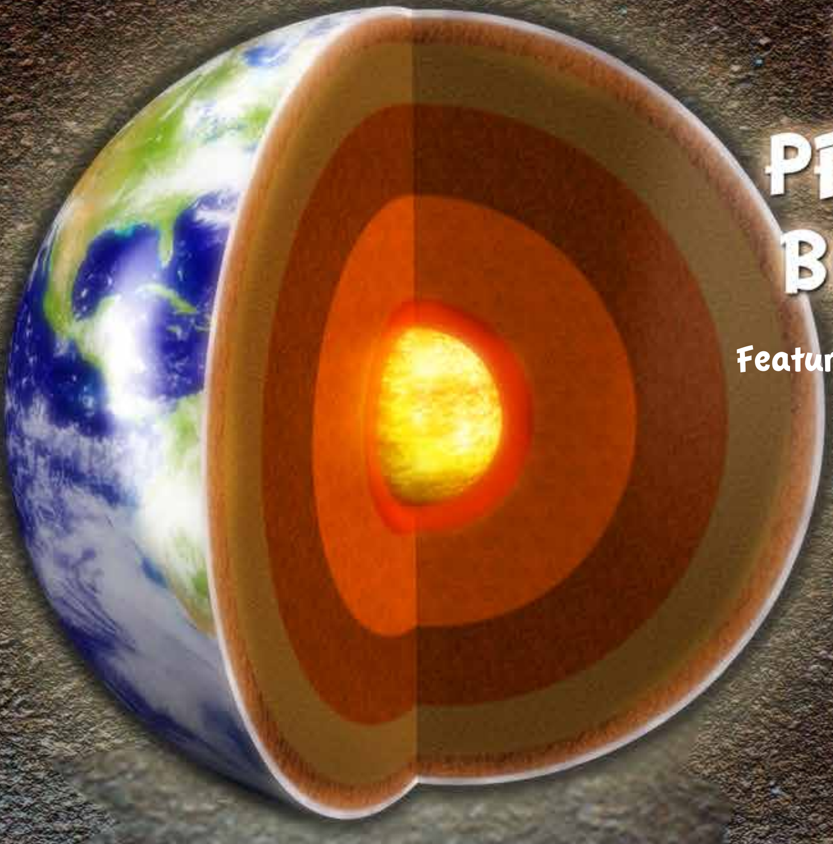
FOCUS ON

MIDDLE SCHOOL GEOLOGY

3rd Edition

PREVIEW BOOKLET



Featuring Chapters from:

Student Textbook
Laboratory Notebook
Teacher's Manual
Lesson Plan
Study Notebook
Quizzes
Graphics Package

Rebecca W. Keller, PhD

REAL SCIENCE 4 Kids

Introduction

Welcome to the ***Focus On Middle School Geology 3rd Edition Preview Booklet*** where you can take our one semester unit study program for a test run!

The materials sampled in this book are taken from a full semester course, with two chapters from each part of the curriculum:

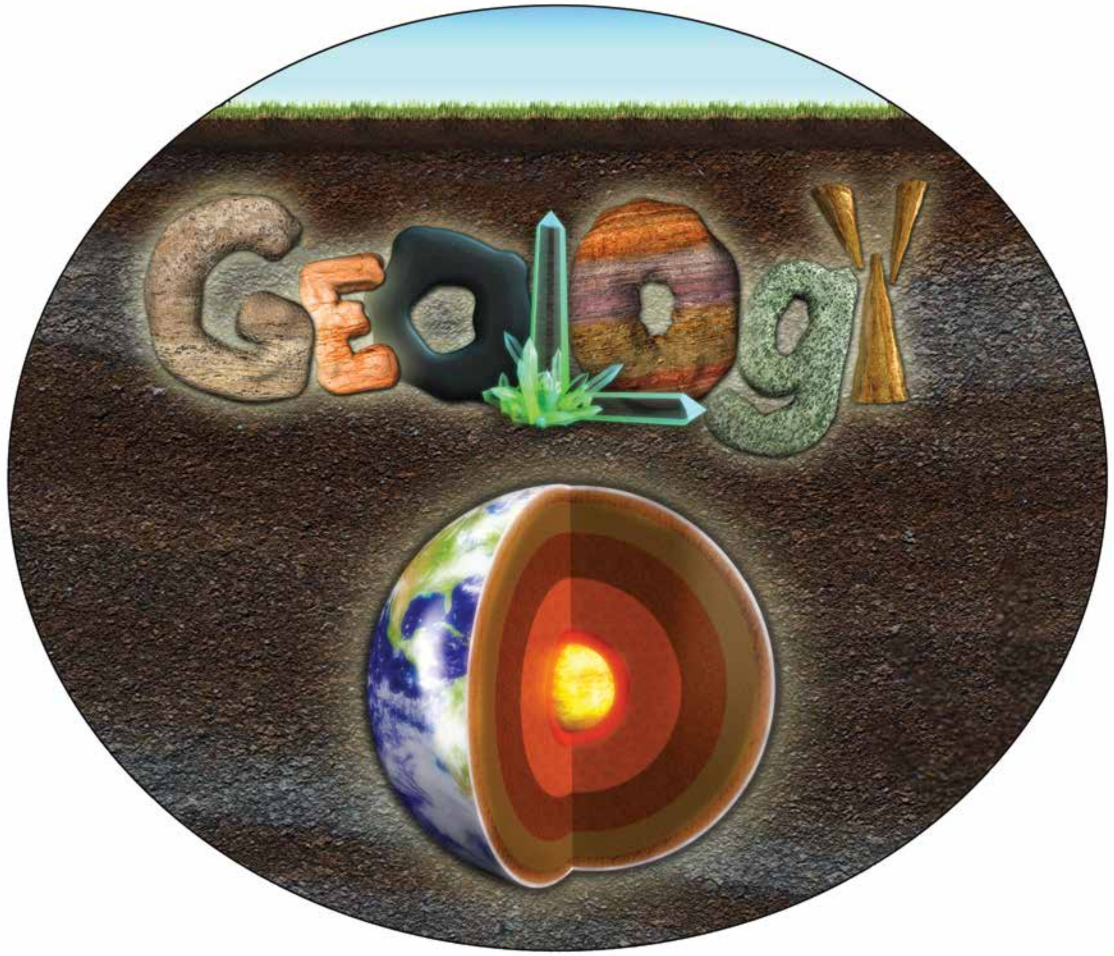
- The ***Focus On Middle School Geology Student Textbook–3rd Edition*** provides foundational science concepts presented in a way that makes it easy for students to read and understand. The many colorful illustrations make each chapter fun to look at and reinforce concepts presented.
- With two science experiments for each chapter, the ***Laboratory Notebook*** helps young students learn how to make good observations, an important part of doing science. Open-ended questions help students think about what they are learning, and information is provided to assist students with understanding what they observed while performing their experiments.
- The ***Teacher's Manual*** includes instructions for helping students conduct the experiments, as well as questions for guiding open inquiry. The commonly available, inexpensive materials used for all the experiments can be seen in the complete materials lists included in this booklet.
- Using the ***Lesson Plan*** makes it easy to keep track of daily teaching tasks. A page for each chapter in the ***Student Textbook*** has the objectives of the lesson and questions for further study that connect science with other areas of knowledge, such as history; philosophy; art, music, and math; technology; and language. Forms are included for students to use to do a review of material they've learned and to make up their own test for the chapter. Also included are icons that can be copied onto sticker sheets and used to help plan each day of the week.
- With the ***Study Notebook*** students learn to use critical and creative thinking while exploring their ideas about science. Thought questions are provided, and students are invited to take ownership of their learning by coming up with more questions and by doing research into their areas of interest.
- The one final and two midterm ***Quizzes*** are self-explanatory. For those who are not fans of quizzes, students can use the self-test at the end of the ***Lesson Plan*** instead.
- Another type of teaching aid is provided in the ***Graphics Package,*** which has two full-color images from each chapter of the ***Student Textbook.*** These graphics can be used to create additional teaching aids, such as flash cards, wall posters, PowerPoint lectures, or overhead projections.

FOCUS ON

Grades 5-8

MIDDLE SCHOOL

3rd Edition



Rebecca W. Keller, PhD

Real Science-4-Kids

Illustrations: Janet Moneymaker

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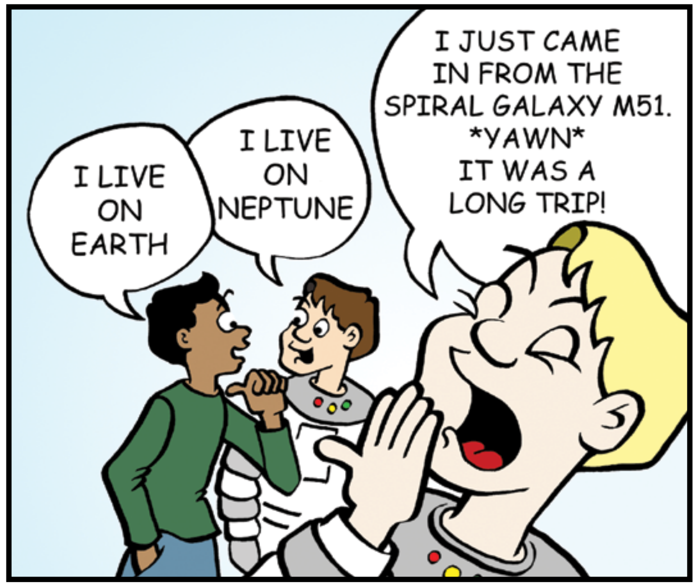
1.1 Introduction



Most people probably don't often think about Earth being the place where they live. When you ask someone where they live, they might reply "on 4th Street" or "in Minneapolis," but rarely do you hear "on Earth." In fact, everyone lives on Earth, and as far as we know, there is no one living on any other planet. Most people don't often wonder about what the Earth is made of or think about Earth being only one of many planets in the universe.

So what is the Earth? What is it made of? Has it always been this way, or has it changed? Why can Earth support life and the Moon can't? What makes Earth special? Finding out about the Earth, what it is made of, and how it changes are inquiries into the scientific field of geology.

1.2 What Is Geology?

The word geology comes from the Greek root words *geo* which means "earth" and *logy* which means "the study of." So geology is "the study of Earth." Geology is a science that focuses on bringing about a better understanding of the structure and history of Earth, the planet we live on.

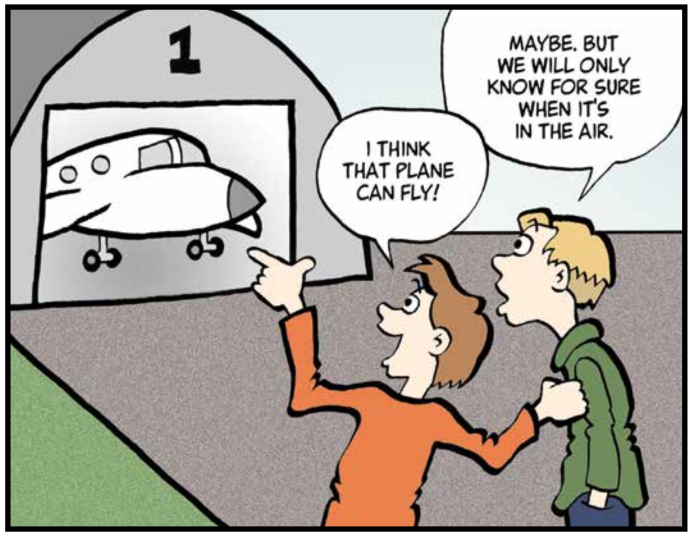
The field of geology is divided into two broad categories — physical geology and historical geology.

Physical geology examines the chemical and physical nature of Earth and also the processes that operate on and inside Earth. Physical geology explores the Earth's surface, the processes that form the Earth, and the heat energy that drives these processes.

Historical geology examines the origin of Earth and incorporates biology, chemistry, and physics in an attempt to create a chronological narrative, or story, about how the Earth came into being and how it has changed over time.

1.3 Interpreting Geological Data

Science has two parts. One part is collecting scientific data through observation and experimentation. The second part is to find out what the data mean, and this is called interpretation. Interpreting scientific data is the process that scientists use to draw conclusions, formulate theories, and develop scientific laws and principles.



Because science is a human endeavor, the interpretations of scientific data are subject to human bias and presupposition. In science a presupposition is an assumption about how something works and is usually based on preexisting beliefs and sometimes on previous experience. For example, because it is known that planes can fly, if a plane is seen in a hangar, the assumption may be that the plane will fly even if this particular plane has not been seen in the air.

It is not incorrect for presuppositions to be used in science, and scientists do use them all the time. However, scientists may begin research with differing presuppositions, and even though scientists use logic and strive to be objective, there is often disagreement about how scientific data should be interpreted.

Disagreements in science are a vital part of scientific investigation and should be encouraged because they can lead to new ideas and new ways of thinking about observations. However, many people, including scientists, are uncomfortable with arguing.

Many scientists see the world in a certain way, and since they are not open to other points of view, they insist that every other scientist see the world in the same way. The way someone "sees the world" is called their worldview. Someone's worldview is made up of the philosophies and beliefs that they use to understand the world around them. There are as many different worldviews as there are people because no two people see the world in exactly the same way. This difference between worldviews causes many arguments in the scientific community.

Geologists with different worldviews disagree about how the Earth came into being, how old it is, and how it has changed over time. Most of these disagreements occur in the area of historical geology and the historical narrative for Earth. But sometimes they also occur in the area of physical geology, especially if historical presuppositions are used to develop physical theories.

This text will focus on physical geology and will not discuss different historical narratives for Earth. However, it is important to keep in mind that interpreting geological data is an exciting and dynamic part of studying geology and that disagreements help advance our understanding of Earth.

1.4 Why Study Earth?

Have you ever wondered why mountains are very tall and oceans are deep? Have you ever wondered why a desert has very little rain but it rains all the time in a tropical forest? Have you ever wondered where earthquakes come from or why some mountains erupt as volcanoes and others don't? Have you ever thought about where we get iron, copper, and oil?

Earth is a unique planet in our solar system and provides the habitat for all living things, including human beings! By studying Earth we begin to understand what makes Earth so special.

We can learn where to find natural resources that improve the quality of our lives. We can also learn what causes certain geological catastrophes, such as earthquakes and hurricanes so we can help people prepare for and protect against devastating losses. We can learn how beautiful landscapes or vast forests have developed and work to preserve Earth's geological features. By studying Earth we can both protect Earth's native beauty and resources and use them to provide a future for the next generation.

1.5 What Do Geologists Study?

If you've ever met a geologist, you might have noticed that they can spend a lot of time outdoors — hiking up mountains and walking through fields. They also tend to collect a lot of rocks!

Geologists study the Earth, and in order to do this they go outside to explore and observe what is on and in the Earth.

A geologist studies snow
Photo Credit: US Geological Survey/by Lyn Topinka

There is much to investigate since Earth is a complex planet that is changing every moment of every day — whether it's rocks falling in a landslide, the top of a mountain breaking apart as a volcano erupts, or the ground moving in an earthquake.

A geologist studies erosion near the Dead Sea, Israel

Photo Credit: Mark A. Wilson, The College of Wooster

There are many different branches of geology, and each focuses on different aspects of the Earth. One branch of geology is called geochemistry. Geochemistry is the study of the chemistry of Earth. The Earth is made of atoms and molecules, just like all matter, and geochemists study the specific types of atoms and molecules that form Earth. In order to study the chemistry of Earth, geochemists take samples of the rocks, minerals, soils, and other matter that Earth is made from and analyze the samples. In this book we will take a close look at the matter that makes up Earth.

Another branch of geology is called structural geology, which deals with the internal structure, form, and arrangement of rocks. Structural geologists study how rocks deform to make mountains and valleys. Deformation occurs when the shape and size of rocks change due to bending, twisting, or fracturing.

There are also geologists who look for energy resources like gas, oil, and coal. This branch of geology is called resource geology. Resource geologists look for the natural resources that humans need for living on Earth.

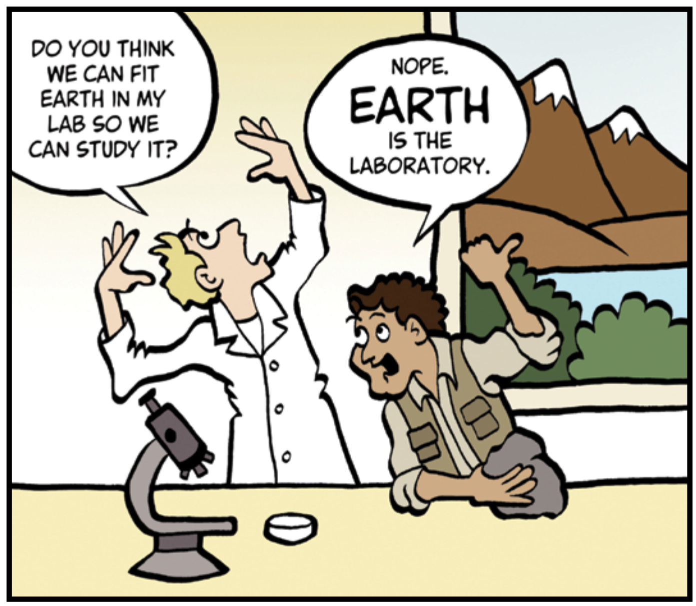
Deformed rock near Barstow, California

Photo Credit: Mark A. Wilson, The College of Wooster

When humans interact with Earth, sometimes they modify or change the environment, which includes those factors that affect living organisms, such as landscape, water, and air quality. Geologists need to monitor changes to the environment to help protect and clean it up. Geologists who study environmental changes caused by human activities are called environmental geologists.

1.6 Geology and the Scientific Method

In the science of geology, Earth itself is often the laboratory. Because things can happen very slowly on Earth, designing experiments and collecting results can be difficult. For this reason, geologists address many questions about Earth by observing features in rocks or landscapes, collecting rock samples, and using electronic equipment, among other things. Geologists formulate hypotheses based on what they've observed and then test those hypotheses. The conclusions they draw may be modified if the hypotheses are found to be incorrect.



Because many of Earth's features are not as testable or as provable as experiments in chemistry or physics, there is often disagreement about what the data mean. Even so, general principles about Earth's features can be proposed. These principles can be thought of as "scientific maps," and it is useful to keep in mind that scientific maps can change with new data or revised hypotheses.

1.7 Summary

- Geology is the study of Earth.
- Geology is divided into two broad categories — physical geology and historical geology.

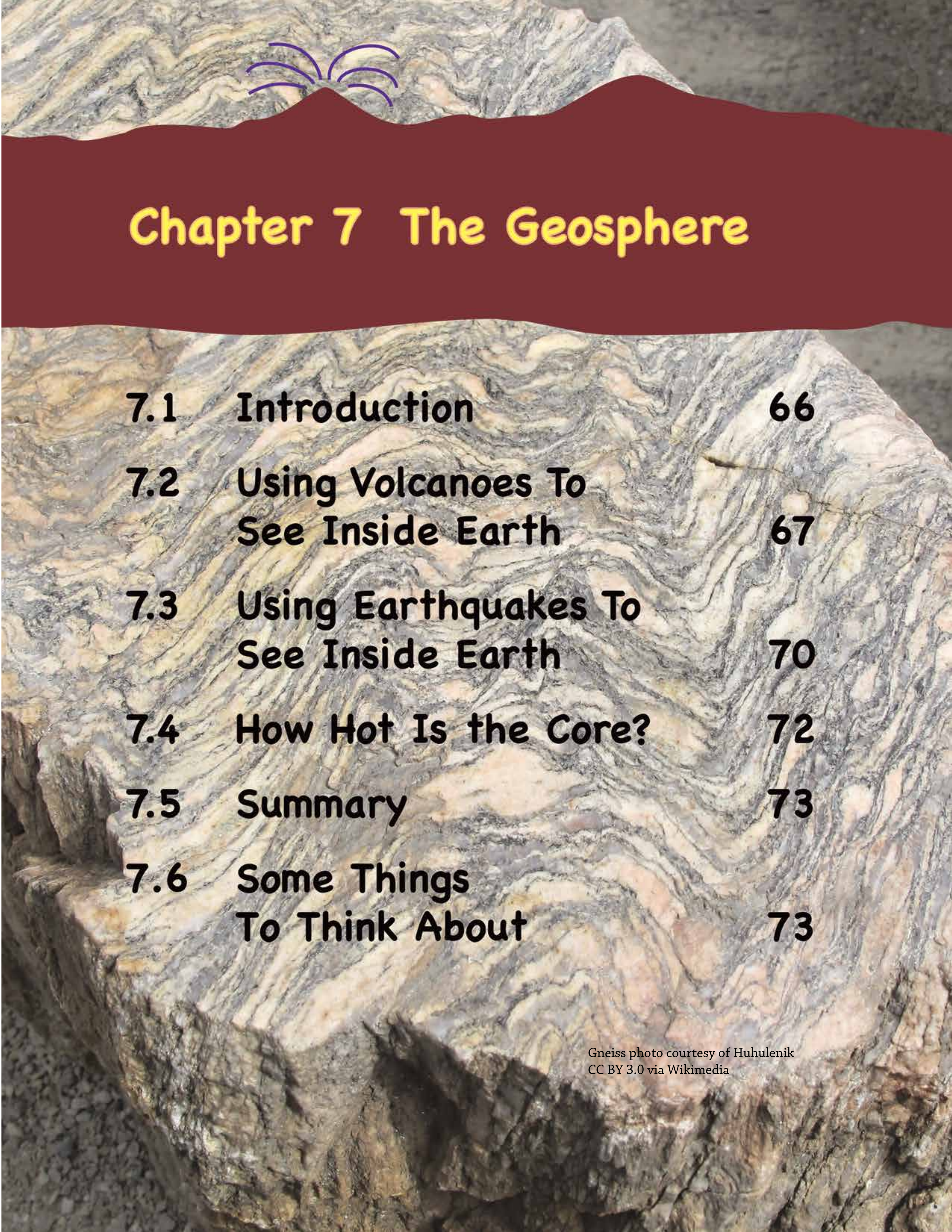
- Physical geology examines the chemistry and physics of Earth. Historical geology attempts to create a chronological and historical narrative about Earth's origins.
- A person's worldview is made up of the philosophies and beliefs they use to understand the world around them.
- Geologists study Earth to learn more about Earth's features, to protect Earth's environment, and to find Earth's resources.

1.8 Some Things to Think About

- Go outside and look around. Based on what you see, describe what you think the Earth is made of.
- Which category of geology do you think would be the most interesting to study: physical geology or historical geology? Why?
- Do you think it can be difficult for people to listen to others who are expressing a very different worldview? Why or why not?
- Do you think it can be difficult for people to change their worldview? Why or why not?
- What would you most like to learn about Earth? Why would you find this interesting?
- Which of the following branches of geology do you think would be the most interesting to study? Why?

  Geochemistry
  Structural geology
  Resource geology
  Environmental geology
- How would you define a "scientific map"?

Chapter 7 The Geosphere

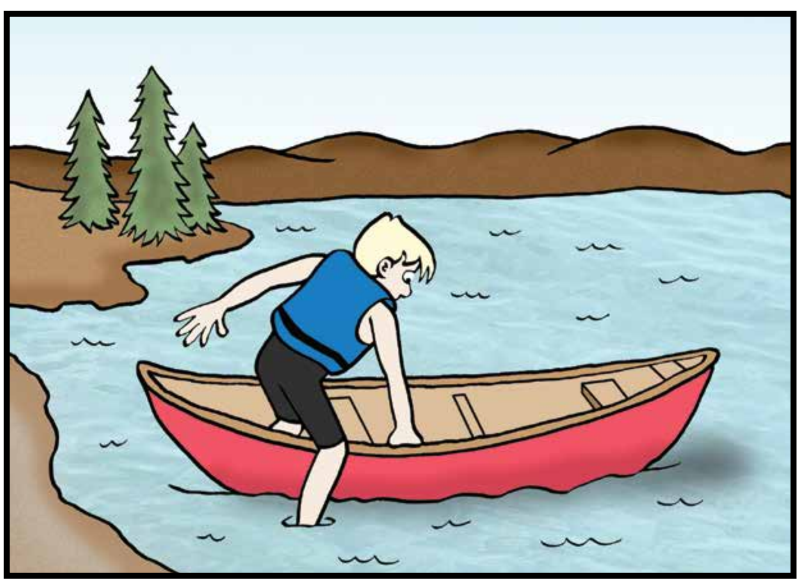


Gneiss photo courtesy of Huhulenik CC BY 3.0 via Wikimedia

7.1 Introduction

If you take a walk through the forest, you might notice birds sitting in the trees, small plants growing from the soil, mushrooms bursting out of rotten logs, and squirrels gathering food for the winter. All of the living things you see are supported by the rocks, soil, and minerals beneath the forest floor. Without a solid surface, plants could not grow and animals could not collect the food they need for survival. The rocky part of Earth is called the geosphere and is made of rocks, minerals, soils found on the surface, and molten rock, or magma, found deep below the surface.

Recall that humans live on the crust, the uppermost part of the geosphere. Although people can travel in the sky to get to another city or traverse the oceans in a boat, all of human life is supported by the rocky geosphere. Humans build houses from materials found on Earth's crust, grow plants and raise animals on Earth's crust, and use rocks and minerals from the crust to create cars, airplanes, and trains. Humans also extract gas and coal from the crust to fuel factories and power boats and even use nuclear energy obtained from rocks to provide electricity to entire cities. We know a lot about the crust, but what do we know about the parts of Earth below the crust? How do geologists study the other layers of Earth?



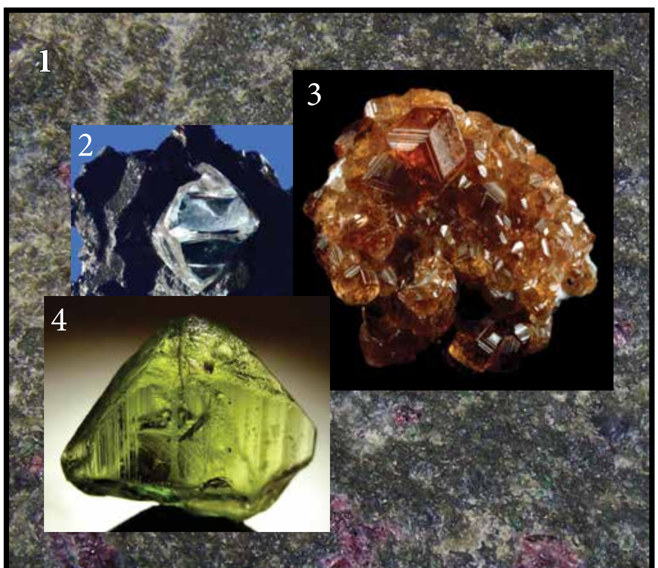
7.2 Using Volcanoes To See Inside Earth

How do scientists know what Earth's interior is made of if we can't sample rocks and minerals below the upper part of the crust? One way scientists study rocks and minerals deep in the Earth is to observe what happens when volcanoes erupt and to study the lava, rocks, and ash that come from the volcanoes.

Gneiss (metamorphic) Granite (igneous)

Gneiss photo courtesy of Huhulenik - CC BY 3.0 via Wikimedia

In a volcanic eruption, magma from within the Earth is brought to the surface. In addition, pieces of rocks formed inside the Earth are often ejected when they are torn loose and carried by the magma as it pushes towards the surface with tremendous force. Granite, an igneous rock, and gneiss, a metamorphic rock, are the most common types of rock ejected by volcanoes.

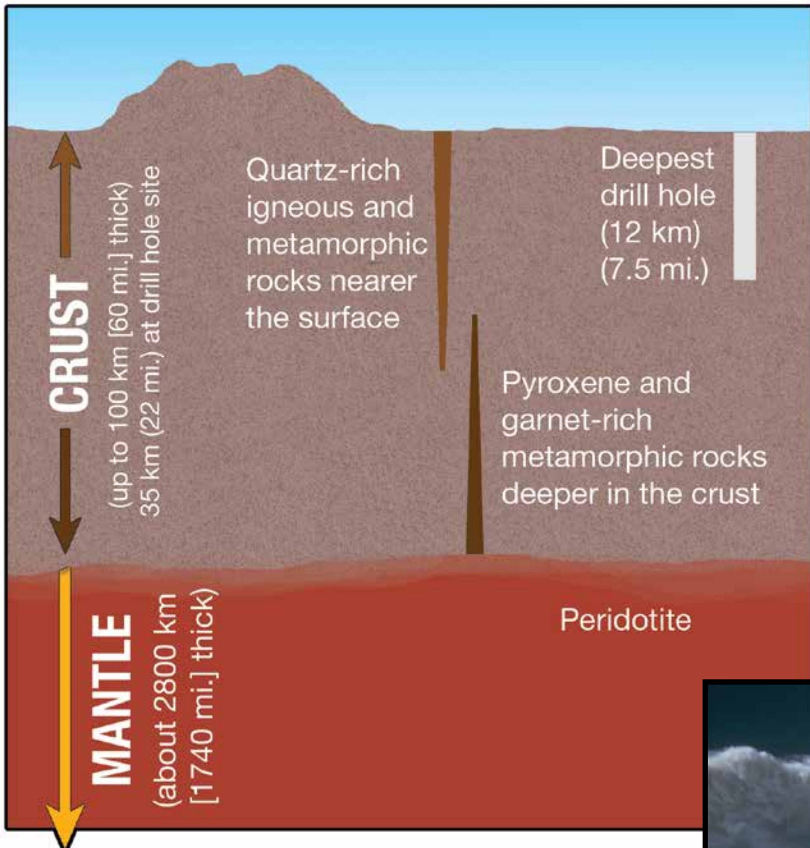


1. Garnet peridotite;
2. Rough diamond in rock (Courtesy of USGS);
3. Garnet (Courtesy of USGS);
4. Olivine (Courtesy of Rob Lavinsky-iRocks.com, CC BY SA 3.0)

Rare gems such as diamonds have been found in rocks that have been ejected during volcanic eruptions. Diamonds are made of pure carbon and most often form more than 150 km (93 mi.) below Earth's surface. Volcanoes also bring up chunks of peridotite, an igneous rock made mostly of the minerals olivine and pyroxene. Peridotite may also contain garnets, some of which can be used as gemstones. Laboratory experiments show that garnet peridotite forms at depths greater than 50 km (31 mi.).

Volcanoes and Volcanologists

1. A volcanic eruption in Hawaii Courtesy of Hawaiian Volcano Observatory (HVO)/USGS by J. D. Griggs
2. Setting up a GPS system to measure deformation of ground (becoming higher or lower), Mt. St. Helens, Washington State Courtesy of USGS by Mike Poland; 3. Collecting volcanic ash samples in Alaska Courtesy of Alaska Volcano Observatory (AVO)/USGS by Kristi Wallace; 4. Taking a sample of lava, Kilauea, HI Courtesy of HVO/USGS; 5. Taking gas samples at the Cookie Monster skylight, HI Courtesy of HVO/USGS by J. D. Griggs; 4. Collecting lava samples, Kilauea, HI (hornito formation in background) Courtesy of HVO/USGS



Information gathered from volcanoes has given scientists an idea about what forms below Earth's surface, with quartz-rich rocks forming nearer the surface of the crust and pyroxene and garnet peridotite in the lower part of the crust closer to the mantle.

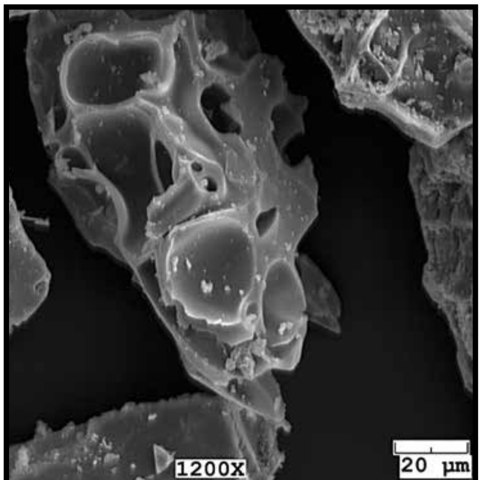
Geologists also study the makeup of volcanic ash to learn more about the interior structure of Earth. Volcanic ash is formed when a volcano erupts explosively. Magma contains dissolved gases that can cause the magma to explode if the gases expand and escape violently into the atmosphere. Solid rock can also be exploded when the force of the escaping gases shatters the rocks.

Ash from Mt. St. Helens, WA collected 39 km away in Idaho

Courtesy of Cascades Volcano Observatory/USGS

Eruption plume of gases and ash Mt. St. Helens, Washington State

Courtesy of Cascades Volcano Observatory/USGS



Ash particle, SEM micrograph

Courtesy of AVO/ USGS/Univ. of Alaska, Fairbanks, by Pavel Izbekov, Jill Shipman

Volcanic ash isn't soft like the ash from a wood fire. Instead, it is made of hard, sharp bits of rock that are the size of grains of sand or smaller. Because the force of the explosion thrusts the ash up into the atmosphere, winds can carry the tiny particles far from the volcano — as much as thousands of kilometers away! By studying the composition of the ash particles, geologists can learn more about what the interior of Earth is made of.

7.3 Using Earthquakes To See Inside Earth

If you live in an area of the globe that's prone to earthquakes, you might have awakened in the middle of the night to a deep rumbling sound and felt your house being shaken by an earthquake. Earthquakes happen in different parts of the world and can be devastating for people living near the origin, or epicenter, of the earthquake. They can cause extensive damage to homes, schools, city buildings, farmland, and other structures that exist on Earth's surface.

A building collapsed on a car during an earthquake, Loma Prieta, CA

Courtesy of USGS by J. K. Nakata

However, earthquakes are very useful for finding out more about Earth's layers. Earthquakes create waves that are caused by the movement of the crust and lithosphere, and these waves can be used to create images of Earth's interior.

Aerial view of the San Andreas Fault in California

Courtesy of Ikluft, CC BY SA 3.0

A satellite view of the Piqiang Fault in China showing how Earth's crust has moved

Courtesy of NASA Earth Observatory images by Robert Simmon and Jesse Allen, using Landsat data from the USGS Earth Explorer

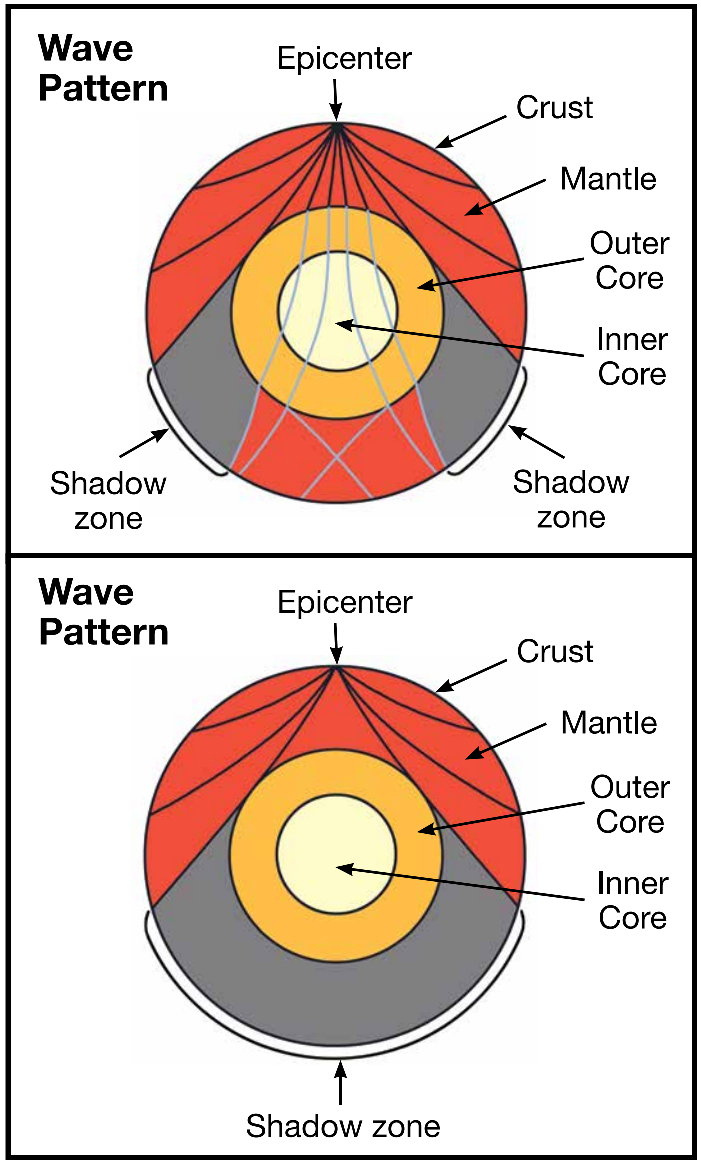
Waves are the transfer of energy through a material such as air, water, wood, rocks, or magma. When you throw a pebble into a pond or strike a tuning fork against a surface, you are creating waves.

When the tectonic plates of Earth's crust move, slide, or bump up against each other, stresses build up as the rough edges of the plates stick together, but the plates themselves continue to move. An earthquake occurs when the stresses become too great and the plates suddenly lurch as the edges release their hold on each other. An earthquake starts at the point where the release between two plates occurs (the epicenter), and the energy this sudden movement creates travels through the surrounding rock in the form of waves.

To measure the waves generated by an earthquake, geologists use a seismometer. Recall from Chapter 2 that a seismometer is a very sensitive instrument that can detect and amplify waves on Earth's surface, in the body of the crust, and below the crust.

How can earthquake waves tell us about Earth's interior? It turns out that the way an earthquake wave travels through the Earth's crust and also through Earth's lower layers allows geologists to construct an image of Earth's interior. Earthquake waves can be used like an x-ray, giving scientists a picture of Earth's internal structure. By using seismometers stationed in many locations on Earth, scientists can determine how fast a seismic wave from an earthquake travels through the Earth from the epicenter of the earthquake to where it comes back to the surface in another location. Scientists can also determine the direction the wave is traveling. Combining the direction of the wave with its speed reveals the velocity of the wave.

This illustration shows how two different wave patterns travel through Earth from the epicenter of an earthquake. The initial waves are caused by movements of tectonic plates that create an earthquake. The waves from the earthquake then pulse through Earth's layers. As the waves move, they are reflected and refracted when they encounter different materials. In some cases the waves are not able to travel through a material. This leaves areas where waves cannot be detected at the surface by seismometers, and these areas are called shadow zones.



We can see that the behavior of seismic waves helps scientists explore and identify the interior parts of Earth's crust, mantle, and core. There is much yet to be discovered about Earth's interior.

7.4 How Hot Is the Core?

How hot is the center of the Earth? If you've ever seen a volcano erupt and watched as hot lava consumed trees, buildings, and cars, you can imagine that the molten rock in the mantle of the Earth is very hot. But how hot is the molten rock at the center of Earth?

The information gathered from earthquake seismic waves traveling through Earth gives scientists some very basic information about the temperatures of the inner and outer cores. Because the analysis of seismic waves can determine whether rock is solid or liquid, scientists can tell whether the rock is above or below its melting temperature. As we have seen, the movement of seismic waves suggests that the outer core is liquid and the inner core is solid.

Since the inner core is thought to be mostly iron that is under extreme pressure from the weight of all the materials above it, lab tests have been done that put iron under extreme pressure to get an indication of what core temperatures might be. The results of these tests combined with computer modeling have helped scientists arrive at estimated temperatures for the inner core.

Currently, the combined data gathered by various research methods suggests that the outer core is about 3000° to 5000°C (5400° to 9000°F). The inner core is thought to reach temperatures of about 6000°C (10,800°F), which is as hot as the surface of the Sun!

7.5 Summary

- The geosphere is the rocky part of Earth and is made of rocks, minerals, soils found on the surface, and magma found deep below the surface. The geosphere extends all the way from the surface of Earth to its very center.
- The Earth has layers that are divided into different sublayers.
- Lava, ash, and rocks ejected by volcanoes can be used to investigate what exists below Earth's crust.
- Earthquakes create waves that can be detected by seismometers and used to investigate Earth's layers.
- The temperature of Earth's inner core is believed to be about 6000°C.

7.6 Some Things to Think About

- Make a list of some of the functions of the geosphere.
- What do you think geologists learn from volcanoes?
- Do you think volcanic eruptions change the geosphere? Why or why not?

- When you have been out walking or riding in the car, what have you observed about rocks and landscapes in your region?

  Do all rocks look alike? Are they the same size, shape, color, and texture?

  Do rocks in a small area tend to look similar? What about in a large area?

  Do they form mountains or sand?

  Write about all the things you have noticed about rocks.

- What do you think earthquakes tell geologists about the geosphere?

- How do geologists study earthquakes?

- Do you think we will someday be able to predict earthquakes? Why or why not? How would earthquake prediction be helpful?

- What factors do you think would need to be taken into account when calculating the temperature of the core?

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Keeping a Laboratory Notebook

A laboratory notebook is essential for the experimental scientist. In this type of notebook, the results of all the experiments are kept together along with comments and any additional information that is gathered. For this curriculum, you should use this workbook as your laboratory notebook and record your experimental observations and conclusions directly on its pages, just as a real scientist would.

The experimental section for each chapter is pre-written. The exact format of a notebook may vary among scientists, but all experiments written in a laboratory notebook have certain essential parts. For each experiment, a descriptive but short *Title* is written at the top of the page along with the *Date* the experiment is performed. Below the title, an *Objective* and a *Hypothesis* are written. The objective is a short statement that tells something about why you are doing the experiment, and the hypothesis is the predicted outcome. Next, a *Materials List* is written. The materials should be gathered before the experiment is started.

Following the *Materials List,* the *Experiment* is written. The sequence of steps for the experiment is written beforehand, and any changes should be noted during the experiment. All of the details of the experiment are written in this section. All information that might be of some importance is included. For example, if you are to measure 236 ml (1 cup) of water for an experiment but you actually measured 300 ml (1 1/4 cup), this should be recorded. It is hard sometimes to predict the way in which even small variations in an experiment will affect the outcome, and it is easier to track down a problem if all of the information is recorded.

The next section is the *Results* section. Here you will record your experimental observations. It is extremely important that you be honest about what is observed. For example, if the experimental instructions say that a solution will turn yellow, but your solution turned blue, you must record blue. You may have done the experiment incorrectly, or you might have discovered a new and interesting result, but either way, it is very important that your observations be honestly recorded.

Finally, the *Conclusions* should be written. Here you will explain what the observations may mean. You should try to write only valid conclusions. It is important to learn to think about what the data actually show and what cannot be concluded from the experiment.

Contents

Experiment 1

Observing Your World

Photo Credit: US Geological Survey/by Lyn Topinka

Introduction

Do you think if you go outside and look carefully, you will see things you haven't noticed before? Try it!

I. Think About It

❶ What features do you think you will see when you go outside?

❷ What do you think the dirt in your yard or in the park looks like?

❸ What geological features do you see when you go to the grocery store?

❹ What man-made features do you see when you go to the grocery store?

❺ In what ways does the weather change where you live? Do you think any changes in the weather affect the landscape?

❻ Do you think places such as a city or a rural area have a history? Why or why not?

II. Experiment 1: Observing Your World

Date ___________

Objective ____

____

Hypothesis ____

____

____

Materials

pencil, pen, colored pencils
small jar
trowel or spoon
binoculars (optional)

EXPERIMENT

❶ Step outside your front or back door and walk until your feet are on some type of ground (dirt, grass, or concrete).

❷ Observe where you are. Are you in a city? Are you in the country? Use the space below to draw or write what you see.

❸ Observe any geological features near you. Do you see mountains? Do you see lakes or rivers? Do you see the ocean? Do you see other geological features? Record what you are observing.

❹ Use the trowel to collect a small sample of dirt. (If you live in the city, walk to a park or some other place where you can collect a dirt sample.)

❺ Observe the dirt sample. Is it light in color? Dark? Does it contain small rocks? Large rocks? Does it have any organic matter (living things, such as grass or bugs)? Record what you observe.

❻ Observe any man-made structures. Do you see buildings? Roads? Bridges? Other man-made structures? Record what you see.

❼ Observe any dynamic features in your area including the weather. Do you get earthquakes? Do you live near a volcano? Does it rain frequently, or do you get very little rain where you live? Do you have tornadoes, hurricanes, or severe snow storms?

❽ Think about the area in which you live. What is its history? How long has it looked the way it looks today? If you are in a city, how long has the city been there? What do you think it looked like before there were buildings, roads, or other structures? Write your observations below.

Results

Assemble your data in the chart below.

Data Describing Where I Live	
Geological Features	
Soil Type	
Man-made Structures	
Dynamic Processes	
Weather	
History	

III. Conclusions

Review the observations you made during this experiment. What did you observe that you had not noticed before? Do you think that taking the time to look at things carefully makes a difference in what you observe? Why or why not?

IV. Why?

The first step towards understanding the world around you is to observe it. Before you can know what the world looks like, how it changes, and how the different parts work together, you have to go outside and observe buildings, rocks, the soil, clouds, sunlight, plants, and animals. You need to observe the weather, how it changes, and how it affects the landscape and living things. Observations made over time are important for noticing how living things and their activities change with the seasons. Even though you may "think" you know what the world around you looks like, you don't actually know until you observe it. Also, the world around you changes daily, weekly, monthly, and yearly.

If you live in the city, buildings are constructed, torn down, and rebuilt. Weather fades colors that were once brightly painted. Trees grow and fall down. Grass grows and is mowed. In the country, fields are plowed and crops grow and are harvested. Animals have babies that grow to be adults. Storms create rivers, and snow and ice melt, sometimes creating floods.

By observing the world around you, you can learn about how geology works. The world becomes more interesting when you pay attention to what things look like, how they change, and how they stay the same.

V. Just For Fun

Imagine you got an email from someone on the planet Alpha Centauri Bb. They have never been to Earth, and they ask you what Earth is like. Using the data you have collected, write a narrative (story) describing what the area is like where you live. Include enough detail that the Alpha Centaurian can form a mental image of your surroundings.

Email to an Alpha Centaurian

Experiment 7

Modeling Shaky Ground

A building collapsed on a car during an earthquake, Loma Prieta, CA

Courtesy of USGS by J. K. Nakata

Introduction

Learn more about the geosphere by making a model.

I. Think About It

❶ Have you ever experienced an earthquake? If so, what was it like? If not, what do you think it would be like?

❷ Do you think the way buildings and roads are designed can help minimize damage from an earthquake? Why or why not?

❸ Do you think scientists can predict where an earthquake might happen? Why or why not?

❹ Do you think scientists can predict when an earthquake might happen? Why or why not?

❺ What difficulties do you think scientists face when studying earthquakes?

❻ Do you think science will someday be used to prevent earthquakes? Why or why not?

II. Experiment 7: Modeling Shaky Ground

Date ___________

Objective ____

____

Hypothesis ____

____

____

Materials

Jell-O or other gelatin (any color/any flavor)
graham crackers
marshmallows (Optional: large and small)
toothpicks
baking pan — 24 cm x 28 cm (9.5" x 11")

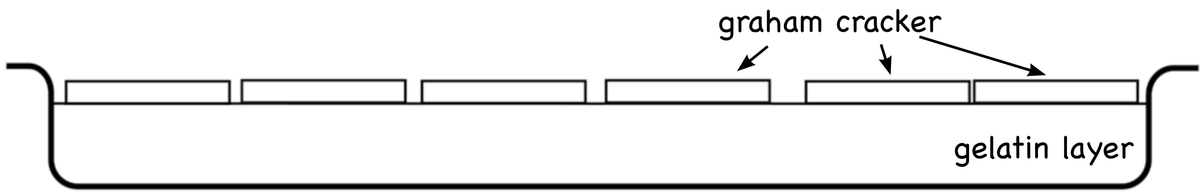
EXPERIMENT

❶ Mix the gelatin according to the instructions on the box. Pour the liquid gelatin into the baking pan and refrigerate until firm.

❷ Remove the gelatin from the refrigerator. Place graham crackers on top of the gelatin. Observe how they are arranged. (Are they touching? Far apart? Flat? At an angle? What else can you notice?) In the box below, draw and label your observations.

Observations—Jell-O and crackers

Example of basic diagram of experimental setup:



❸ Press down on the graham crackers at one edge of the pan and observe what happens. (How far down does the graham cracker move? When you press on one graham cracker, do the others move? How? What else can you observe?)

❹ Repeat several times, experimenting with pressing on different crackers, more than one at a time, using more or less pressure, pulsing the crackers, etc.

❺ In the following two boxes, draw and label your observations. Use additional sheets of paper for more observations.

Observations—Pressing on Crackers

More Observations—Pressing on Crackers

❻ Place marshmallows on the graham crackers. Experiment with pressing on different crackers, more than one at a time, using more or less pressure, pulsating the pressure, etc. What happens to the marshmallows?

Record your results in the *Results* section.

❼ Try stacking the marshmallows and repeat Step ❻. What happens?

Record your results in the *Results* section.

❽ Using toothpicks, secure the marshmallows to the graham crackers. Repeat Step ❻. What happens? Can you get the marshmallows to move?

Record your results in the *Results* section.

Results

Observations—Marshmallows

(Continue on next page.)

More Observations—Marshmallows

(Continue on separate sheets of paper.)

III. Conclusions

Discuss what you learned by creating a model of Earth. What does the gelatin represent? What do the graham crackers represent? What does this model represent? What are some limitations of this model and models in general?

IV. Why?

Model building is an important aspect of scientific investigation. Scientists build models of their ideas to help them see how things work and how to think of new ways to understand scientific phenomena. Scientists can use models to understand how Earth's layers may interact to create earthquakes.

However, model building isn't always easy, and finding the right materials to model important features can be a challenge. For example, you might have elected to use modeling clay instead of gelatin to model the soft layer of the asthenosphere and then found it difficult to create movements in the modeling clay that would create earthquake-like movements of the graham cracker plates. Or you might have decided to make plates of modeling clay and found them to not be rigid enough for your experiment.

Models don't generally duplicate all the important features of the idea or object a scientist is trying to understand. Knowing which features to include and which to ignore depends on what the model is being used to explore.

V. Just For Fun

Think about how you might change this experiment to learn more about earthquakes. For example, what would happen if, instead of using marshmallows, you built different types of structures from different materials? Could you use something besides graham crackers for the plates? What would happen if you made gelatin of different thicknesses by adding more or less water when you mixed it? What else can you change?

Create your own experiment. Use separate sheets of paper, give your experiment a name, and follow the outline of the Modeling Shaky Ground experiment.

Grades 5-8

Focus On Middle School Geology

Teacher's Manual

3rd Edition

Rebecca W. Keller, PhD

Real Science-4-Kids

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A Note from the Author

This curriculum is designed to engage middle school level students in further exploration of the scientific discipline of geology. The *Focus On Middle School Geology Student Textbook—3rd Edition* and the accompanying *Laboratory Notebook* together provide students with basic science concepts needed for developing a solid framework for real science investigation into geology.

The experiments in the *Laboratory Notebook* allow students to expand on concepts presented in the *Student Textbook* and develop the skills needed for using the scientific method. This *Teacher's Manual* will help you guide students through the laboratory experiments.

There are several sections in each chapter of the *Laboratory Notebook*. The section called *Think About It* provides questions to help students develop critical thinking skills and spark their imagination. The *Experiment* section provides students with a framework to explore concepts presented in the *Student Textbook*. In the *Conclusions* section students draw conclusions from the observations they have made during the experiment. A section called *Why?* provides a short explanation of what students may or may not have observed. And finally, in each chapter an additional experiment is presented in *Just For Fun*.

The experiments take up to 1 hour. Materials needed for each experiment are listed on the following pages and also at the beginning of each experiment.

Enjoy!

Rebecca W. Keller, PhD

Materials at a Glance

Experiment 1	Experiment 3	Experiment 4	Experiment 5	Experiment 6
pencil, pen colored pencils small jar trowel or spoon **Optional** binoculars **Experiment 2** pencil pen colored pencils compass small jar or container with a lid small items to place in jar (student selected) **Optional** garden trowel	known mineral samples: calcite, feldspar, quartz, hematite (from local rock and mineral store or order online) * several rocks from backyard or nearby copper penny steel nail streak plate (unglazed white ceramic tile) paper scissors marking pen tape vinegar (small amount) lemon juice (small amount) eyedropper or spoon	Students will select materials and use them to make a model of Earth's layers **Chocolate Lava Cake** butter: 113 grams (1/2 cup) semi-sweet chocolate chips: 133 ml (1/2 cup + 1 Tbsp.) 2 whole eggs 2 egg yolks powdered sugar: 192 ml (3/4 cup + 1 Tbsp.) flour: 94 ml (1/3 cup + 1 Tbsp.)	student-made brittle candy (materials in Foods column on next page) 1 jar smooth peanut butter (for students with allergies to peanuts, whipped cream can be substituted) 118 ml (1/2 cup) crushed graham crackers plate or second cookie sheet materials to make a model volcano — student's choice	internet access (a program that unzips files may be needed) **Optional** printer and paper colored pencils

Experiment 7	Experiment 9	Experiment 10	Experiment 11	Experiment 12
Some suggestions for student chosen model making materials: modeling clay of different colors marble or steel ball ingredients to make various colored cakes materials for making paper maché Styrofoam balls **Experiment 8** 2 liter (2 quart) plastic bottle with cap warm water matches blank paper	gravel, about 1-2 liters** sand, about 1-2 liters** dirt (soil), about 1-2 liters** pottery clay, about 1-2 liters** water (4) Styrofoam cups, about 355 ml (4) 16 oz. clear plastic cups, glasses, or other clear containers pencil marking pen measuring cups graduated cylinder, 100 ml large bowl scissors plastic wrap or plastic bags cardboard or other material to make a trough strong tape utility or X-Acto knife bucket and/or outdoor area **Optional** stopwatch or clock with a second hand small piece of screen or coarse cloth	field notebook, 1-2 (new or existing) pencil and colored pencils small backpack water bottle snacks binoculars (inexpensive ones are fine; small, lightweight ones are easier to carry) field guide to the birds book (for example, *The Young Birder's Guide to Birds of North America*, by Bill Thompson, III) **Optional** magnifying glass bird feeders and birdseed camera cellphone or tablet bird identification app (such as free app from Audubon Society, http://www.audubon.org/apps)	steel needle bar magnet piece of cork tape medium size bowl water compass small object of student's choice to use for treasure	pencil pen imagination **Optional** notebook

* A Mineral Scale of Hardness Set of Minerals is available from Home Science Tools: http://www.hometrainingtools.com

** Quantities may vary. See Experiment 9, Just For Fun. Materials can be found where art, aquarium, or building supplies are sold.

Materials

Quantities Needed for All Experiments

Equipment

backpack, small
binoculars (inexpensive ones are fine; small, lightweight ones are easier to carry)
book, field guide to the birds (for example, *The Young Birder's Guide to Birds of North America,* by Bill Thompson, III)
bowl, large
bowl, medium
bucket (and/or outdoor area)
compass
cookie sheet, 1-2, approx. 30x36 cm (12"x14")
cups (4), plastic, clear, 16 oz.; or clear glasses or other clear containers
eyedropper or spoon
graduated cylinder, 100 ml
jar, small
jar, small (or container) with a lid
knife, utility or X-Acto
magnet, bar
measuring cups
needle, steel
penny, copper
plastic bottle with cap, 2 liter (2 quart)
plate or second cookie sheet
saucepan, 2 liter (2 qt)
scissors
spatula, 2
streak plate (unglazed white ceramic tile)
thermometer, candy
trowel or spoon
water bottle

Optional

bird feeders
camera
cellphone or tablet
magnifying glass
printer
stopwatch or clock with a second hand

Materials

cardboard or other material to make a trough
clay, pottery, about 1-2 liters (1-2 qts.)**
cork
cups (4), Styrofoam, about 355 ml (12 oz.)
dirt (soil), about 1-2 liters (1-2 qts.)**
gravel, about 1-2 liters (1-2 qts.)**
items, small, (student selected) to place in jar
matches
materials, student selected, for making a model volcano
materials, suggested, student selected for making model of Earth's layers:
- modeling clay of different colors
- marble or steel ball
- ingredients to make various colored cakes
- materials for making paper maché
- Styrofoam balls

mineral samples (known): calcite, feldspar, quartz, and hematite (from local rock and mineral store or order online) *
nail, steel
notebook (field), 1-2 (new or existing)
paper
pen
pen, marking
pencil
pencils, colored
plastic wrap or plastic bags
rocks, several, from backyard or nearby
sand, about 1-2 liters (1-2 qts.)**
tape
tape, strong, such as duct tape

Optional

birdseed
notebook
screen or coarse cloth, small piece

Foods

graham crackers, crushed, 118 ml (1/2 c.)
lemon juice (small amount)
peanut butter, 1 jar smooth (for students with allergies to peanuts, whipped cream can be substituted)
snacks
vinegar (small amount)

Chocolate Lava Cake (Exper. 4)

- butter: 113 grams (1/2 cup)
- semi-sweet chocolate chips: 133 ml (1/2 cup + 1 Tbsp.)
- 2 whole eggs
- 2 egg yolks
- powdered sugar: 192 ml (3/4 cup + 1 Tbsp.)
- flour: 94 ml (1/3 cup + 1 Tbsp.)

Brittle Candy (Exper. 5)

- white sugar: 237 ml (1 cup)
- light corn syrup: 118 ml (1/2 cup)
- salt: 1.25 ml (1/4 teaspoon)
- water: 59 ml (1/4 cup)
- butter: 28 grams (2 Tbsp)
- baking soda: 5 ml (1 teaspoon)

Other

internet access (a program that unzips files may be needed)

Optional

bird identification app (such as free app from Audubon Society, http://www.audubon.org/apps)

* A Mineral Scale of Hardness Set of Minerals is available from Home Science Tools: http://www.hometrainingtools.com
** Quantities may vary. See Experiment 9, Just For Fun. Materials can be found where art, aquarium, or building supplies are sold.

Contents

Experiment 1

Observing Your World

Materials Needed

- pencil, pen, colored pencils
- small jar
- trowel or spoon

Optional

- binoculars

Objectives

In this experiment students will collect data from their observations of the world around them and organize the data in a chart.

The objectives of this lesson are for students to:

- Make careful observations.
- Record and organize data.

Experiment

I. Think About It

Read this section of the *Laboratory Notebook* with your students.

Ask questions such as the following to guide open inquiry.

- *Do you think if you go outside and look at things carefully you will observe details that you hadn't noticed before? Why or why not?*
- *If you are riding your bike or walking outside, what kinds of things do you notice that tell you where you are?*
- *Do you think buildings are different in the city than they are in the country? Why or why not?*
- *Do you think there are the same kinds of landscapes in a city and in the country? Why or why not?*
- *What kinds of weather do you have in your area?*
- *Does weather affect the landscape where you live? Why or why not?*

II. Experiment 1: Observing Your World

In this experiment students will explore their local world—the world around them.

Have the students read the entire experiment, noting the experimental steps to be followed.

Objective: Have the students write an objective. Some examples:

- *To learn more about the place where I live.*
- *To better understand my hometown (or city, etc.)*
- *To observe my surroundings and find out more about Earth through my observations.*

Hypothesis: Have the students write a hypothesis. Have them think about what they might learn by doing this experiment. Some examples:

- *By making observations, I will better understand where I live.*
- *By making observations, I can understand how the area where I live changes over time.*
- *I will be able to assemble a list of features that describe where I live.*

❶-❸ Students walk to a place where they are standing on some type of ground (e.g., dirt, grass, concrete) and then observe what is around them. In the boxes provided, they will write or draw what they see. If binoculars are available, students can use them to observe the details of landforms and other features that are farther away.

❹-❺ Have students go to a place where they can dig up a small sample of dirt with a trowel or spoon. They can put the dirt sample in a small jar. Have them examine the dirt carefully, looking for color, texture, the presence of organic matter, and any other features they can observe. Have them record their observations.

❻ Have the students observe any man-made structures nearby. These can include things such as homes, roads, buildings, parks, fences, and utility poles.

❼ Have the students explore how dynamic features near their home may have changed the way the area looks. For example, heavy rains or snowmelt runoff might have caused erosion. Lightning might have damaged a tree.

❽ Have the students explore the history of the place where they live. Have them research when their house was built, when their city was founded, or when the land surrounding them became farms or industrial parks.

Results

Have the students use the chart to assemble the information they've collected.

III. Conclusions

Have the students review the results they recorded for the experiment. Have them draw conclusions based on the data they collected.

IV. Why?

Read this section of the *Laboratory Notebook* with your students.
Discuss any questions that might come up.

V. Just For Fun

Have the students imagine they got an email from someone on the planet Alpha Centauri Bb asking for information about what Earth is like. Have the students use the data they have collected to write a narrative describing the area where they live. Have them think about how they would describe the area so that someone who has not seen it could imagine it.

Experiment 7

Modeling Shaky Ground

Materials Needed

- Jell-O or other gelatin (any color/any flavor)
- graham crackers
- marshmallows (Optional: large and small)
- toothpicks
- baking pan—24 cm x 28 cm (9.5" x 11")
- student-selected materials *(Just For Fun)*

Objectives

In this experiment students will learn more about the layers of the geosphere and earthquakes through model making.

The objectives of this lesson are for students to:

- Explore the features of the geosphere by making a model.
- Explore earthquakes.

Experiment

I. Think About It

Read this section of the *Laboratory Notebook* with your students.

Ask questions such as the following to guide open inquiry.

- *Which layers of Earth do you think are involved in earthquakes?*
- *What do you think makes an earthquake happen?*
- *Do you think an earthquake can happen anywhere on Earth? Why or why not?*
- *How do you think people could prepare for earthquakes?*
- *How do you think it would be helpful if scientists could predict when and where an earthquake will occur?*

II. Experiment 7: Modeling Shaky Ground

Have the students read the entire experiment.

Objective: Have the students think of an objective for this experiment (What will they be learning?).

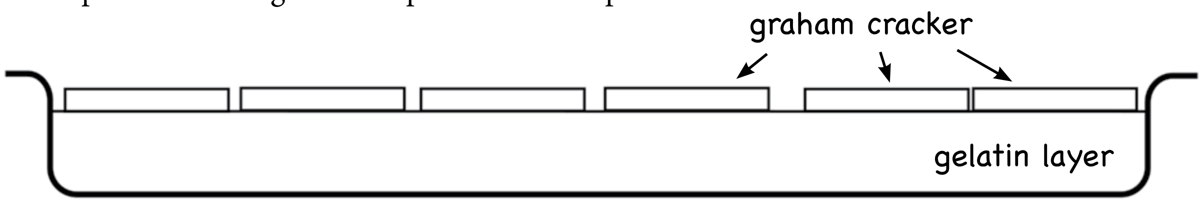
Hypothesis: Have the students think of a hypothesis for this experiment.

EXPERIMENT

❶ Help the students make gelatin according to the instructions on the box. Have them pour the gelatin into the baking pan and refrigerate it.

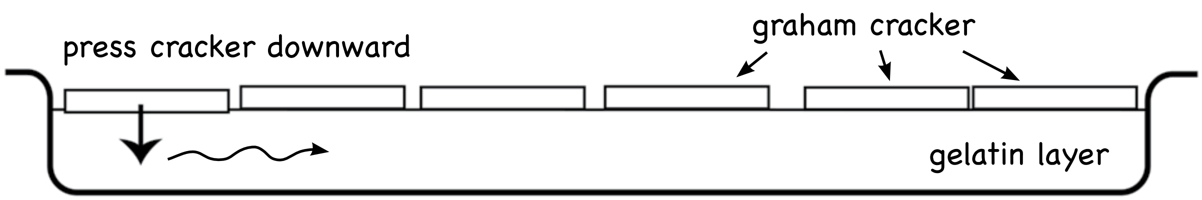
❷ When the gelatin has set completely, have the students remove it from the refrigerator. Have them place graham crackers on top of the gelatin. Have them decide how they want to divide the crackers. They can make all the pieces the same size or different sizes. Help the students observe how the crackers are arranged. (Are they touching? Far apart? Flat? At an angle? What else can they notice?) Have them draw and label their observations in the box provided. They can draw a top view, a side view, or both.

Example of basic diagram of experimental setup:



❸ Students are directed to press down on the graham crackers at one edge of the pan and observe what happens. (For example: How far down does the graham cracker move? When they press on one graham cracker, do the others move? How? What else can they observe?)

Pressing on a graham cracker is expected to cause movement in the Jell-O.



❹ Have students repeat as many times as they'd like, experimenting with pressing on different crackers, more than one at a time, using more or less pressure, pulsing the crackers, etc.

❺ In the two boxes provided, have them draw and label their observations. They are invited to use additional sheets of paper for more exploration.

❻ The students are directed to place marshmallows on the graham crackers. Have them experiment with pressing on different crackers, more than one at a time, using more or less pressure, pulsing the crackers, etc. What happens to the marshmallows?

Have them record their results in the *Results* section.

❼ Have the students try stacking the marshmallows, repeat Step ❻, and observe what happens.

Have them record their results in the *Results* section.

❽ Have them use toothpicks to secure the marshmallows to the graham crackers, then repeat Step ❻. What happens? Can they get the marshmallows to move?

Have them record their results in the *Results* section.

III. Conclusions

Have the students think about what they learned by building a model of Earth's layers. Help them think about what the gelatin and graham crackers represent. What does the model as a whole represent? What did they learn about earthquakes by building this model? What are some limitations of this model and models in general?

IV. Why?

Read this section of the *Laboratory Notebook* with your students.
Discuss any questions that might come up.

V. Just For Fun

Students are directed to create their own experiment based on the one they just performed and using the same format.

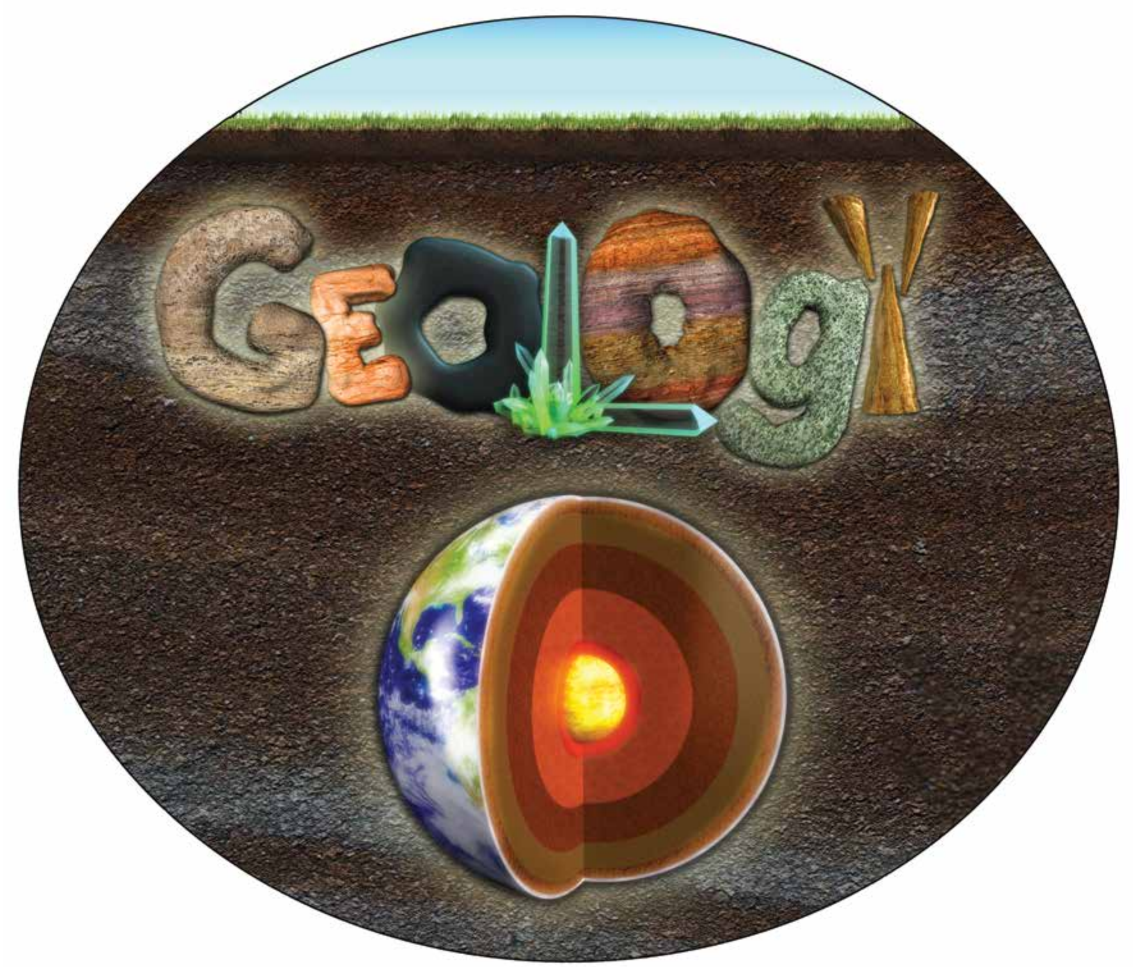
Help the students think about how they might change this experiment to learn more about earthquakes. For example, what would happen if, instead of using marshmallows, they built different types of structures from different materials? Could they use something besides graham crackers? What would happen if they made gelatin of different thicknesses by adding more or less water when mixed? Have them think about other changes they could make.

Have the students use separate paper to write up their experiment.

Focus On

Middle School

Grades 5-8



Lesson Plan

3rd Edition

Rebecca W. Keller, PhD

Real Science 4 Kids

Real Science-4-Kids

Focus On Middle School Geology Lesson Plan—3rd Edition

Published by Gravitas Publications Inc.
www.gravitaspublications.com
www.realscience4kids.com

LESSON PLAN INSTRUCTIONS

This *Lesson Plan* accompanies *Focus On Middle School Geology Student Textbook*, *Laboratory Notebook,* and *Teacher's Manual—3rd Edition*. It is designed to be flexible to accommodate a varying schedule as you go through the year's study. And it makes it easy to chart weekly study sessions and create a portfolio of your student's yearlong performance. The PDF format allows you to print pages as you need them.

This Lesson Plan file includes:

- Weekly Sheets
- Self-Review Sheet
- Self-Test Sheet
- Sticker Templates

Materials recommended but not included:

- 3-ring binder
- Indexing dividers (3)
- Labels—24 per sheet,1.5" x 1.5" (Avery 22805)

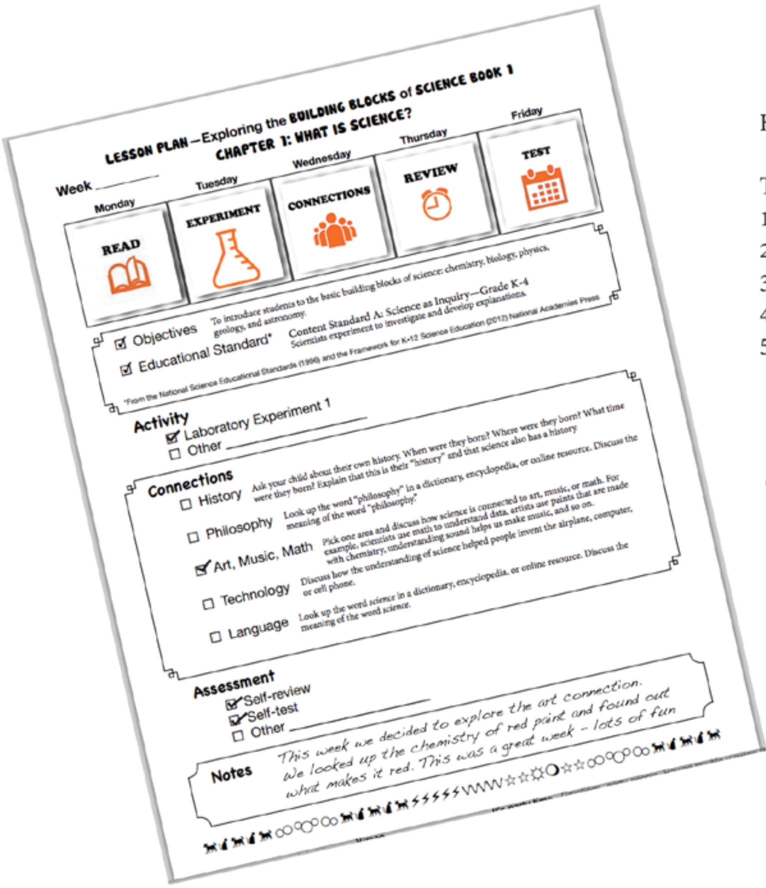
Use the Weekly Sheets to map out daily activities and keep track of student progress. For each week you decide when to read the text, do the experiment, explore the optional connections, review the text, and administer tests. For those families and schools needing to provide records of student performance and show compliance to standards, there is a section on the Weekly Sheets that shows how the content aligns to the National Science Standards.

To use this Lesson Plan:

- Print the Weekly Sheets
- Print Self-Review Sheets
- Print Self-Test Sheets
- Print the stickers on 1.5" x 1.5" labels
- Place all the printed sheets in a three-ring binder separated by index dividers

At the beginning of each week, use the squares under each weekday to plan your daily activities. You can attach printed stickers to the appropriate boxes or write in the daily activities. At the end of the week, use the *Notes* section to record student progress and performance for that week.

WEEKLY LESSON PLAN SAMPLES



LESSON PLAN — Exploring the BUILDING BLOCKS of SCIENCE BOOK 1
CHAPTER 1: WHAT IS SCIENCE?

Week ____

Monday	Tuesday	Wednesday	Thursday	Friday
READ	EXPERIMENT	CONNECTIONS	REVIEW	TEST

☑ Objectives: To introduce students to the basic building blocks of science: chemistry, biology, physics, geology, and astronomy.

☑ Educational Standard*: Content Standard A: Science as Inquiry—Grade K-4. Scientists experiment to investigate and develop explanations.

*From the National Science Educational Standards (1996) and the Framework for K-12 Science Education (2012) National Academies Press

Activity
☑ Laboratory Experiment 1
☐ Other

Connections
☐ History — Ask your child about their own history. When were they born? Where were they born? What time were they born? Explain that this is their "history" and that science also has a history.
☐ Philosophy — Look up the word "philosophy" in a dictionary, encyclopedia, or online resource. Discuss the meaning of the word "philosophy."
☑ Art, Music, Math — Pick one area and discuss how science is connected to art, music, or math. For example, scientists use math to understand data, artists use paints that are made with chemistry, understanding sound helps us make music, and so on.
☐ Technology — Discuss how the understanding of science helped people invent the airplane, computer, or cell phone.
☐ Language — Look up the word science in a dictionary, encyclopedia, or online resource. Discuss the meaning of the word science.

Assessment
☑ Self-review
☑ Self-test
☐ Other

Notes This week we decided to explore the art connection. We looked up the chemistry of red paint and found out what makes it red. This was a great week – lots of fun.

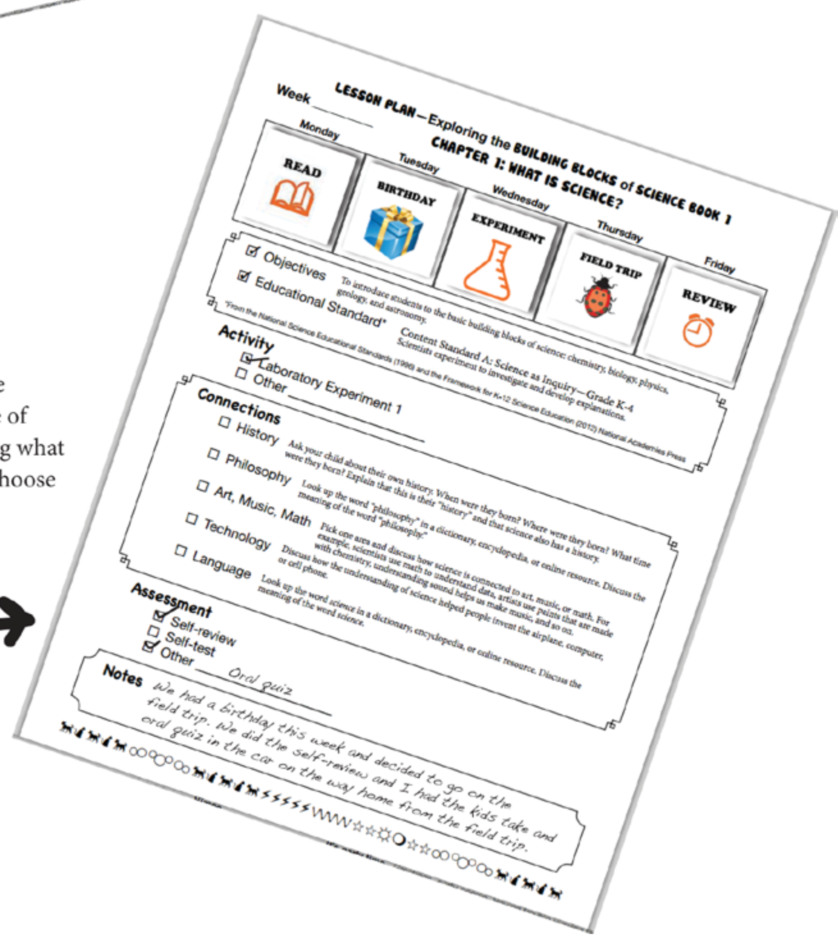
Here is a sample of a normal week.

The recommended sequence is
1 - Read the student textbook on the first day.
2 - Do the laboratory experiment on the second day.
3 - Pick one or more connections to explore on the third day.
4 - Do the self-review sheet on the fourth day.
5 - Administer the self-test or another exam on the fifth day.

Here is a sample of a week with other activities

1- Find at least one day to READ the text.
2 - Find a day to perform the EXPERIMENT.
3 - Find a day to do the REVIEW or TEST.

Any activity that is missed can be rescheduled for the following week. However, keep to the main sequence of reading the text, doing the experiment, and reviewing what has been covered. If an activity needs to be missed, choose the CONNECTIONS or SELF-TEST.



LESSON PLAN — Exploring the BUILDING BLOCKS of SCIENCE BOOK 1
CHAPTER 1: WHAT IS SCIENCE?

Week ____

Monday	Tuesday	Wednesday	Thursday	Friday
READ	BIRTHDAY	EXPERIMENT	FIELD TRIP	REVIEW

☑ Objectives: To introduce students to the basic building blocks of science: chemistry, biology, physics, geology, and astronomy.

☑ Educational Standard*: Content Standard A: Science as Inquiry—Grade K-4. Scientists experiment to investigate and develop explanations.

*From the National Science Educational Standards (1996) and the Framework for K-12 Science Education (2012) National Academies Press

Activity
☑ Laboratory Experiment 1
☐ Other

Connections
☐ History — Ask your child about their own history. When were they born? Where were they born? What time were they born? Explain that this is their "history" and that science also has a history.
☐ Philosophy — Look up the word "philosophy" in a dictionary, encyclopedia, or online resource. Discuss the meaning of the word "philosophy."
☐ Art, Music, Math — Pick one area and discuss how science is connected to art, music, or math. For example, scientists use math to understand data, artists use paints that are made with chemistry, understanding sound helps us make music, and so on.
☐ Technology — Discuss how the understanding of science helped people invent the airplane, computer, or cell phone.
☐ Language — Look up the word science in a dictionary, encyclopedia, or online resource. Discuss the meaning of the word science.

Assessment
☑ Self-review
☐ Self-test
☑ Other Oral quiz

Notes We had a birthday this week and decided to go on the field trip. We did the self-review and I had the kids take and oral quiz in the car on the way home from the field trip.

Week ________

CHAPTER 1: WHAT IS GEOLOGY?

Monday	Tuesday	Wednesday	Thursday	Friday

☑ Objectives To introduce students to general geological cycles.

☑ Educational Standard* **Content Standard MS-ESS2 (Science and Engineering Practices)**
Collect data to answer scientific questions.
Scientific knowledge is open to revision in light of new evidence.

*From the Next Generation Science Standards (NGSS)

Activity

- ☐ Laboratory Experiment 1
- ☐ Other ____________________

Connections

- ☐ History Look up the history of geology and explore how our understanding of Earth has changed over time.
- ☐ Philosophy Discuss why interpretation of scientific data is an important part of science.
- ☐ Art, Music, Math Explore how architects use natural formations as inspiration for creating beautiful and artistic living areas for people.
- ☐ Technology Discuss how modern technology helps geologists study Earth.
- ☐ Language Look up the word *geology* in a dictionary, encyclopedia, or online resource and discuss its meaning.

Assessment

- ☐ Self-review
- ☐ Self-test
- ☐ Other ____________________

Notes

Week ________

CHAPTER 7: THE GEOSPHERE

Monday	Tuesday	Wednesday	Thursday	Friday

☑ Objectives To examine the features of the geosphere.

☑ Educational Standard*

Content Standard MS-ESS2-1
Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.

*From the Next Generation Science Standards (NGSS)

Activity

☐ Laboratory Experiment 7
☐ Other ______________________

Connections

☐ History How has our understanding of the geosphere changed over time?

☐ Philosophy Discuss how philosophy has shaped our understanding of the geosphere.

☐ Art, Music, Math Explore how math is used to understand the geosphere.

☐ Technology Explore the types of technology used to study the geosphere.

☐ Language Look up the word *geosphere* in a dictionary, encyclopedia, or online resource and discuss its meaning.

Assessment

☐ Self-review
☐ Self-test
☐ Other ______________________

Notes

SELF-REVIEW

Think about all of the ideas, concepts, and facts you read about in this chapter. In the space below, write down everything you've learned.

Date ________________ Chapter ____

SELF-TEST

Imagine you are the teacher and you are giving your students an exam. In the space below, write 5 questions you would ask a student based on the information you learned in this chapter.

Date ________________ Chapter ____

READ READ READ READ

REVIEW REVIEW REVIEW REVIEW

EXPERIMENT EXPERIMENT EXPERIMENT EXPERIMENT

CONNECTIONS CONNECTIONS CONNECTIONS CONNECTIONS

TEST TEST TEST TEST

READ READ READ READ

HOLIDAY

HOLIDAY

HOLIDAY

HOLIDAY

FIELD TRIP

FIELD TRIP

FIELD TRIP

FIELD TRIP

BIRTHDAY

BIRTHDAY

BIRTHDAY

BIRTHDAY

REST DAY

REST DAY

REST DAY

REST DAY

REST DAY

REST DAY

REST DAY

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SICK DAY

SICK DAY

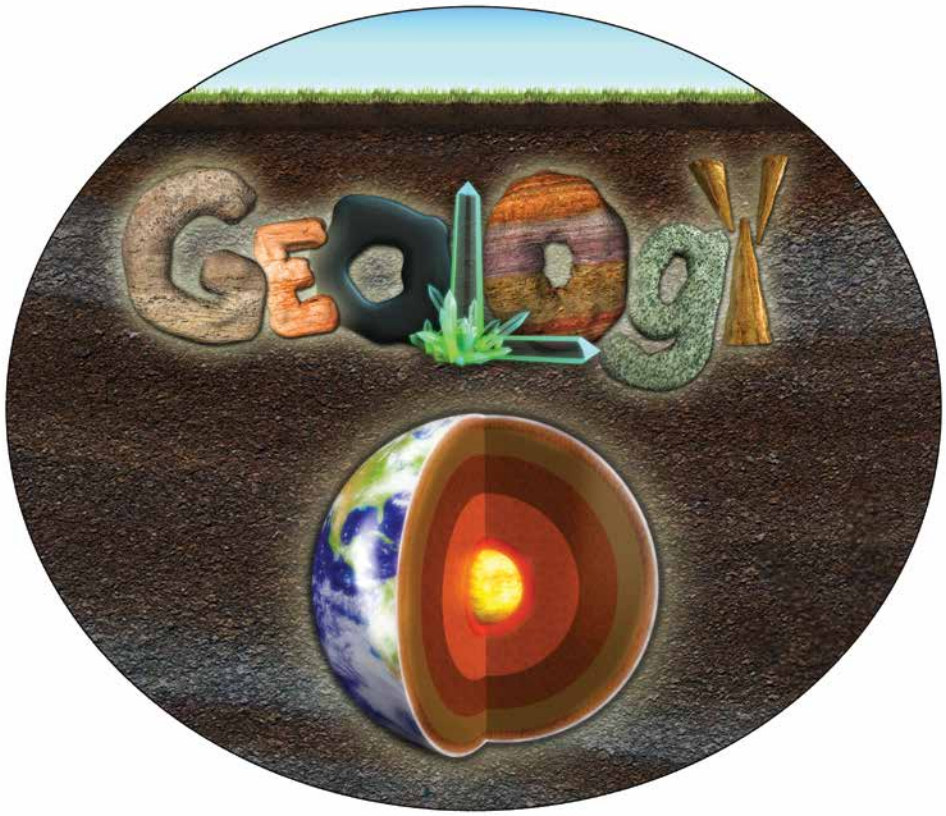
SICK DAY

SICK DAY

Focus On

Grades 5-8

Middle School



Study Notebook

3rd Edition

Rebecca W. Keller, PhD

Illustrations: K. Keller

Focus On Middle School Geology Study Notebook

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Welcome to your study notebook

This notebook is your place to record anything you want as you learn about rocks and minerals, volcanoes and earthquakes, Earth's spheres, Earth as a system, and all the other amazing facts and concepts we call geology.

There are questions and suggestions. Some are serious and some are whimsical. If you don't like them, cross them out and create your own.

Just explore what you think about all the topics you are learning and try not to get too worried about writing down the "right" answers. This is an opportunity for you to explore what YOU like.

There are places in this notebook that are unscripted and have little instruction. There are also questions that just dangle on the edges of the page. That's OK. Just record, draw, or paste images that you think apply. Add extra pages as you like. Answer the questions and suggestions in a way that makes the most sense to you. Most of real science is unscripted and making discoveries has no set of instructions. Just play with it. You'll be fine and you might find out something unexpected and amazing.

This notebook is not meant to be graded. So parents and teachers, just let it go. Don't grade this notebook or make your student "turn it in." If your student wants to share all they are learning, great! If not, let that be OK too.

day month year

CHAPTER 1

objectivity: forming observations without the influence of bias, i.e., personal beliefs, feelings, or opinions; representing fact without prejudice

Is it possible to be objective?

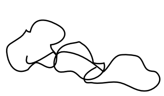
Draw a mountain.

Research a landform you find interesting; include pictures and facts.

day month year

CHAPTER VII

Pick a type of rock (any type of rock) and research how and where that rock is formed.

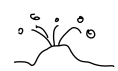


What is the difference between the crust and the lithosphere?

What do you think the lithosphere would be like if the asthenosphere were not liquid?

Look up the etymology of the word volcano.

Write a story from a volcano's point of view.



+ More paper!

Name ___________________________ **Date** _________________

Focus On Middle School Geology 3rd Edition - Midterm 1
Chapters 1-6, 18 questions, 10 points each

1. Check the statements that are true about presupposition in science. (10 points)
   - ☐ A presupposition is usually based on preexisitng beliefs and sometimes on previous experience.
   - ☐ Presuppositions may lead to disagreements between scientists and this never leads to new ideas but only makes scientists mad at each other.
   - ☐ It is always wrong to use a presupposition in science and scientists never use them.
   - ☐ A presupposition is an assumption about how something works.

2. By spending time outdoors geologists can... (Check all that apply.) (10 points)
   - ☐ Investigate volcanoes erupting, changes to the land made by earthquakes, and rocks that have fallen in a landslide.
   - ☐ Observe how human activity has changed the environment.
   - ☐ See how rocks have deformed to make mountains and valleys.
   - ☐ Collect rock samples to analyze.

3. Someone's worldview is made up of the philosophies and beliefs they use to understand the world around them. (10 points)
   - ○ True
   - ○ False

Focus On Middle School Geology 3rd Edition - Midterm 2
Chapters 7-12, 18 questions, 10 points each

1. The inner and outer core of Earth are not part of the geosphere. (10 points)
   - ○ True
   - ○ False

2. Earthquakes are useful for finding out more about Earth's layers because... (Check all that apply.) (10 points)
   - ☐ Seismic waves can be studied to get information about what the interior layers of Earth are made of.
   - ☐ Scientists can use seismometers to measure the waves that travel through the Earth's interior.
   - ☐ Earthquakes are not actually useful for anything.
   - ☐ Earthquakes only affect the surface of Earth.

3. Volcanoes can help geologists learn more about Earth's interior because they can study... (Check all that apply.) (10 points)
   - ☐ Rocks brought up from deep in the Earth that are ejected by a volcano.
   - ☐ Ash formed from exploding magma and rock.
   - ☐ Volcanoes do not tell us anything about Earth's interior.
   - ☐ Lava that is still molten and flowing on the surface.

Focus On Middle School Geology 3rd Edition - Final Quiz
Chapters 1-12, 24 questions, 10 points each

1. Match the term with its description. (10 points)

______ Physical geology	a. The study of Earth.
______ Worldview	b. A broad category that attempts to create a chronological narrative of Earth's origins.
______ Geology	c. A broad category that is involved with the chemistry and physics of Earth.
______ Historical geology	d. Deals with the internal structure, form, and arrangement of rocks.
______ Geochemistry	e. The study of the chemistry of Earth.
______ Structural geology	f. A set of philosophies and beliefs someone uses to understand the world around them.

2. An environmental geologist studies factors that affect living organisms, such as landscape, water, air quality, and changes made by human activity. (10 points)
   - ○ True
   - ○ False

13. To study Earth's geosphere, geologists... (Check all that apply.) (10 points)
   - ☐ Study rocks, lava, and ash that come out of volcanoes.
   - ☐ Use thermometers to measure the temperature of the core.
   - ☐ Study rock samples taken from mines and from drilling.
   - ☐ Use seismic data from earthquakes to find out about the structure of Earth's layers.

14. The geosphere is made up of... (Check all that apply.) (10 points)
   - ☐ Water.
   - ☐ Magma.
   - ☐ Living things.
   - ☐ Rocks and minerals.
   - ☐ Air.
   - ☐ Nothing in particular.
   - ☐ Soils.

Answer Sheet

Focus On Middle School Geology 3rd Edition - Midterm 1
Chapters 1-6, 18 questions, 10 points each

1. A presupposition is usually based on preexisitng beliefs and sometimes on previous experience., A presupposition is an assumption about how something works.
2. Investigate volcanoes erupting, changes to the land made by earthquakes, and rocks that have fallen in a landslide., Observe how human activity has changed the environment., See how rocks have deformed to make mountains and valleys., Collect rock samples to analyze.
3. True

Focus On Middle School Geology 3rd Edition - Midterm 2
Chapters 7-12, 18 questions, 10 points each

1. False
2. Seismic waves can be studied to get information about what the interior layers of Earth are made of., Scientists can use seismometers to measure the waves that travel through the Earth's interior.
3. Rocks brought up from deep in the Earth that are ejected by a volcano., Ash formed from exploding magma and rock., Lava that is still molten and flowing on the surface.

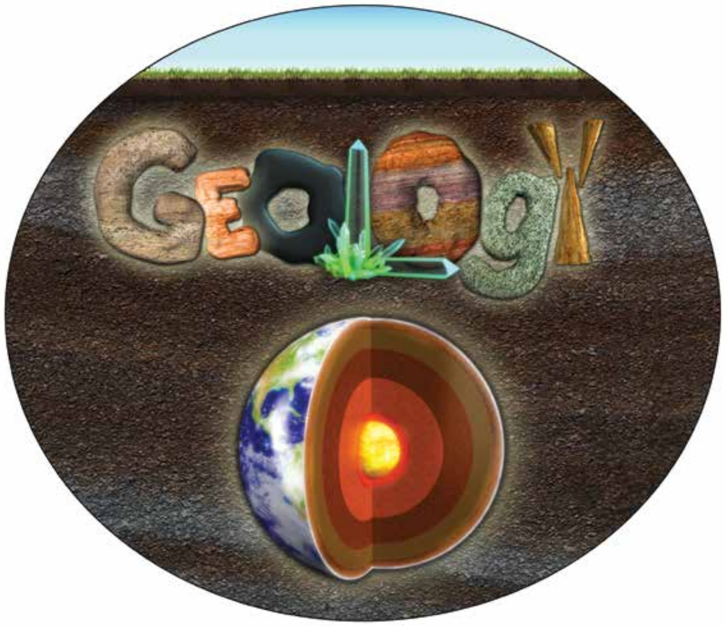
Focus On Middle School Geology 3rd Edition - Final Quiz
Chapters 1-12, 24 questions, 10 points each

1. c, f, a, b, e, d
2. True

13. Study rocks, lava, and ash that come out of volcanoes., Study rock samples taken from mines and from drilling., Use seismic data from earthquakes to find out about the structure of Earth's layers.
14. Magma., Rocks and minerals., Soils.

FOCUS ON MIDDLE SCHOOL

Grades 5-8



GRAPHICS

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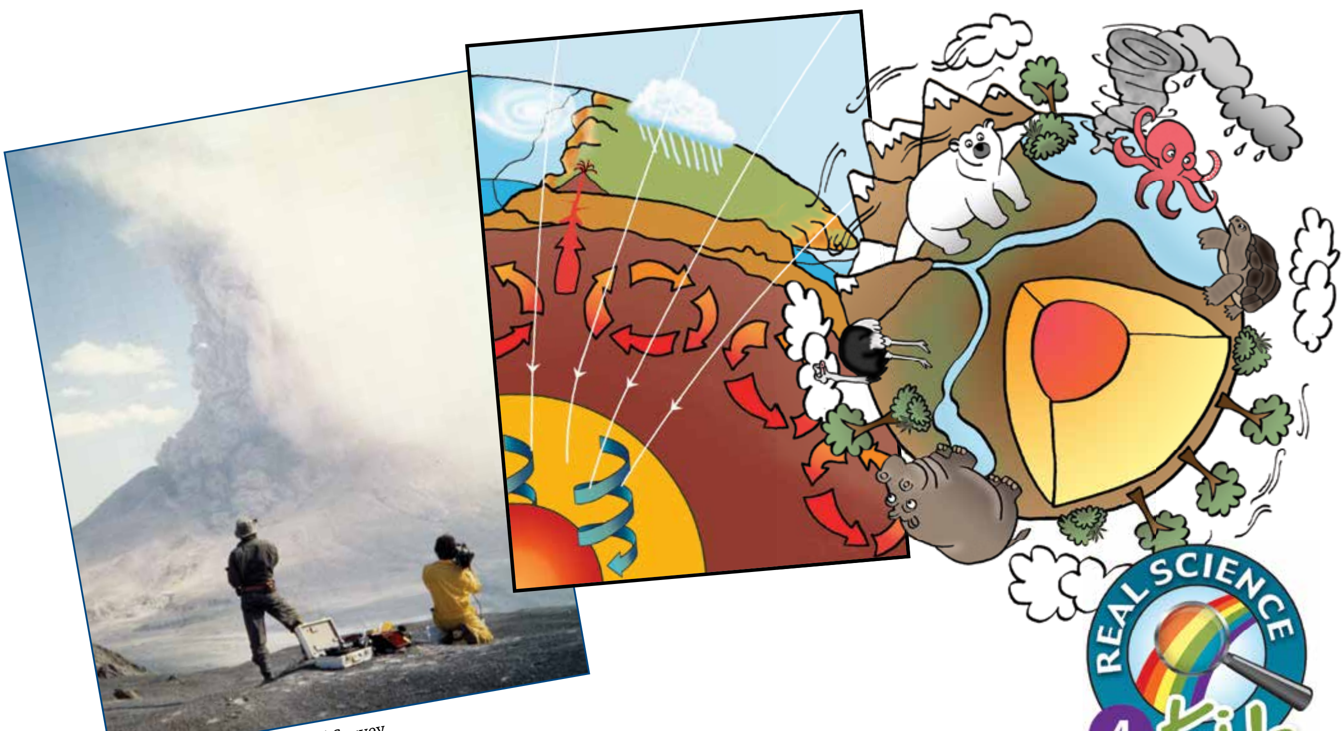

Photo Credit: US Geological Survey

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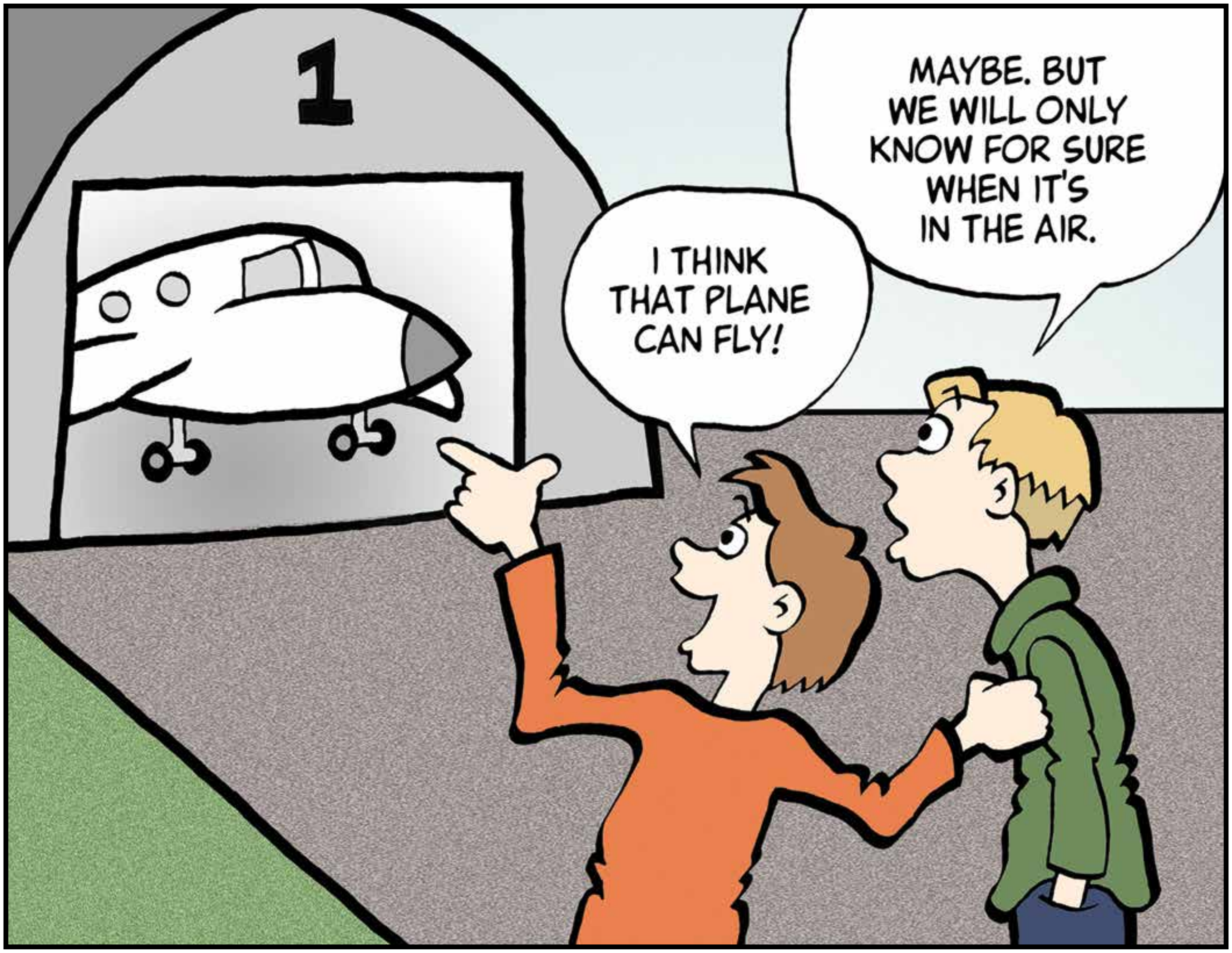
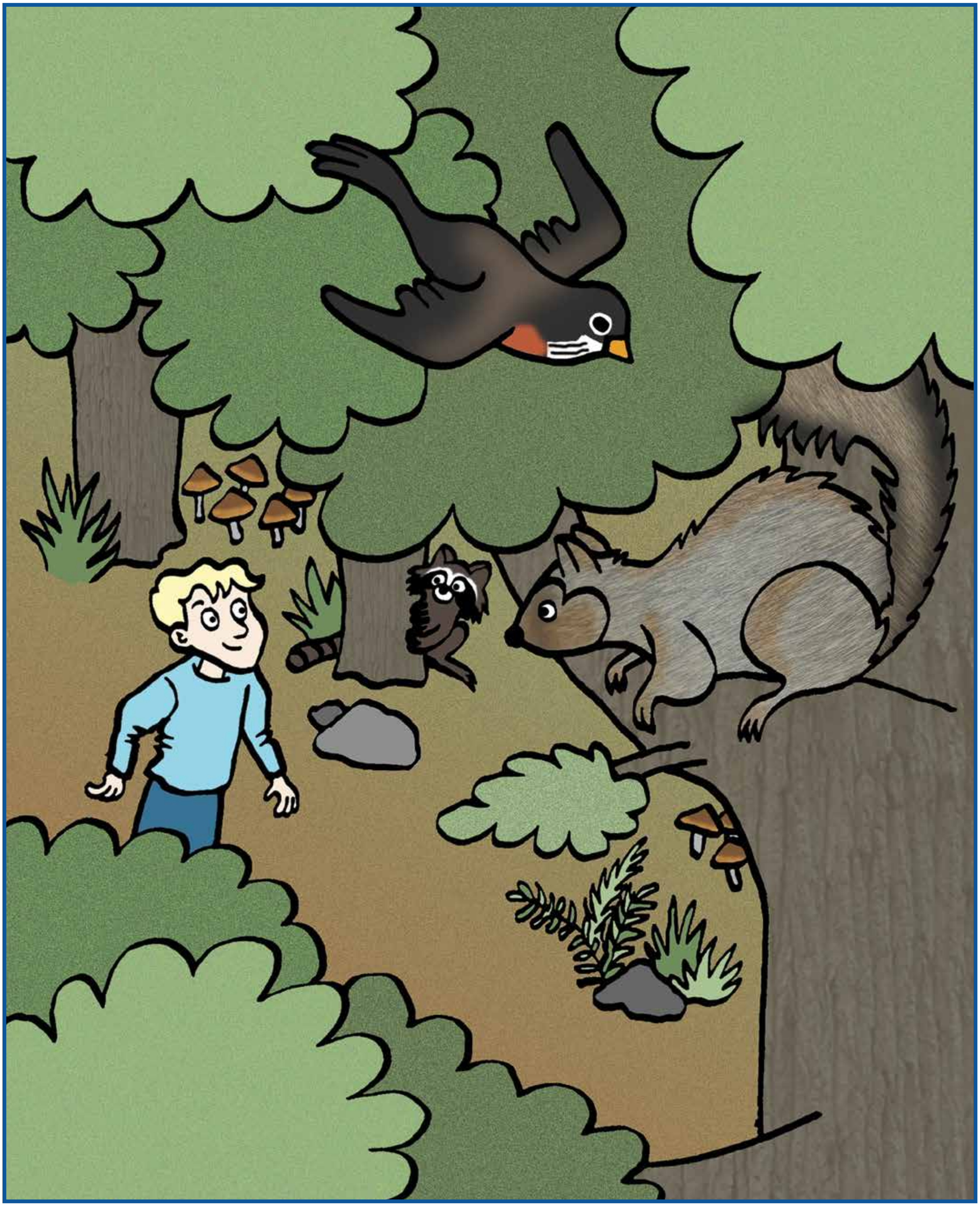
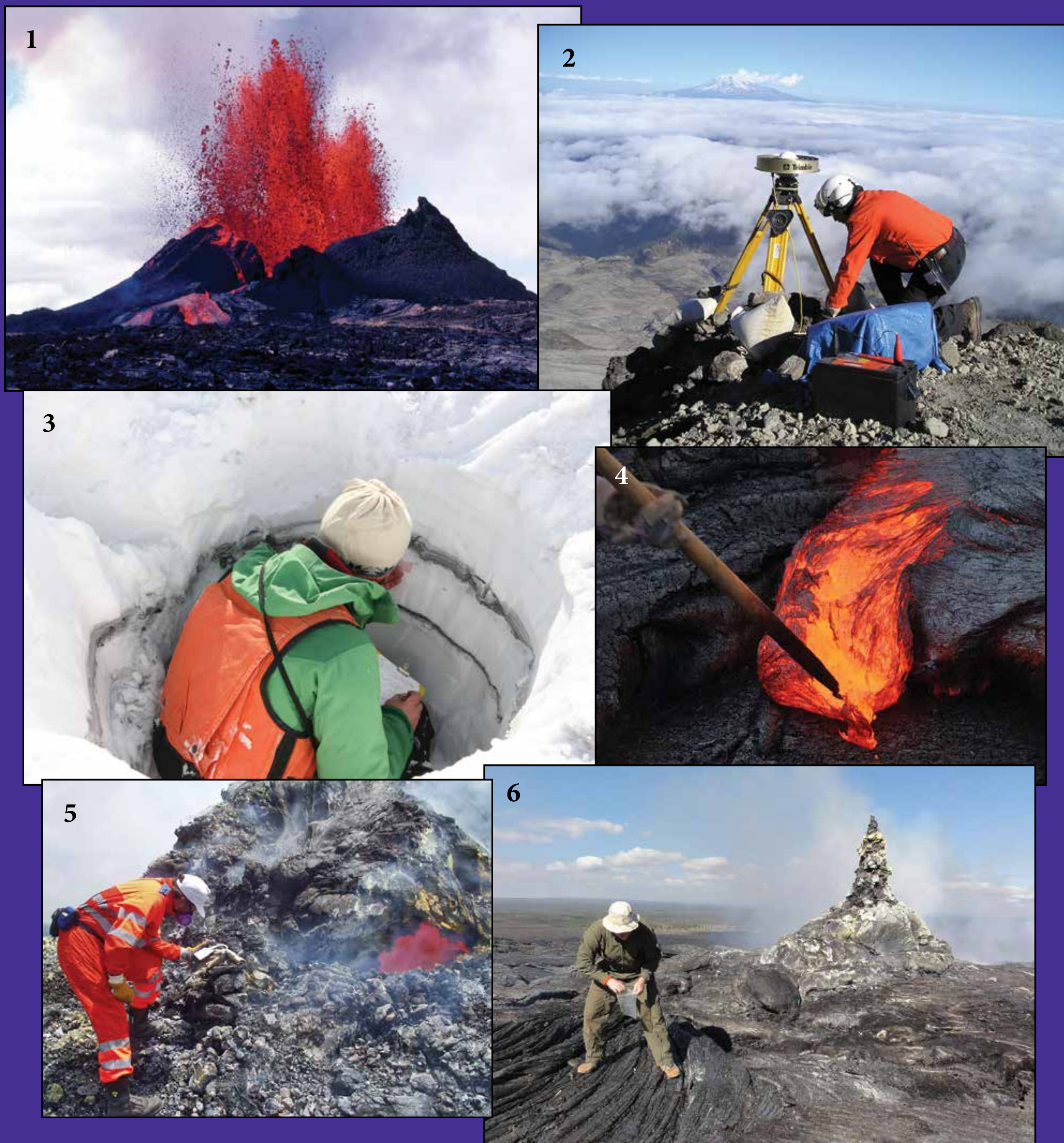

1
I THINK THAT PLANE CAN FLY!
MAYBE. BUT WE WILL ONLY KNOW FOR SURE WHEN IT'S IN THE AIR.

A geologist studies snow

Photo Credit: US Geological Survey/by Lyn Topinka



Volcanoes and Volcanologists



1. A volcanic eruption in Hawaii Courtesy of Hawaiian Volcano Observatory (HVO)/USGS by J. D. Griggs
2. Setting up a GPS system to measure deformation of ground (getting higher or lower), Mt. St. Helens, Washington State Courtesy of USGS by Mike Poland; 3. Collecting volcanic ash samples in Alaska Courtesy of Alaska Volcano Observatory (AVO)/USGS by Kristi Wallace; 4. Taking a sample of lava, Kilauea, HI Courtesy of HVO/USGS; 5. Taking gas samples at the Cookie Monster skylight, HI Courtesy of HVO/USGS by J. D. Griggs
4. Collecting lava samples, Kilauea, HI (hornito formation in background) Courtesy of HVO/USGS

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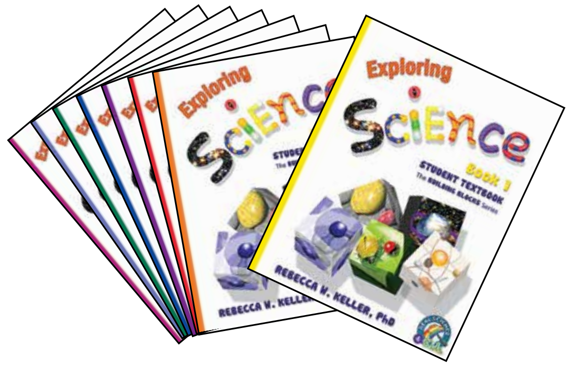

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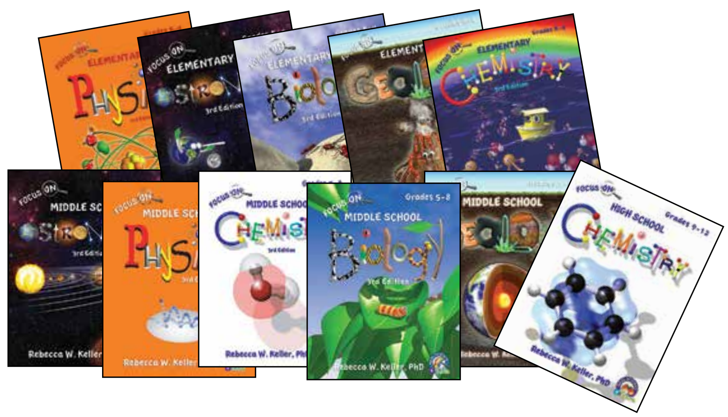

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