GEOLOGY

3–8 Science Unit Study

THE GOOD AND THE BEAUTIFUL

Geology

Created by The Good and the Beautiful Team

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Unit Information

Science Journal

All The Good and the Beautiful science units include activities in a student journal. Each student should have his or her own student journal, and the parent or teacher will direct the student regarding when to complete the activities as directed in the lessons. Science journals can be purchased by going to **goodandbeautiful.com/science** and clicking on the *Geology* unit link.

Science Wall

All The Good and the Beautiful science units include vocabulary words to be placed on your science wall, which is a wall or tri-fold presentation board in your learning area to which you can attach the vocabulary words and other images. ***Cut out the vocabulary word cards at the beginning of the unit.*** The course will indicate when to place them on the wall.

Lesson Preparation

All The Good and the Beautiful science units include easy-to-follow lesson preparation directions at the beginning of each lesson.

Activities and Experiments

Many of The Good and the Beautiful science lessons involve hands-on activities and experiments. An adult should always closely supervise children as they participate in the activities and experiments to ensure they are following all necessary safety procedures.

Experiment Videos

Go to **goodandbeautiful.com/sciencevideos** and click on the *Geology* link or use the Good and Beautiful Homeschool app to see videos of experiments used in this unit. This is a convenient way to watch experiments that may be more complicated. Children often learn best through hands-on experience; therefore, this unit includes a supply list and instructions for all experiments, and you may choose to do as many as you wish.

Unit Videos

Some lessons include videos that were created by The Good and the Beautiful. Have a device available that is capable of playing the videos from **goodandbeautiful.com/sciencevideos** or from the Good and Beautiful Homeschool app.

Content for Older Children

Some lessons include extra content that is more applicable for older children (grades 7–8). Parents or teachers may choose to skip this content if instructing only younger children.

Content for Younger Children

Some lessons include extra content that is more applicable for younger children (grades 3–6). Parents or teachers may choose to skip this content if instructing only older children.

Versions

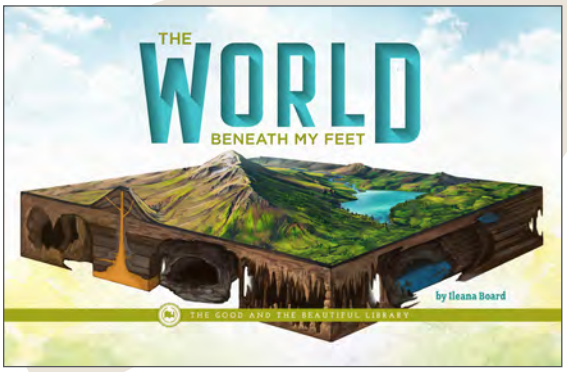
New discoveries in geology are being made on an ongoing basis. This course is reviewed and revised periodically to keep the information as up-to-date as possible. This version is the second edition of this unit.

Rocks and Minerals Kit

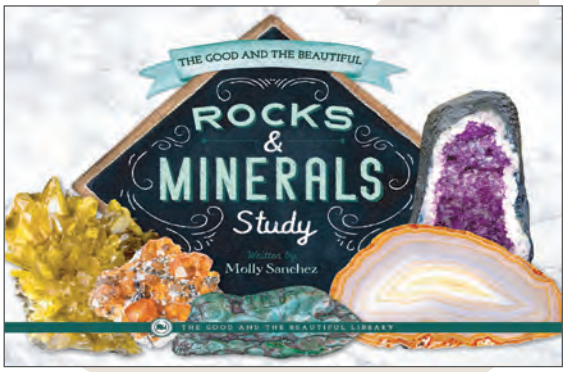
This unit incorporates *The Good and the Beautiful Rocks and Minerals Kit*. Using the testing tools, six minerals, and three rocks included in the kit, lessons will prompt children to observe and test different materials, providing hands-on experiences with geology. This kit is available at **goodandbeautiful.com**.

Read-Aloud Book Pack

The two books below are optional read-aloud books that complement this unit. These books can be purchased as a book pack by going to **goodandbeautiful.com/science** and clicking on the *Geology* link.



The World Beneath My Feet
by Ileana Board



The Good and the Beautiful Rocks and Minerals Study
by Molly Sanchez

CORRELATED BOOKS

The Good and the Beautiful Library has several books that correlate well with the *Geology* unit. It can be a wonderful experience for children to read books at their levels that are related to the subjects they are learning in science. The library includes both fiction and nonfiction books organized according to reading level. Find the correlated books by going to **goodandbeautiful.com/science** and clicking on the *Geology* science unit product page.

GRADES 7–8

Lesson Extensions

How the Extensions Work

Each lesson has an optional lesson extension for children in grades 7–8. Complete the lesson with all the children, and then have the older children complete the self-directed lesson extension. These extensions are located in the *Grades 7–8 Student Journal*.

Answer Key

The answer key for the lesson extensions can be found on the free Good and Beautiful Homeschool app in the science section. Visit **goodandbeautiful.com/apps** for information on accessing the app. The app can be accessed from a computer, phone, or tablet.

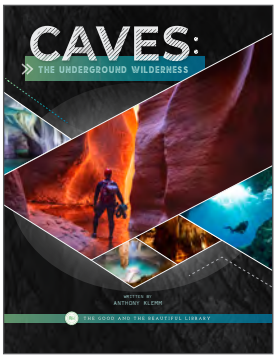
Flexibility

The amount of time it will take to complete each lesson extension will vary for each child. The average time is about 10–15 minutes per extension. You and the children may choose to omit parts of the extension lesson if desired. Encourage the children to stretch their capabilities, but also reduce work if needed.

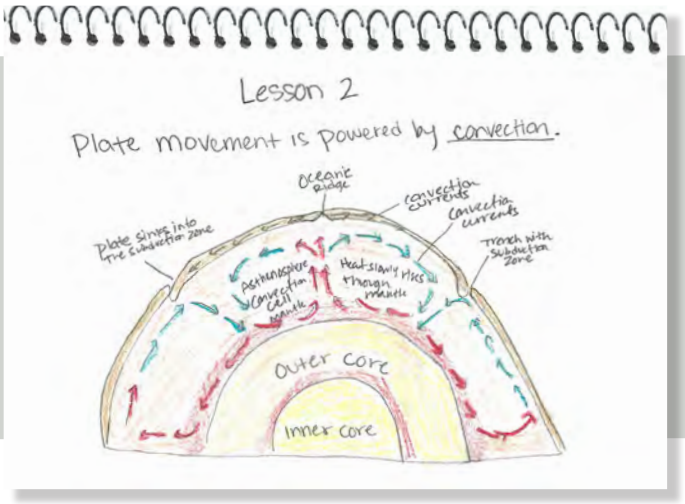
Taking Notes

Some of the Grades 7–8 Lesson Extensions have the children summarize the material read. Teach the children to look for key information, summarizing the most important points. Students can also add notes with their thoughts and the facts that are most interesting to them.

Optional Grades 7–8 Reading Book



We recommend the book *Caves: The Underground Wilderness* by Anthony Klemm as extra reading for students in grades 7–8. This book can be purchased at goodandbeautiful.com on the *Geology* science unit product page or at **goodandbeautiful.com/library**.



Supplies Needed

This section is divided into supplies needed for **activities** and supplies needed for **experiments**. If you would prefer to watch the experiments instead of perform them, you can watch all the experiments at **goodandbeautiful.com/sciencevideos**. The activities, however, are not filmed.

Lesson 1

- *The Good and the Beautiful Rocks and Minerals Kit* (or a rock of any kind)
- Hard-boiled egg
- Butter knife
- Bible (optional)

Lesson 2

- Orange
- Bowl of water

The following items are needed for each child (although it is possible to use only one set of supplies for the parent to demonstrate with):

- 1 cup of frosting
- Butter knife
- 3 fruit leather pieces (at least 3x2 in)
- 5 graham cracker pieces
- 10-inch piece of tinfoil or parchment paper

Lesson 3

- Brick or large stone (not too heavy for child to hold)
- Hammer
- One stick (per child), thin enough that a child can break it easily
- 2 sanding sponges (or other similar items that will grip when rubbed together, like tennis shoes)
- One rubber band (per child)

Lesson 4

- Cup of water
- Towel
- Red marker, crayon, or colored pencil (per child)

Lesson 5

- Optional: Visit goodandbeautiful.com/volcanoes to find detailed instructions and supply lists for a volcano experiment that best suits your family or school group.

Lesson 6

- 1 Tbsp salt
- 1 Tbsp salt mixed with dirt
- 3 sets of LEGO® bricks that each include 3 bricks that are the same shape, color, and size, but each set is different bricks
- *The Good and the Beautiful Rocks and Minerals Kit*: See the front of this unit for more information if needed.

Lesson 7

- A few pieces of scrap paper
- Optional: Geode kit (or small* geode, hammer, protective eyewear, cloth, flathead screwdriver or chisel) **Larger geodes may require power tools. Note: Some geodes are faulty and may not contain crystals.*
- 1 cup water (per child)
- 3 cups sugar, plus some extra for coating (per child)
- Clothespin (per child)
- Stick (skewer or craft stick; for each child)
- Clear glass jar or cup (for each child)
- Funnel (optional)
- Food coloring (optional)
- 1 tsp liquid flavoring extract (optional)
- Pot
- Stove

Lesson 8

- An empty egg carton or compartment box OR a rock kit or collection of rocks
- Optional: Paint and paintbrushes or markers for decorating cartons or kits

Lesson 9

- Candle and candleholder (it needs to be straight or tapered so the wax can drip down the side) OR use a birthday candle held in nonflammable clay
- Lighter or match
- Dominoes or wooden blocks (15–30 pieces)
- 2 small containers or boxes (big enough to hold the dominoes or blocks)
- *The Good and the Beautiful Rocks and Minerals Kit*

Supplies Needed

This section is divided into supplies needed for **activities** and supplies needed for **experiments**. If you would prefer to watch the experiments instead of perform them, you can watch all the experiments at **goodandbeautiful.com/sciencevideos**. The activities, however, are not filmed.

Lesson 10

- Empty, clean plastic or glass container with a lid, like a pickle jar
- Water
- *The Good and the Beautiful Rocks and Minerals Kit*
- Ruler
- Two handfuls of soil and any or all of other various sediments: small pebbles or other rock fragments, sand, salt (rock or ice-cream salt, fine table salt, pink salt, and/or coarse salt), and baby powder

Lesson 11

- Sediment jar from last lesson
- Ruler
- 3 STARBURST® candies of different colors (per child)
- Rolling pin or kitchen mallet
- Aluminum foil
- Hair dryer
- *The Good and the Beautiful Rocks and Minerals Kit*
- Optional: Each child's rock collection box (from Lesson 8)

Lesson 12

- Brick of milk or dark chocolate (or a HERSHEY'S™ chocolate bar)
- Brick of white chocolate
- Cheese grater
- Aluminum foil
- Access to a freezer (or an ice pack)
- Microwave
- 2 microwave-safe bowls
- 2 spoons
- 2 plates
- Hair dryer
- Rolling pin

Lesson 13

- 11"x15" baking pan
- Bricks, blocks, or something else to raise one side of the pan
- Sand
- 3–4 ice cubes
- Pitcher of water
- Straw (per child)
- Optional: towel or pan to catch any overflow of water or sand

Lesson 14

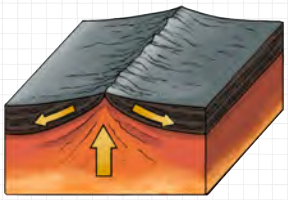
- Watercolor cakes or paint
- A sheet of blank or watercolor paper (per child)
- Paintbrush (per child)
- Water
- Pencil (per child)
- Palette or plate

Vocabulary

Instructions: Cut out the vocabulary cards in this section. Place them on your science wall when prompted to do so in the lessons. Review the vocabulary words several times during this unit and, if desired, at various times throughout the school year.

Geology

the study of the earth and its materials, structure, and processes and the history of how these things have changed over time



Divergent Boundary

an area where two tectonic plates move away from each other

Convergent Boundary

an area where two tectonic plates collide, often resulting in one plate sinking and sliding under the other (subduction)

Introduction to Geology & Earth's Composition

Objective

Help the children understand the study of geology and learn about the composition of the earth.

Preparation:

- ☐ None

Activity Supplies:

- *The Good and the Beautiful Rocks and Minerals Kit* (or a rock of any kind)
- Hard-boiled egg
- Butter knife
- Bible (optional)

☐ Opening Activity

Pass around a rock (you may pick one or several out of *The Good and the Beautiful Rocks and Minerals Kit*). Let the children feel and observe the rock(s). As they do so, ask the children the following: What are you holding? [a rock]

Where do you think this/these rock(s) could be found? **Show the children the page at the end of the lesson titled "Earth's Landscapes." Identify the rocks that are found in each image. Explain that mountains, the seafloor, sand, and even dirt are all made of rocks.**

☐ If Rocks Could Talk

Read to the children: Rocks are elements that the earth is made of. Rocks are not born and do not die (although they may change shape and form); rocks and the minerals they are made of have been around since the creation of the earth. They have been present for every generation, civilization, and historical event. Wouldn't it be interesting if rocks could talk and tell you the stories of the earth and its people?

Imagine you are a stone that could be present for any time period or place in history. Where would you like to be? What would you love to be able to observe? **Allow the children to ponder and discuss together.** Now, rocks can't actually speak and use words to tell us of **(repeat some of the things the children listed, or mention Christ's birth, the signing of the Declaration of Independence, etc.)**, but there are things that they can tell us about the history of Earth. Geologists are scientists who study Earth, its processes, and its materials. They seek to understand the hidden mysteries of the earth and to discover what Earth and its components have to tell us about our home.

Geology includes the study of rocks and what they are made of. It also includes the study of many amazing land structures, such as tall mountains, deep canyons, and frozen tundra. The face of the earth has changed over time because of earthquakes, volcanoes, storms, floods, and erosion. Geologists study these events and how they affect and change our world.

Science Wall: Vocabulary Word

Place the vocabulary card GEOLOGY on your science wall. Read and discuss the word and definition.

Layers of the Earth Activity

Show the children the egg. Read to the children: Just like an egg, the earth is composed of three main layers.

Crust: The shell of this egg will represent Earth's crust; it is a very thin layer of the earth. It is on top of the earth's crust that soil and rocks rest and plants grow. **Gently crack open the egg and peel away the shell.**

Mantle: Beneath the earth's crust is the mantle. This white layer of the egg will represent the mantle. **Using a butter knife, carefully cut the egg in half**.

Core: The very center of the earth is called the core. This yellow part of the egg represents Earth's core.

Layers of the Earth Video

Watch the video titled "Layers of the Earth" at goodandbeautiful.com/sciencevideos or from the Good and Beautiful Homeschool app.

Student Journal: Layers of the Earth

Have the children turn to the "Layers of the Earth" page in Lesson 1 of their student journals and complete the page. (Answer keys are provided at the end of this lesson.)

Build Our Foundation on Christ

Read to the children: There is so much we can learn from rocks; they are the foundation of the earth we stand on. Christ taught us that wise men build their foundations upon rock. **(If desired, see Matthew 7:24–27.)** There is only one True Rock that is strong enough to withstand the storms of this life. The foundation on which we need to build our lives is Jesus Christ.

Recite the following scripture together:

> **"The Lord is my rock, and my fortress, and my deliverer. . . . In him will I trust."**
>
> **–2 Samuel 22:2–3**

As we learn about geology and study the incredible earth that God created for us, let's remember that God created all things for us to lead us to Him and help us learn more about Him. All that we study and learn can open the door for us to more deeply ponder God, His love for us, and how we can better build our foundation on the true and sure Rock: our Savior, Jesus Christ.


"Christ and Child" by Carl Bloch (1834–1890), 1873

Lesson 1 Extension

7–8

Have the children grades 7–8 complete the self-directed Lesson 1 extension titled "Discovering Earth's Interior" in their student journals.

Earth's Landscapes

Volcanoes: Magma and Lava

Objective

Help the children learn about the Ring of Fire and how magma emerges to create different types of volcanoes.

Preparation:

- ☐ None

Activity Supplies:

- Cup of water
- Towel
- Red marker, crayon, or colored pencil (per child)

☐ Volcanoes in Art

Have the children turn to the "Mount Semeru Art" page in Lesson 4 of their student journals and observe it while you read aloud the page "Story of Semeru" included at the end of this lesson.

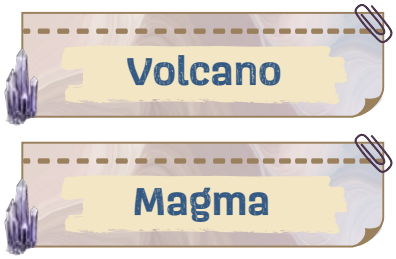
☐ Magma

Read to the children: We know that the upper mantle is made of mostly solid rock, but pockets of molten (melted) lava called ***magma*** can travel through it and escape through to the surface. **Have the children cup their hands and place a towel under to catch any excess water. Slowly pour water in their cupped hands and have the children observe how water leaks through the cracks in between their fingers.** Magma flows through the cracks between plate boundaries out toward the crust just like water can leak between your fingers. When this happens, a volcano forms and is released through a crack in the earth's crust. Once magma has reached the earth's surface, it's called *lava*.

Volcanoes can have huge impacts on our earth. Eruptions send gas, ash, and debris high into the air, which can even block out the sun and affect other parts of the world. As the lava cools and hardens, new rocks form, changing the very face of the planet. We will learn more about these kinds of rocks later on.

☐ Science Wall: Vocabulary Words

Place the vocabulary cards VOLCANO and MAGMA on your science wall. Read and discuss the words and definitions.



☐ Ring of Fire

Have the children turn to "The Ring of Fire" (map page) in Lesson 4 of their student journals. (An answer key is provided at the end of this lesson.) Read to the children: This is a map of tectonic plates that make up the earth's crust. Do you see how the view of this map is different than most maps? Most

Story of Semeru

The cool breeze brushed across the trees on the island of Java, making them come to life. White clouds sweetly glided over the merchants' heads. In the distance dense smoke began to puff through the sky. This thick cloud may have alarmed a visitor to this Indonesian island. Was it a forest fire? Did a hut in the mountains catch fire? No, with a closer look, one sees the thick smoke is gently puffing directly out of the top of the tallest peak—a volcano! Why do the merchants and farmers continue on with their work and the children continue to run about with their chores and games? A tourist rushes to a man nearby to warn him of the impending danger, but he soon realizes that the volcano is nothing new to the local people.

After a few minutes, the small amount of ash and smoke is blown away with the breeze, and it seems, for a moment, that the mountains are still. The gusts of smoke don't stay away for long though. Every 20–40 minutes, a small rush of smoke and ash erupts once again, reminding us that the earth and the mountains are active and that respect is due for all of God's creations.

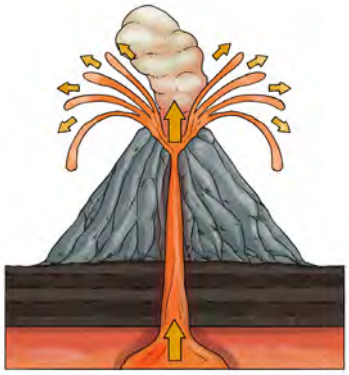
While Mount Semeru's constant volcanic activity has become a part of daily life and often causes no harm, devastating eruptions from this volcano have taken place, sending destructive lava and mudflows across land and property. The first recorded eruption was in 1818, but in over 200 years, only about 10 of the eruptions have caused significant devastation.

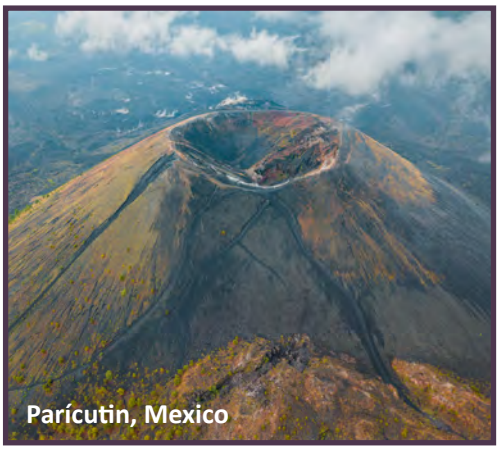
Types of Volcanoes

Shield Volcano

#1: These volcanoes have shallow, sloping sides and are short but very wide. Their shape resembles a warrior's shield. They are formed from much thinner lava than other types of volcanoes, which allows the lava to spill out in all directions rather than in a massive, violent eruption. This lava can travel quite far before it cools and hardens.

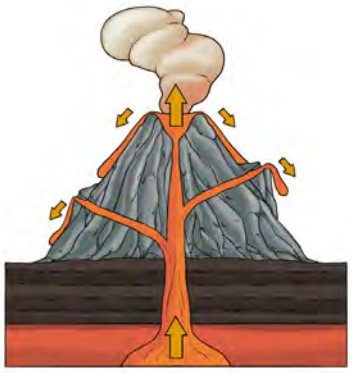
Cinder Cone





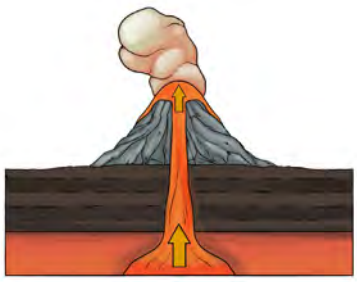
#2: These volcanoes are cone-shaped and often look like smooth sand dunes. Despite their smooth look, they expel rough, hardened lava rocks during very explosive eruptions. These eruptions happen quickly and with a lot of built-up pressure that shoots the rocks, lava, and ash high into the air. The lava and debris fall straight down and cool quickly and, therefore, often endanger fewer lives and less property.

Composite Volcano



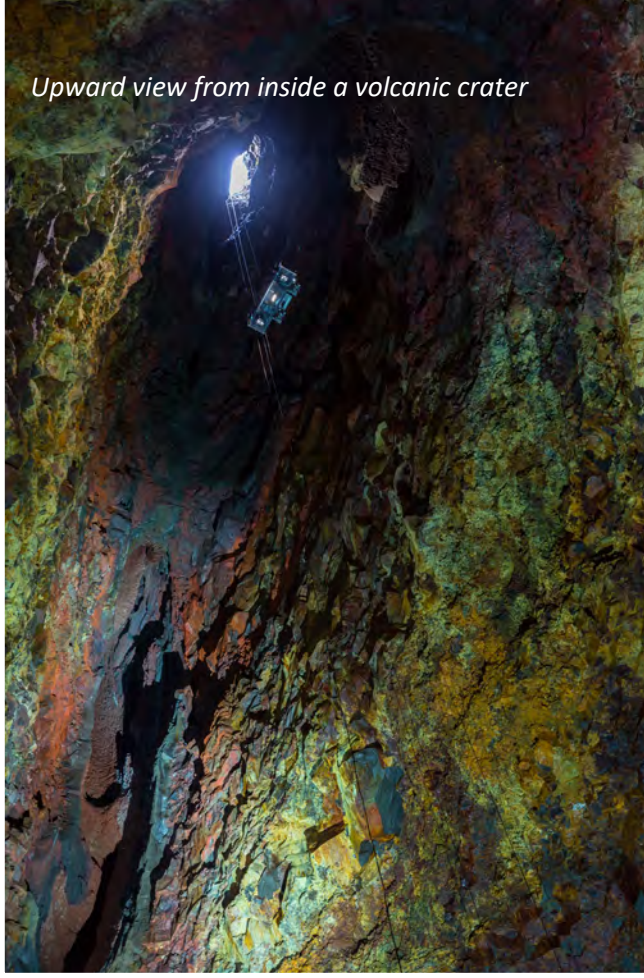
#3: These cone-shaped volcanoes often end up being some of the tallest volcanoes in the world. Composite volcanoes have extremely thick lava that traps gas until it finally breaks through in a humongous explosion that throws burning rocks and gas into the air. These volcanoes can have many side vents where the thick lava can ooze out and slowly move down the sides of the volcano, traveling quite a distance before it cools.

Lava Dome



#4: These types of volcanoes can vary in shape and size, being short and circular or tall and pointed. They form as thick lava slowly erupts underneath the ground. The underground eruption causes a large mound to form as the volcanic materials build up without breaking through the surface. Lava that does spill out does not move quickly or far before hardening. These volcanoes can form on their own or within the crater of a previous volcanic eruption.

Volcanic Structures



Upward view from inside a volcanic crater

Minerals

Objective

Help the children learn about what a mineral is and the physical properties used to identify types of minerals.

Preparation:

- ☐ None

Activity Supplies:

- 1 Tbsp salt
- 1 Tbsp salt mixed with dirt
- 3 sets of LEGO® bricks that each include 3 bricks that are the same shape, color, and size, but each set is different bricks
- *The Good and the Beautiful Rocks and Minerals Kit*: See the front of this unit for more information if needed.

☐ Ye Are the Salt of the Earth

Show the children the sample of salt and the sample of salt mixed with dirt. Read to the children: Which one would you use to salt your food? Why? It seems pretty clear that we wouldn't want to add salt mixed with dirt into our food. In the Bible salt is frequently used to teach godly principles. For example, Matthew 5:13 says, "Ye are the salt of the earth: but if the salt have lost his savour, wherewith shall it be salted?" Salt is a ***mineral*** and has been used since biblical times. When salt is added to food, it helps prevent the growth of bacteria, which decays the food. In a similar way, God wants us to add spiritual salt into our lives and into the world to prevent moral decay.

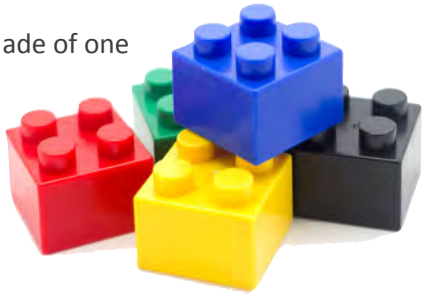
☐ Science Wall: Vocabulary Word

Place the vocabulary card MINERAL on your science wall. Read and discuss the word and definition.

☐ Atoms and Elements

Read to the children: In science, substances such as salt must meet five requirements in order to be called minerals. Before we can understand what those requirements are, we need to know a little bit of chemistry. All things are made of building blocks called *atoms*. You can think of atoms as LEGO® pieces. **Hold up a single LEGO® piece.**

There are many different types of LEGO® pieces (and atoms!). **Show a few other different-shaped LEGO® pieces one at a time.**



An *element* is a substance made of one specific type of atom. **Using three LEGO® pieces of the exact same size, shape, and color, build a small structure.**

Each different type of atom makes up a different element. **Grab a different LEGO® piece than before and build another structure of three LEGO® pieces that are the same size, shape, and color as the new LEGO®.**

watches because when it's near electricity, it vibrates at a consistent frequency. This helps regulate watches and keeps them ticking at a steady rate. [Yes, it fits all the requirements.]

Observing Mineral Properties

Read to the children: If you had a collection of rocks or gems, how could you tell each of them apart? Geologists identify minerals by the minerals' physical properties. These properties include features such as color, hardness, and appearance.

Have the children turn to the "Observing Mineral Properties" page in Lesson 6 of their student journals. For this activity we will be using the following minerals from our rocks and minerals kit: talc, selenite, chalcopyrite, fluorite, quartz, and aquamarine. **Point to each of those minerals in the kit.** We will start with talc.

1. **Have the older children write "talc" in one of the boxes on the "Mineral Observations" page in Lesson 6 of their student journals.**
2. **Read (or have a child read) the section "Color" in their student journals. Determine the color of talc and record it on the "Mineral Observations" page.**
3. **Continue by reading the sections "Luster" and "Fracture + Cleavage." Then read, observe, and discuss the details of those properties and have the children record their descriptions.**
4. **Read (or have a child read) the section "Streak." Demonstrate how to streak the mineral across the streak plate in the same way you would draw a straight line with a crayon. Then observe and have the children record the color of talc's streak dust. Be sure to dust off the streak plate before it is used again. *NOTE: Some minerals cannot be streaked if they are harder than the streak plate; instead, the mineral just scratches the plate.***

Read to the children: Have you ever gone shopping for a new couch? You test out couches by sitting on each one to feel how comfortable it is. Some are too soft; some are too hard. Geologists do a similar test for the hardness of minerals. In 1812, German geologist Friedrich Mohs invented the Mohs Hardness Scale. He performed a scratch test on basic minerals of different hardness and ordered them with 1 being the softest and 10 being the hardest. A mineral only leaves a scratch mark on another mineral if that mineral is softer than itself. For example, quartz is harder than apatite because quartz can scratch apatite, but quartz is softer than topaz because quartz cannot scratch topaz. The Mohs Hardness Scale is a standard still used today.

Rather than ranking our minerals on a scale of 1–10 like Mohs did, we are going to decide if our minerals are soft, medium, or hard.

5. **Read (or have a child read) the section "Hardness," and then complete the hardness test and have the children record their findings.**
6. **Read the section "Other" and allow the children to add any additional observations they have and draw sketches of the rock.**

Have the children complete steps 1–6 with the other minerals. You may do this as a group or allow the children to complete the rest of the minerals on their own by taking turns with remaining minerals (selenite, chalcopyrite, fluorite, quartz, and aquamarine).

☐ Lesson 6 Extension

7–8

Have the children grades 7–8 complete the self-directed Lesson 6 extension titled "Minerals and Mud Pots" in their student journals.

Sedimentary Rock

Objective

Help the children learn about the processes that form sedimentary rocks and learn about rock strata.

Preparation:

- ☐ Cut out the "Rock Identification Memory Cards."
- ☐ Place two handfuls of soil into the plastic/glass container.

Activity Supplies:

- Empty, clean plastic or glass container with a lid, like a pickle jar
- Water
- *The Good and the Beautiful Rocks and Minerals Kit*
- Ruler
- Two handfuls of soil and any or all of other various sediments: small pebbles or other rock fragments, sand, salt (rock or ice-cream salt, fine table salt, pink salt, and/or coarse salt), and baby powder

☐ Sedimentary Rock Video

WATCH ONLINE

Watch the video called "Sedimentary Rock" at goodandbeautiful.com/sciencevideos or from the Good and Beautiful Homeschool app.

After watching the video, discuss the following questions with the children: What are sedimentary rocks made from? [pieces of other rocks] How do sedimentary rocks form? [from the compaction and cementation of pieces of other rocks (called sediments)]

☐ Rock Strata

Show the children the "Rock Strata" page included at the end of this lesson. Read to the children: What do you notice about these rocks? These different layers form from different types of sedimentary rock that are compacted on each other.

☐ Science Wall: Vocabulary Words

Place the vocabulary cards SEDIMENTARY ROCK, SEDIMENT, and STRATA on your science wall. Read and discuss the words and definitions.

Sediment Types

Read to the children: The smallest particle (or sediment) size is known as clay. It is often chunky because the particles are so small that they are not distinguishable, and they clump together.

Silt is like small dust particles that are still so small that individual particles are difficult to see. Dry silt is soft like flour, and when it gets wet it is more slippery than grainy, but it is grainy enough that if some blew into your mouth, you would notice the grains on your tongue.

Sand is big enough that you can see individual particles in your hand, but it is still so small that it would be nearly impossible to pick up a single piece of sand with your fingers.

A pebble is between 4–64 mm (0.2–2.5 in) long. The smallest pebbles are a little smaller than the eraser end of a pencil.

Cobble is a stone that is between 64–256 mm (2.5–10 inches).

A boulder is any fragmented rock that is bigger than 256 mm (10 in). So, boulders can range from about a foot long to taller than a building. Giant Rock in California, USA, (shown below) is the largest known boulder in the world and is seven stories high!

Sediment Jar Activity

Read to the children: Today we are going to make our own model of sedimentary rocks. **Help the children complete the following instructions:**


Rock Strata

Rock Identification Memory Cards

Conglomerate

Sediment

Siltstone

Shale

Breccia

Coquina

Sandstone

Limestone

Rock Salt

Gypsum

Coal

Mountains and Other Landforms

Objective

Help the children learn about the major and minor landforms and how they form.

Preparation:

- ☐ Cut out the "Major Landforms Match" cards.

Optional Activity Supplies:

- Watercolor cakes or paint
- A sheet of blank or watercolor paper (per child)
- Paintbrush (per child)
- Water
- Pencil (per child)
- Palette or plate

☐ I Spy

Have the children turn to the "I Spy" page in Lesson 14 of their student journals. Take a few minutes outside to look at the surroundings. Have the children imagine and discuss how the landscape would look without any buildings and then sketch and/or label in their journals what it would look like. (Depending on where you live, you may see mountains, hills, ocean, streams, ponds, lakes, etc., or it may be flat with grasses, shrubs, and trees.)

☐ Science Wall: Vocabulary Words

Read to the children: Our earth is covered with incredible diversity. Areas around the world greatly vary in their ***landforms*** and ***terrain***. **Place the vocabulary cards LANDFORM and TERRAIN on your science wall. Read and discuss the words and definitions.**

Read to the children: Throughout this unit we have learned that these landforms have been created through movement of tectonic plates, earthquakes, volcanoes, and water.

☐ Art and Poetry Study

Have the children turn to the artwork by Nicholas Chevalier in Lesson 14 of their student journals. Read the following poem to the children while they observe the artwork.

The Hills by Madison Cawein

There is no joy of earth that thrills
My bosom like the far-off hills!
Th' unchanging hills, that, shadowy,
Beckon our mutability
To follow and to gaze upon
Foundations of the dusk and dawn.
Meseems the very heavens are massed
Upon their shoulders, vague and vast
With all the skyey burden of
The winds and clouds and stars above.

Volcanic Mountains

In our study of volcanoes, we've learned that volcanic mountains can form as lava cools and hardens. We know that volcanic mountain chains are also found on the seafloor. It is common to find volcanic mountains along subduction zones where magma can break through the crust. Mount St. Helens in Washington, USA, and Mount Fuji in Japan are beautiful, grand volcanic mountains. **Have the children find these mountains in their student journals and observe the characteristics of the mountains. Then have them label them or draw a line to VOLCANIC MOUNTAINS.**

☐ Optional Mountain Painting Activity

Read to the children: The Blue Ridge Mountains in the eastern United States (pictured to the right) are part of the Appalachian Mountain Range. Notice how the peaks of these mountains seem to go on endlessly into the distance.

Give each child a blank piece of paper (or watercolor paper) and have him or her complete the following steps to create a watercolor mountain landscape.

1. **With a pencil, lightly sketch 5–8 layers of mountains similar to the examples shown here.**

2. **Then select one or more watercolor cakes to dilute. Do this by adding a few drops of water onto a palette or plate. With a wet paintbrush, rub the brush on the cake to extract color, and mix the color with the water on a palette or plate.**

3. **Then paint the layer that is closest to the bottom of the paper first. Mix more water into the colors already on the palette so that the color lightens, and paint the next layer with the lightened color. Dilute the color even more for the next layer. Repeat this process so that the colors get progressively lighter as they move farther into the distance.**

☐ Lesson 14 Extension

7–8

Have the children grades 7–8 complete the self-directed Lesson 14 extension titled "Earth's Resources" in their student journals.

Major Landforms Match

MOUNTAINS

Mountains are land that is lifted up higher than the surrounding area. While some mountains have very steep sides and others are more rounded, all mountains have high elevations with a defined summit. A summit is the highest peak on the mountain. Mountains can have several jagged, rounded, or flat peaks.

HILLS

Hills are mounds of land that rise above the surrounding area. They are usually rounded and are not as high as mountains. This makes hills much easier to climb. You could run up a hill, but you would have to climb or hike up a mountainside.

PLAINS

Plains are areas of mostly flat land that can have trees, grasses, or shrubs. They can be dry, wet, hot, or cold. When plains are found between mountains or hills, they are called valleys.

PLATEAUS

Plateaus are elevated landforms with very steep sides and a flat top. They look like mountains with the tops cut off, and that is precisely what makes them different from mountains; instead of summits, they have flat surfaces.

GLACIERS

Glaciers are large masses of ice, snow, rock, and sediment that have compacted together over time to form a frozen landmass.

GEOLOGY

Grades 3-6

STUDENT JOURNAL

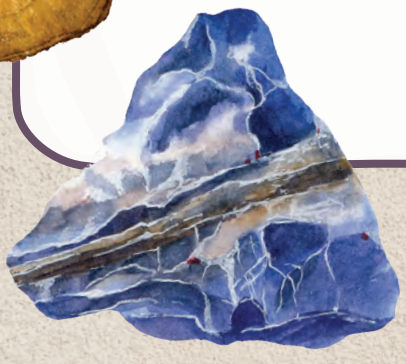
This journal belongs to:

THE GOOD AND THE BEAUTIFUL

INSTRUCTIONS

This student journal accompanies *The Good and the Beautiful Geology* science unit. It contains all the worksheets and journal pages that are needed to complete the unit. Each student will need his or her own copy of the student journal.

Have each student take his or her time to create high-quality work as the activities and worksheets are completed. Students may enjoy looking back on their past discoveries when they've finished.



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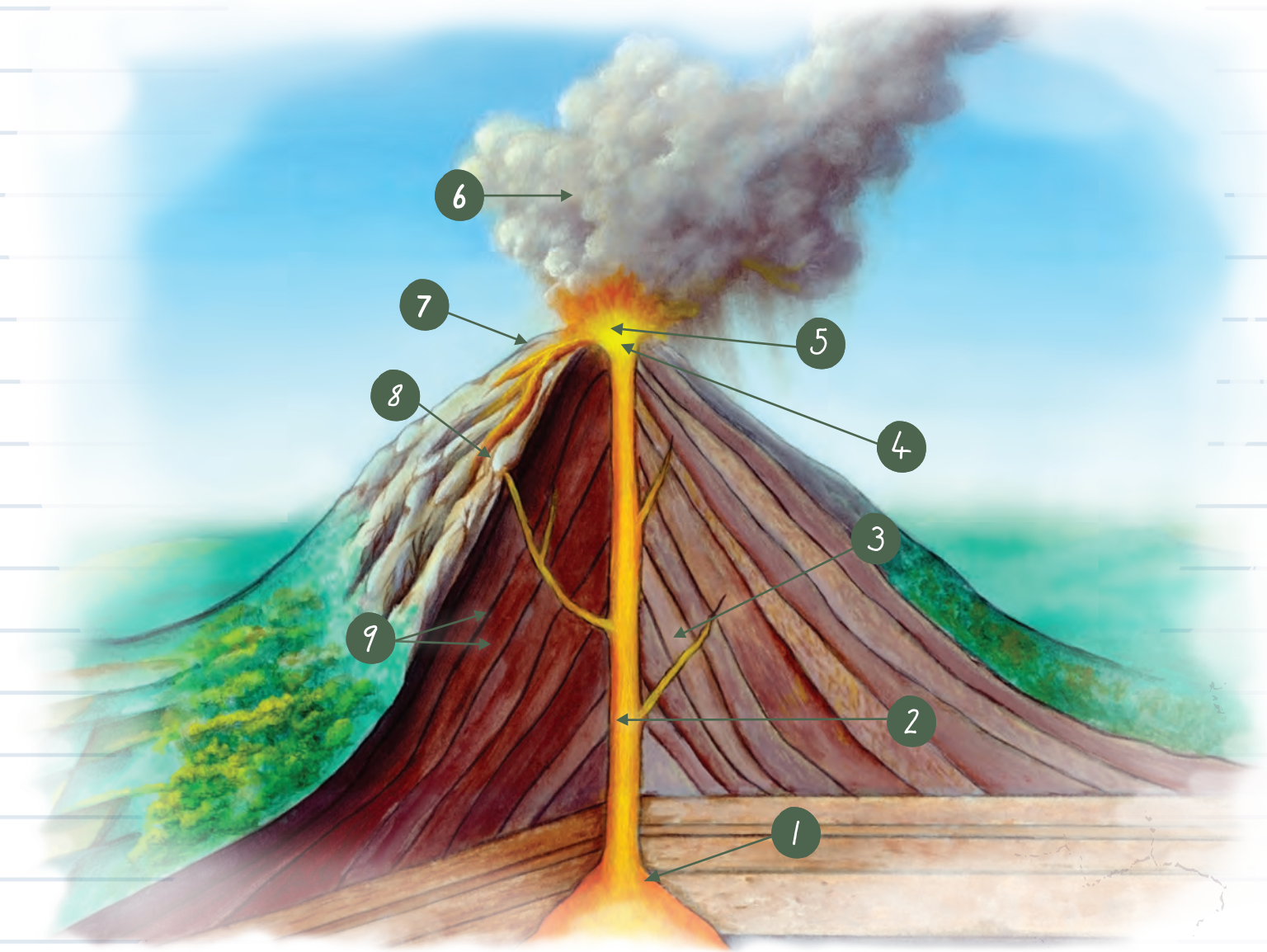
Lesson 5

STRUCTURE OF A VOLCANO

Draw a line to connect each word to the correct part of the volcano.



magma chamber

side vent

conduit

dike

lava

layers of ash and lava

ash cloud

main vent

crater

IS THIS A MINERAL?

1

yes no

2

yes no

3

yes no

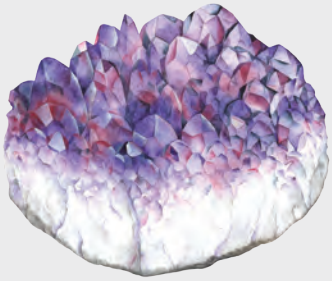
4

yes no

5

yes no

6



yes no




Mineral Name: SELENITE

Color: ● ● ● ● ● ● ● ● ● ○

Streak: ● ● ● ● ● ● ● ● ● ○

Luster: glassy pearly | metallic greasy | dull silky

Hardness: soft | medium | hard

Fracture: smooth chipped | splintered jagged

Sketch:

Cleavage? YES or NO

# of sides: _____

Mineral Name: FLUORITE

Color: ● ● ● ● ● ● ● ● ● ○

Streak: ● ● ● ● ● ● ● ● ● ○

Luster: glassy pearly | metallic greasy | dull silky

Hardness: soft | medium | hard

Fracture: smooth chipped | splintered jagged

Sketch:

Cleavage? YES or NO

# of sides: _____

Mineral Name: AQUAMARINE

Color: ● ● ● ● ● ● ● ● ● ○

Streak: ● ● ● ● ● ● ● ● ● ○

Luster: glassy pearly | metallic greasy | dull silky

Hardness: soft | medium | hard

Fracture: smooth chipped | splintered jagged

Sketch:

Cleavage? YES or NO

# of sides: _____

Lesson 7

PRECIOUS STONES

Match the words and definitions.

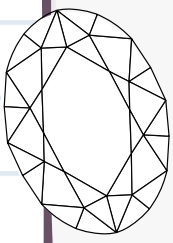
Crystal	a three-dimensional solid that has its internal atoms arranged in a highly organized way
Gem	a rock with a hollow cavity containing crystals
Geode	a crystal mineral that is considered highly valuable; they are often cut and polished to make jewelry

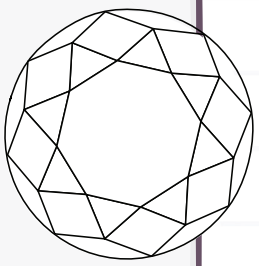
Read the following poem by Christina Rossetti entitled "Precious Stones." Determine which color the three colorless gems should be and color them.

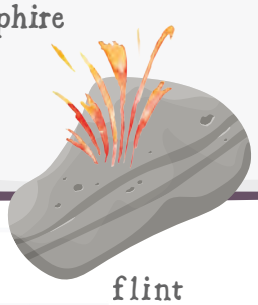

diamond

An emerald is as green as grass;
a ruby red as blood;
A sapphire shines as blue as heaven;
A flint lies in the mud.
A diamond is a brilliant stone,
To catch the world's desire;
An opal holds a fiery spark;
But a flint holds fire.

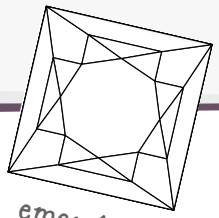

flint


sapphire


ruby


flint


opal


emerald

SEDIMENT JAR

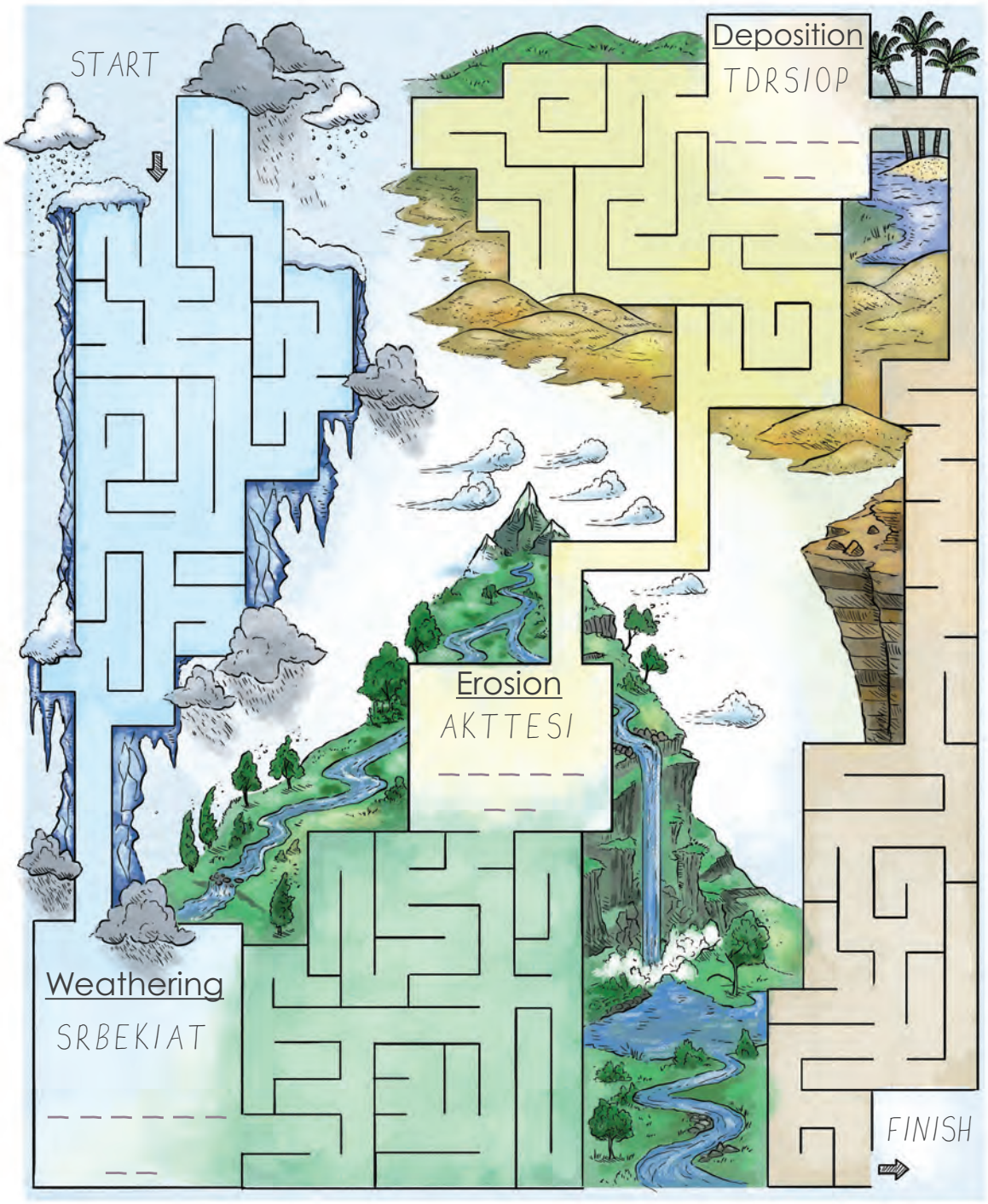
Draw a picture of what your sediment jar looks like. See if you can find and identify any of the layers. If so, use the terms from the word bank below to label the layers.

Soil Salt Sand Pebbles Rocks Baby Powder

Lesson 13

WEATHERING, EROSION, AND DEPOSITION

Find your way through the maze and unscramble the words along the way to find out what each of the processes does.



GEOLOGY

Grades 7-8

STUDENT JOURNAL

This journal belongs to:

THE GOOD AND THE BEAUTIFUL

INSTRUCTIONS

This student journal accompanies *The Good and the Beautiful Geology* science unit. It contains all the worksheets and journal pages that are needed to complete the unit. Each student will need his or her own copy of the student journal.

The lesson extensions are also found here. These extensions are optional for older students (grades 7–8) to complete on their own. Each extension is accompanied by lined paper so the student can keep his or her work in one place.

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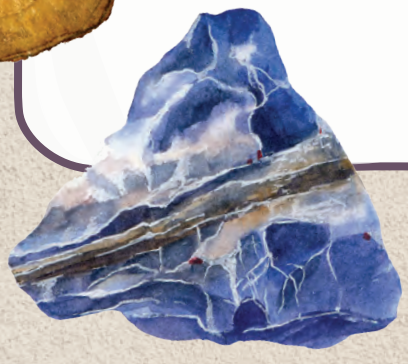

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NAME THAT BOUNDARY

Using the word bank below, find the missing word in each description and write it in the appropriate box. Then write the name of the type of boundary above each description on the line provided.

_____

Oceanic crust converges with oceanic crust. A subduction zone is formed where one crust goes [ ] the other.

_____

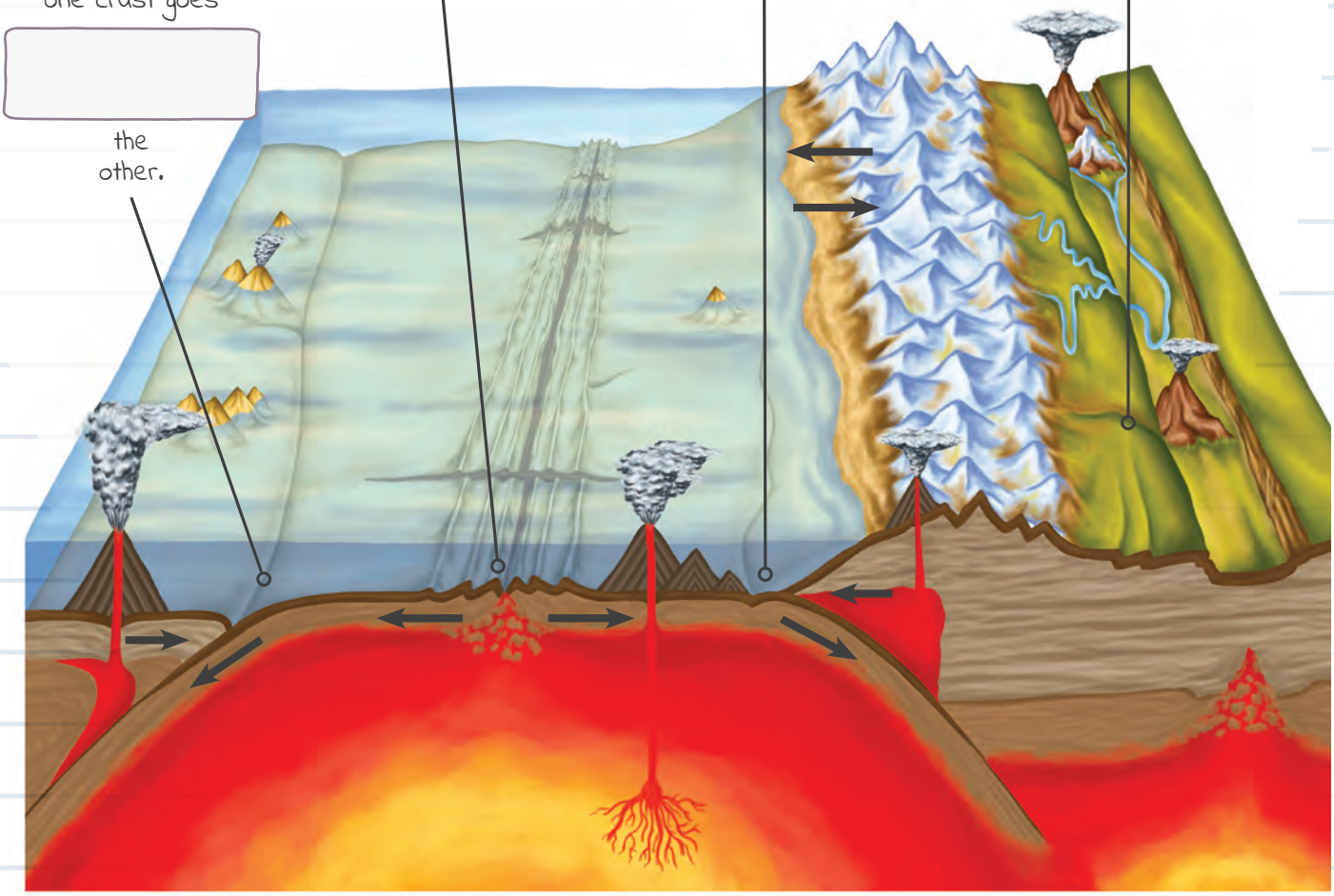
Two plates pull [ ] from each other.

_____

Oceanic crust converges with continental crust. A [ ] zone is formed where the oceanic crust goes under the continental crust.

_____

Two plates slide [ ] each other.



subduction	under	away	past
Convergent Boundary: oceanic/oceanic	Convergent Boundary: oceanic/continental	Divergent Boundary	Transform Boundary

Lesson 6

OBSERVING MINERAL PROPERTIES

COLOR

What is the mineral's color?

Take note that

- different minerals can have the same color. (Ex: Gold and pyrite, also called fool's gold, both have a bright yellow color.)
- some minerals come in more than one color. (Ex: The mineral quartz can be found in colors such as purple, white, or pink.)

LUSTER

How does the mineral reflect light?

Choose one of these descriptive words: glassy, metallic, pearly, greasy, silky, or dull.

Copper: metallic

Garnet: glassy

Stilbite: pearly

Nepheline: greasy

Charoite: silky

Kaolinite: dull

FRACTURE + CLEAVAGE

How does the mineral look when it breaks (fractures)?

- Fractures can be described as smooth, splintered, chipped, or jagged.
- Does it leave a smooth, flat surface or side? If so, it also has cleavage (all minerals fracture, but not all have cleavage). How many sides have cleavage?

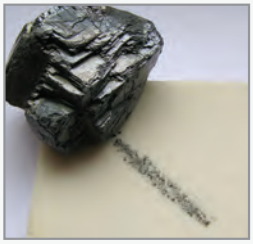
Kyanite: splintered fracture, 1 side of cleavage

Calcite: smooth fracture, 6 sides of cleavage

STREAK

When the mineral is scratched (across a streak plate), what color is the powdered trail that is left behind?

The streak color is specific to each mineral. It is the same color even if the mineral itself can come in different colors. (Ex: Although quartz comes in different colors, its streak color is always white.)



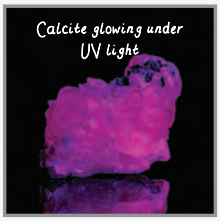
HARDNESS

How hard is the mineral? Hard, medium, or soft?

- The copper nail can only scratch <u>soft</u> minerals.
- The steel nail can scratch both <u>soft</u> and <u>medium</u> minerals.
- Minerals that can't be scratched by either nail are <u>hard</u> minerals.

OTHER

What other observations do you notice? How does it feel and smell? Are there any special things to note?



Some minerals have unusual properties, like glowing in ultraviolet light or under heat, being magnetic, sparking when struck sharply, or fizzing when exposed to acid. (NOTE: You will probably not observe these unusual properties in the minerals you are observing.)

MINERAL OBSERVATIONS

MINERAL NAME:

Color: ____________ Luster: ____________

Fracture: ____________________________

Cleavage? YES or NO # of sides: ____

Streak: __________ Hardness: __________

Other: ____________________________

Sketch:

MINERAL NAME:

Color: ____________ Luster: ____________

Fracture: ____________________________

Cleavage? YES or NO # of sides: ____

Streak: __________ Hardness: __________

Other: ____________________________

Sketch:

MINERAL NAME:

Color: ____________ Luster: ____________

Fracture: ____________________________

Cleavage? YES or NO # of sides: ____

Streak: __________ Hardness: __________

Other: ____________________________

Sketch:

MINERAL NAME:

Color: ____________ Luster: ____________

Fracture: ____________________________

Cleavage? YES or NO # of sides: ____

Streak: __________ Hardness: __________

Other: ____________________________

Sketch:

MINERAL NAME:

Color: ____________ Luster: ____________

Fracture: ____________________________

Cleavage? YES or NO # of sides: ____

Streak: __________ Hardness: __________

Other: ____________________________

Sketch:

MINERAL NAME:

Color: ____________ Luster: ____________

Fracture: ____________________________

Cleavage? YES or NO # of sides: ____

Streak: __________ Hardness: __________

Other: ____________________________

Sketch:

EXTENSION

Instructions:

1. Read the information below.
2. Describe what a mud pot and a travertine terrace are and how minerals play a role in these hydrothermal features.

Minerals and Mud Pots

As we study geology, we gain a greater appreciation for God's handiwork. English physicist James Joule said, "After the knowledge of, and obedience to, the will of God, the next aim must be to know something of His attributes of wisdom, power, and goodness as evidenced by His handiwork."

Some of the most interesting of God's creations include hydrothermal features. Similar to volcanoes, hydrothermal features have openings in the earth's crust from which heat can escape. Rather than lava, they expel water. Under these openings lies a network of channels and chambers in which water collects and escapes back up to the surface.

A special type of hydrothermal feature is called a ***mud pot***. This is an acidic hot spring capable of breaking down the surrounding rock, resulting in mud that rumbles and pops (similar to the way boiling oatmeal would look).

Minerals that are found in the mud can turn the mud pots into various colors. In Yellowstone National Park, USA, there are mud pots known as "paint pots" because they are tinted pink, beige, and gray from the iron oxide found in the mud.

Another beautiful display of the way minerals and hydrothermal features interact is found in ***travertine terraces***. Hot water dissolves minerals such as limestone. The minerals rise with the water, collect, and solidify on land, resulting in stunning terraces. These types of terraces are found at Yellowstone's Mammoth Hot Springs.

This type of hydrothermal feature is also found in Pamukkale [paw–MOOK–kuh–lay], Turkey. *Pamukkale* means "cotton castle" in Turkish. It is a geologic

Yellowstone mud pot

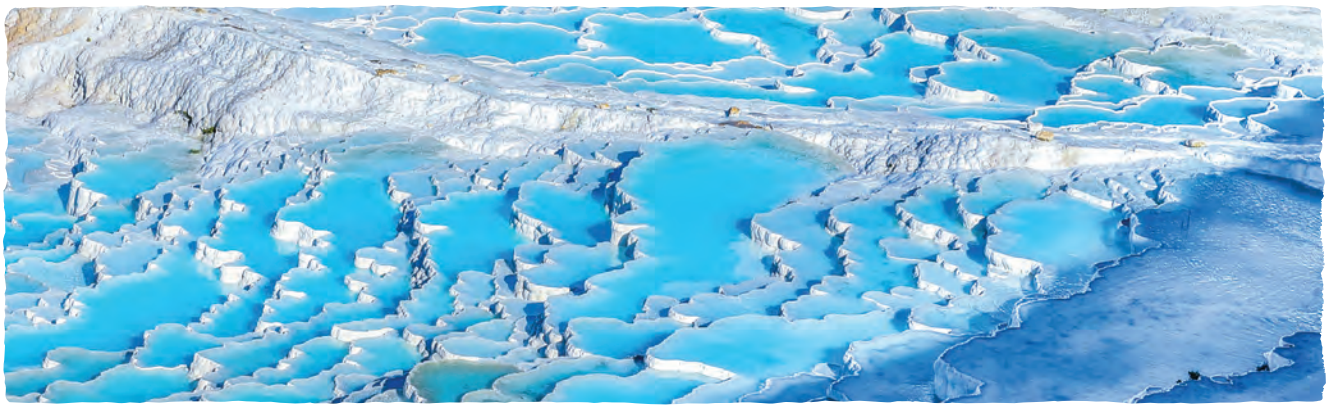
Yellowstone "paint pot" mud pot

hot spot where the heated underground water makes its way to the surface and emerges as hot springs. As the water passes through channels in the rock to reach the surface, a mineral called calcium carbonate dissolves into the water. The mineral-filled water flows across the land and collects in shallow pools. When water evaporates from these pools, the solid terrace-building mineral, called travertine, is left behind. These deposits at Pamukkale are especially striking because of the pure white color of the mineral calcium carbonate and the terraced layers of limestone rock over which it forms, creating the spectacular "cotton" walls that give the region its name.

It's pretty incredible what minerals can do to bring color, beauty, and variety to God's creations that we enjoy here on Earth.

Mammoth Hot Springs, Yellowstone, USA

Pamukkale, Turkey



Lesson 7

PRECIOUS STONES

Match the words and definitions.

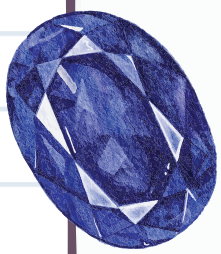
Crystal	a three-dimensional solid that has its internal atoms arranged in a highly organized way
Gem	a rock with a hollow cavity containing crystals
Geode	a crystal mineral that is considered highly valuable; they are often cut and polished to make jewelry

Determine which precious stone name should go in each blank space by looking at the pictures. Fill in the blanks with the correct precious stone name. Then read the following poem by Christina Rossetti entitled "Precious Stones."

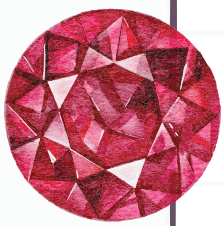
diamond

An _____ is as green as grass;
a _____ red as blood;
A _____ shines as blue as heaven;
A _____ lies in the mud.
A diamond is a brilliant stone,
To catch the world's desire;
An opal holds a fiery spark;
But a flint holds fire.

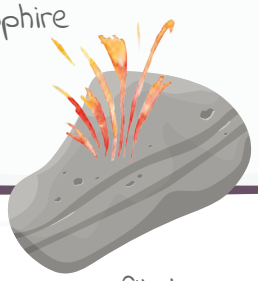
flint



sapphire



ruby



flint

opal

emerald

INTRUSIVE ROCKS

stone granite

This rock has a "salt and pepper" look that is formed from white plagioclase (a type of feldspar) and black minerals called hornblende and biotite. This coarse-grained rock often forms above convergent boundaries (where an oceanic plate subducts beneath a continental plate). In the stone industry, it is often used for faux (fake) granite countertops.

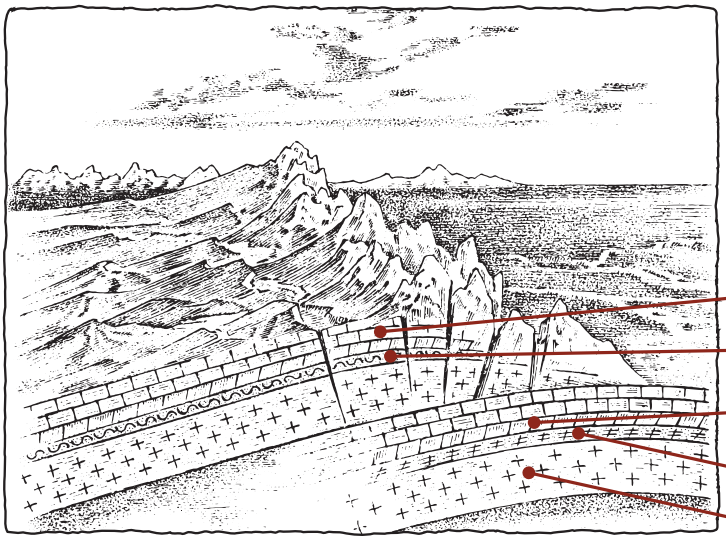
This rock usually looks light pink or gray with distinguishing crystals, which often give it a slightly speckled look. It is mostly made of quartz and feldspar. It is the best-known intrusive igneous rock because there is plenty of it on the earth's surface in mountains that have risen up to above the earth's surface. We use this for many things, such as countertops, tiles, and the outsides of buildings.

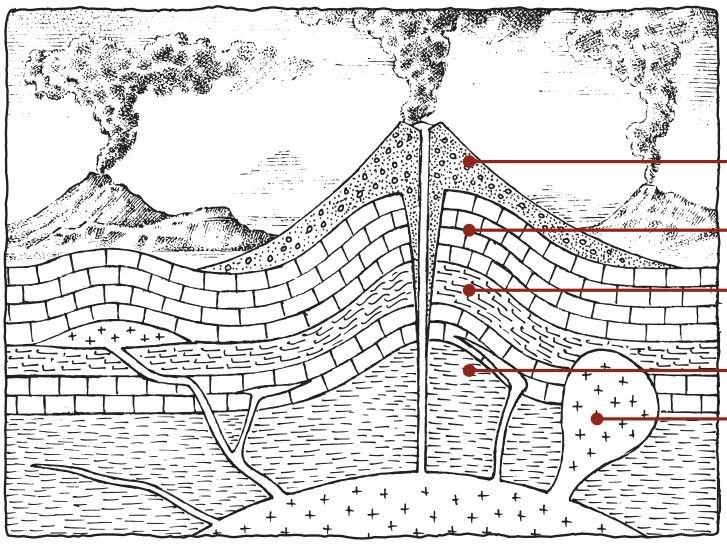
This coarse-grained rock is typically a greenish color. This rock is found in the earth's crust and forms in vertical pipe-like structures. While this is a rarer type of rock, it is well-known because it has the perfect conditions for diamonds to form; in fact, it is the main source of mined diamonds today.

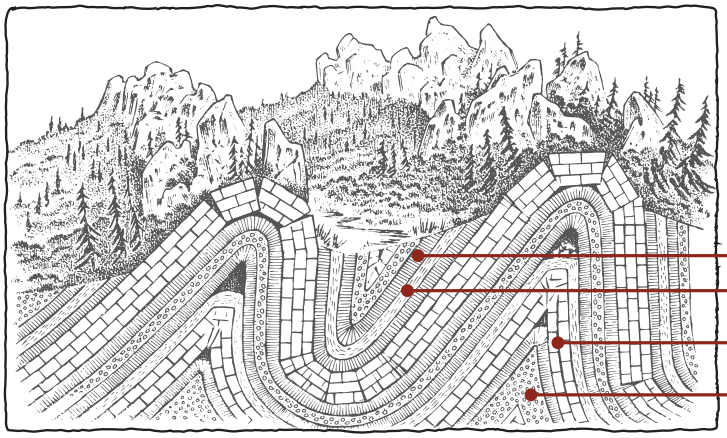
Lithology Maps

LITHOLOGY KEY

- limestone
- conglomerate
- shale
- chalk
- intrusive igneous
- soft clay
- dolostone
- siltstone
- metamorphic rock







EXTENSION

Instructions:

1. Read the information below. In your science journal, create a timeline, marking the dates of theories or creations made by these notable geologists.
2. The discoveries by many geologists were sometimes met with criticism. In your science journal, write down some character traits you believe they possessed in order to continue with their work despite these difficulties.

Notable Geologists

Without the hard work of geologists, we wouldn't know all the amazing things that we do. Their passions, interests, and talents have been able to further our understanding of the earth we live on.

Alfred Wegener (1880–1930)

In 1912 this German geologist proposed a theory called continental drift. Wegener [VAY–gun–er] claimed that the continents used to be one landmass that slowly drifted apart. This idea didn't come to him overnight, but instead, it began as a curious study of a world map. While browsing at the library, he read some interesting research about identical fossils that were found in both Brazil and Africa. He learned of fossils of tropical creatures located in nontropical areas. He also found that the geological composition of the Appalachian Mountains in the United States matched that of the Scottish Highlands in the United Kingdom. Though Wegener used these findings to support his claim, it was widely rejected. However, his ideas set a foundation for the now-accepted theory of plate tectonics.

Louis Agassiz (1807–1873)

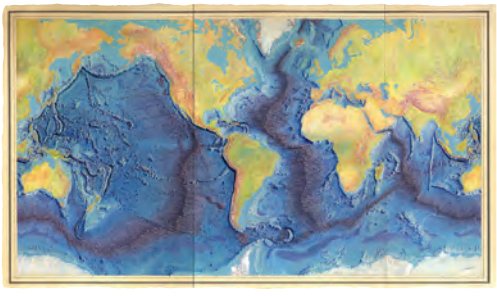
Agassiz [AG–uh–see] studied long scratches in rock that were left by glaciers. These scratches were found on landforms where glaciers could not have existed, such as in warm valleys. In 1840 his research supported the idea of our earth experiencing an Ice Age. Agassiz said, "The glacier was God's great plough set at work ages ago to grind, furrow, and knead over, as it were, the surface of the earth." Agassiz was also a biologist who studied animal kingdoms and classifications, especially living and fossilized fish. He firmly believed that God created the earth and that every species was created as "a thought of God."

William Smith (1769–1839)

This English geologist's interest in rocks was sparked by merely noticing a pattern. For his work, Smith had to descend into mine shafts, where he discovered sequential patterns in the rock strata (layers). He also found numerous fossils in the rock and categorized them into groups. In 1815 he created a geological map of all of England and Wales, based on his findings of different types of rock forms. Smith was incredibly detailed and meticulous in his work, which led him to develop techniques still used by geologists today. He is named the "Founder of Stratigraphy."

Marie Tharp (1920–2006)

Tharp began her study of geology in college just before World War II, where a flyer posted on a bulletin board caught her eye. It not only promised a degree in geology but also guaranteed a job. Since most men were off fighting in the war, many women took part in this degree program. After completing her education, Tharp started a partnership with Bruce Heezen, an American geologist, and spent the next 25 years studying records of how sound waves bounce off the seafloor. This gave hints to the seafloor's topography, or its physical features. By 1957 Tharp and Heezen successfully published a map of the Atlantic Ocean floor, including the discovery of the Mid-Atlantic Ridge. Then, in 1977, they mapped and published *The World Ocean Floor*. Because of Tharp's great work and diligence, we now have a better understanding of the seafloor.



This painting of the mid-ocean ridges was done by Heinrich Berann based on the scientific findings of Marie Tharp and Bruce Heezen (1977).

Lesson 14

MAJESTIC MOUNTAINS

Label each mountain range with the correct mountain form.