museum. The main job duties are to prepare the collection for the public. Learn more about becoming a curator at bigfuture.collegeboard.org/careers/education-museum-work-library-science-curators.



Talking It Over

SHARE: How did you figure out what kind of display to use for your rock collection? If you repeat this project, will your display changed over time?

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REFLECT: What did you learn this year about yourself by completing this activity book?

_____

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GENERALIZE: Make the best better! What is one way you could improve your display?

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APPLY: It takes thoughtfulness and good organization skills to create a display for any collection. What other school projects or household tasks could benefit from the skills you learned doing this project?

_____

_____

_____

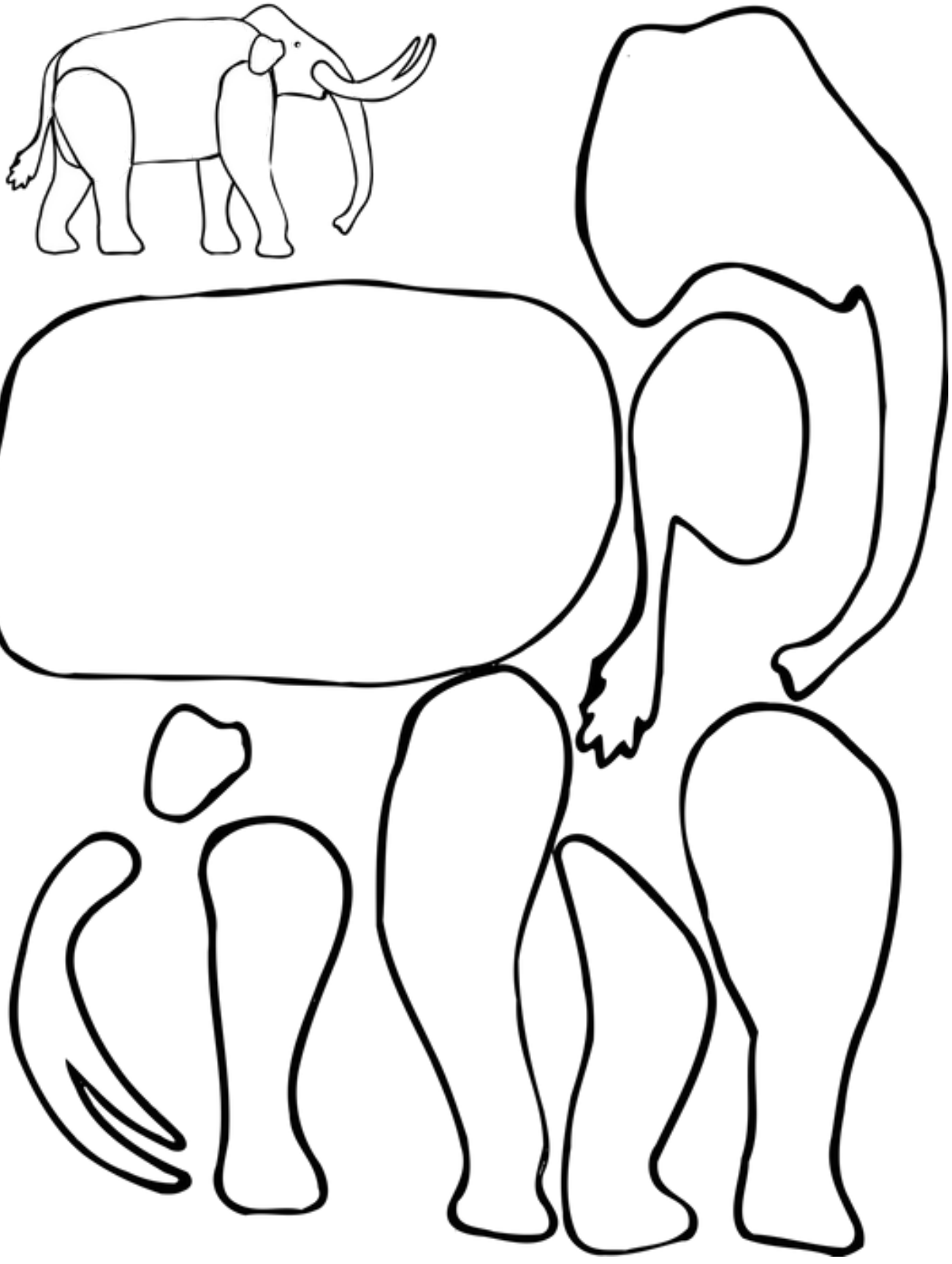
Glossary

- **Continental drift:** Plate tectonics cause our landmasses to move across the earth's surface slowly, in geologic time. Some plate movement is as little as .8 inch per year.
- **Crust:** The thin shell on the outside of the earth. The crust is made of rock.
- **Erosion:** The gradual wearing away of something.
- **Fossil:** The remains or impressions of a prehistoric organism preserved in rock or resin.
- **Gemstone:** A precious and rare mineral used for jewelry.
- **Geologist:** A scientist who studies the how the earth was created, its materials, and ways to locate and use mineral and energy resources, such as natural gas and groundwater.
- **Geology:** The study of Earth, its history, its materials, and how it has changed over time.
- **Igneous:** (IG-nee-us). Rock formed when magma and lava cool and become solid.
- **Inorganic Materials:** Matter that is from non-living sources, such as rocks and minerals.
- **Lava:** Molten rock that has erupted from a volcano.
- **Lithosphere** (LITH-oh-sphere): Rigid outer layer of the earth, which includes the crust and upper mantle. This layer contains the tectonic plates.

Glossary

- **Magma: Extremely hot fluid that flows in and on the earth's crust. Lava and other igneous rocks form when magma cools.**
- **Mantle:** Region of the earth, under the crust, consisting of hot molten rocks and magma.
- **Metamorphic** (meta-MOR-fick): Rock formed by heat and pressure.
- **Mineral:** A solid substance made naturally of inorganic materials.
- **Organic:** Matter that was once a living organism, such as an animal or a plant.
- **Organism:** A life form such as an animal or a plant.
- **Paleontologist** (PAY-lay-on-TAH-lo-jist): A scientist who studies the history of life by analyzing fossils.
- **Petrified:** Plants or animals that have turned into stony material over long periods of time.
- **Resin:** A glue-like, honey-colored substance found in or on (mostly pine) trees.
- **Rock:** Natural, inorganic substance composed of two or more minerals.
- **Sedimentary:** A rock formed from many pieces of sediment.
- **Tectonic Plates:** Plates of crust in the lithosphere that cover the earth and move slowly over time.

Make Your Own Mammoth



The Mammoth Site of Hot Springs South Dakota takes visitors back over 140,000 years into the Ice Age. Named the 'Best Museum in South Dakota' by USA Today, The Mammoth Site offers a 30-minute guided tour. Walk by the edges of a sinkhole where Columbian and woolly mammoths, camels, wolves and giant short-faced bears became trapped, leaving an ancient treasure trove of fossil remains. This active working excavation site features the fossils of over 60 mammoths and more! Apart from active excavation and research, the Mammoth Site offers a wide variety of educational programming to all ages.

The Mammoth Site of Hot Springs,South Dakota, Inc.

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