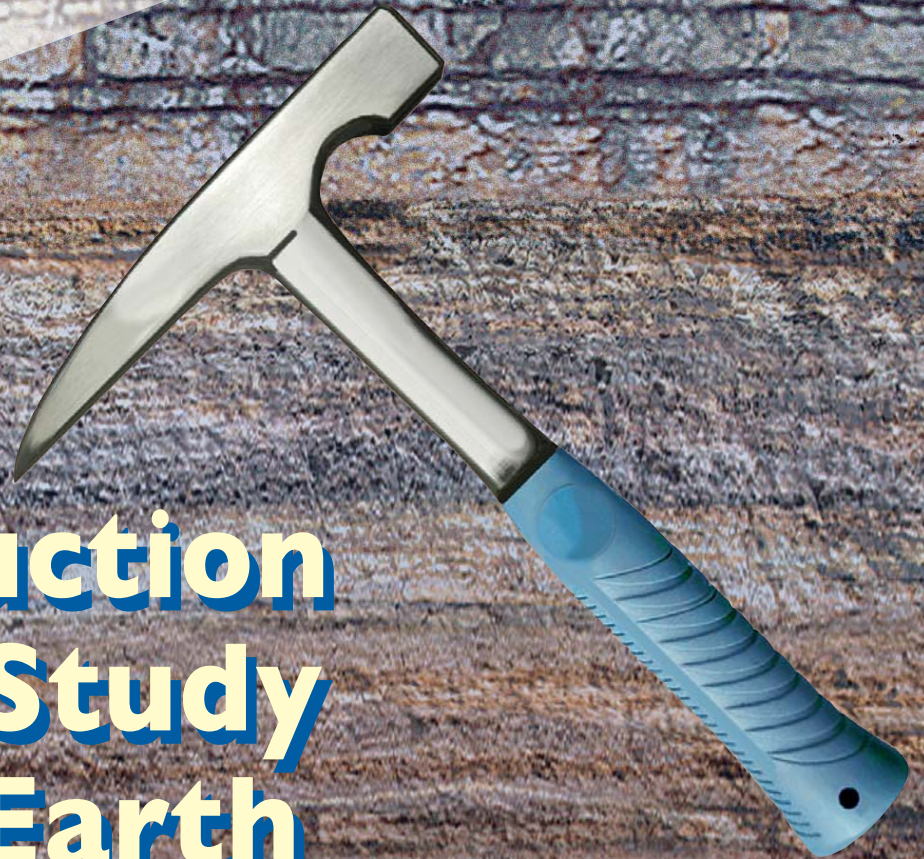




4-H

GEOLOGY



Introduction to the Study of the Earth



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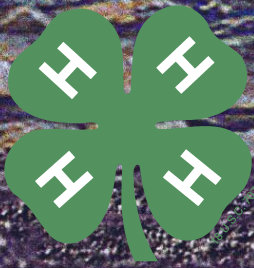
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4-H GEOLOGY



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4-H Geology — Introduction

Geology is the science that studies the earth. It includes the study of materials that make up the earth, the processes that change it, and the history of how it evolved — including life on earth.

The study of geology is filled with the mystery and adventure of what happened to former lands and seas, and to plants and animals that lived on or in them millions of years ago. In this project you will look at the story of the earth to gain a better understanding of the earth and the sources of the minerals you use each day.



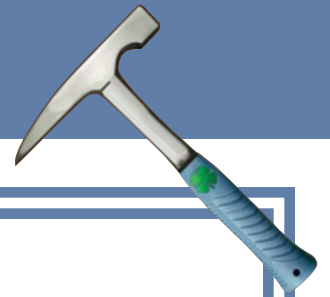
The 4-H Geology project is divided into 4 levels.

- **Pebble Pups 1** — introduces you to collecting and cleaning specimens; learning how rocks, minerals, and fossils are formed; identifying your specimens; and preparing an exhibit of your specimens.
- **Pebble Pups 2** — introduces you to finding sites in your area to collect specimens and getting the required permission; using other methods for cleaning specimens; testing for minerals; learning the characteristics of rocks, minerals, and fossils; identifying a fossil by its phylum.
- **Rockhound 1** — introduces you to testing for specific gravity; exploring the three categories of rocks; understanding how rocks are formed; expanding your collection; and discovering how fossils are formed.
- **Rockhound 2** — helps you explore the economic, historical, and scientific impact of rocks, minerals, and fossils; understand the basics of plate tectonics, and conduct a deeper study of one area of interest.

For each level, you may also include the optional activities suggested in the “**Closer Look**” section of each learning activity. You can choose the activities that most interest you. Or you can create an activity to demonstrate the knowledge you gained about a topic.

You may choose to share your specimen collections at your local 4-H project days or county fair. You will also have opportunities to share your project during a 4-H club meeting or activity. Think about ways you can share your geology project at a school science fair, as part of a classroom project, or with family and friends.

to the Study of the Earth



Pebble Pups 1 will teach you fundamental information and skills. Each level has learning activities that build on the skills from the previous level. The learning activities will include the following sections.

Objectives

The objectives define what you should learn from the learning activity.

Skills

The activities include geology and science skills. You'll practice and talk about the skills when you discuss the activities with your geology project helper.

Tools

A list of the materials you'll need to complete the learning activity.

Digging In

This is the hands-on part of the activity where you will explore the materials that make up the earth.

Discussing Your Results

Share with Your Project Helper — Discuss questions and answers with your project helper; share what you learned.

Examination — You and your geology project helper will discuss what you did, why it was important, and what it meant to you.

Using What You've Learned — Discuss how you could use what you learned in other areas of your life.



Closer Look

Suggestions for ways you can further explore the topic. Some of these are more challenging activities to help you expand your knowledge and skills. Each time you complete one of these activities, record it on the project requirements page and have your project helper initial and date it.



Bright Idea

Hints to help you complete the activity or general information about geology.



Terms to Know

Vocabulary terms from learning activities are listed here. New terms are colored in purple when they are first introduced in the activity. Definitions for these terms are listed in the glossary.



Gems

Interesting facts and trivia about the fascinating world of geology.



A Geology Project Helper

A project helper can make your geology project more fun, successful, and interesting. Your helper will guide you as you explore the elements of earth and will share helpful information and learning experiences with you.

Your project helper will help you achieve goals, discuss what you are learning, and guide you in the learning activities. Your project helper will open up a wider window to the earth and help you see and understand things you may miss on your own.

You will decide who your project helper will be. This can be an adult or older youth who has an interest in geology and is willing to help you complete your project. This could be a 4-H volunteer, teacher, family member, family friend, or someone with expertise in geology. Talk with your club leader or parents about someone you might ask to be your project helper.

When you have decided on a project helper, ask your helper to read and sign the following information.

Your Role as a Project Helper

- Guide the 4-H member in completing the Geology project, one level at a time.
- Share additional knowledge, information, and resources about geology.
- Be supportive of the 4-H member's ideas and encourage his or her learning.
- Provide hands-on activities to explore the study of the earth.
- Assist with the project, but allow the 4-H member to do his or her own work.
- Invite others to join field trips and collections of rocks and other specimens. Traveling in groups provides safety for all members of the group.
- Keep the 4-H member safe! That is your #1 priority.

I agree to serve as a project helper for the 4-H Geology Project.

Print Your Name

Date

Signature

Phone

Email Address

Best Way to Contact You

Pebble Pups 1



Project Requirements

For each year you enroll in Pebble Pups 1, you should complete at least:

- ✓ 3 Required Activities
- ✓ 2 Closer Look Activities

Required Activities	Date Completed	Project Helper's Initials
Go on a collecting field trip and discover interesting specimens.		
Use a notebook to record the location and when you found your specimens.		
Determine the best way(s) to clean your specimens.		
Develop a system for labeling your specimens.		
Learn what minerals are and how they form.		
Learn what rocks are and how they form.		
Learn what fossils are and how to recognize them.		
Begin to learn how to identify your specimens.		
Prepare an exhibit of your specimens.		

Closer Look Activities (Record a short description of activity)	Found on Page #	Date Completed	Project Helper's Initials

Pebble Pups 2



Project Requirements

For each year you enroll in Pebble Pups 2, you should complete at least:

- ✓ 4 Required Activities
- ✓ 3 Closer Look Activities

Required Activities	Date Completed	Project Helper's Initials
Find sites to collect specimens and get the necessary permission.		
Expand your notebook to include descriptions of collecting sites.		
Find other methods for cleaning your specimens.		
Expand on your labeling techniques.		
Learn the tests that identify minerals.		
Learn about crystals and their shapes.		
Learn characteristics of rocks and how to identify.		
Learn to identify a fossil by its phylum.		
Learn what a finite resource is.		
Choose a reference book to help you explore.		

Closer Look Activities (Record a short description of activity)	Found on Page #	Date Completed	Project Helper's Initials

Rockhound 1



Project Requirements

For each year you enroll in Rockhound 1, you should complete at least:

- ✓ 5 Required Activities
- ✓ 4 Closer Look Activities

Required Activities	Date Completed	Project Helper's Initials
Practice the test for specific gravity.		
Explore the three categories of rocks and how they were formed.		
Describe some minerals that occur in rock environments.		
Expand on your collection, concentrating on rocks.		
Learn what the rock cycle is.		
Discover the ways fossils were formed.		
Learn how to conserve geologic resources.		
Test the specific gravity of your mineral collection.		
Arrange to talk to a group of young people about geology.		
Attend a rock club meeting.		

Closer Look Activities (Record a short description of activity)	Found on Page #	Date Completed	Project Helper's Initials

Rockhound 2



Project Requirements

For each year you enroll in Rockhound 2, you should complete at least:

- ✓ 5 Required Activities or other activities of your choosing
- ✓ Any Closer Look Activities or your own activities about a special interest

Required Activities	Date Completed	Project Helper's Initials
Choose an area of interest and explore that topic.		
Create a graphic about mineral resources.		
Study the economic significance of mineral resources in your state.		
Expand on your collection based on your interests.		
Learn about the mineral industry in your state.		
Study one particular type of fossil.		
Spend a day working with a professional geologist.		
Create a web page about your area of interest.		
Other:		
Other:		

Closer Look Activities (Record a short description of activity)	Found on Page #	Date Completed	Project Helper's Initials

The Essentials

Every great **geologist** uses the right tools. Like many other professionals, geologists use specific tools for certain tasks. What you, a budding geologist, will need in the field will depend on two important questions. First question is, "Where am I going?" The second question is, "What is there to be found?" For example, a fisherman on the hunt for fish would go to a body of water that contains fish and may possibly need a boat. To catch the fish, the fisherman would need tools, such as a rod and reel or net.

Objectives

- Learn how to collect specimens in the field
- Choose the right tools to use in the field
- Keep accurate, informative records

Geology Skills

- Use correct and safe collecting techniques
- Understand the importance of keeping accurate records

Tools

- Notebook, pencil

Look at the items listed below and decide which you should take with you on a field trip to collect **specimens**. Give reasons why you think you should "Take It" or "Leave It." Discuss your reasons with your project helper later.

DIGGING IN

Field Equipment

Reasons to Take It

Reasons to Leave It

Rock Hammer

Gloves

Boots

Scissors

Safety Glasses

Hand Lens

Plastic Bags

Tape

Notebook

Pencil

Newspaper

Camera

Cell Phone

First Aid Kit

Water

Map

Ruler

Compass

Discussing Your Results



Share with Your Project Helper

Discuss your reasons for deciding whether to “Take It” or “Leave It.”

Was there an item you weren’t sure about? What resources did you check for information? What did you discover?

Examination

Which items would be most important for the actual collecting part of your field work?

Which items would aid in your comfort and well-being in the field?

Using What You’ve Learned

Describe another situation where you might consider all the things necessary for you to be prepared.

What items will help you in preparing to do the activities in this project book?



Bright Idea

One of your tools should be a toothbrush. The small brush makes cleaning specimens easier. The bristles can get in crevices and remove unwanted dirt.



Terms to Know

Geologist, hand lens, rock hammer, specimen



Gem

Don’t try to cut corners by using a carpenter’s hammer. The steel is too soft and will distort and split quickly when used on rock.

Closer Look — What do you do with the specimens you collect in the field?



1. Explore ways to sort your specimens.
 - Use field guides or conduct an online search to find some suggested methods for sorting your specimens.
 - Discuss your findings with your project helper.
 - Decide which method for sorting specimens would work best for you.
 - Start sorting!
2. Learn why cleaning your specimens is important.
 - A clean specimen can reveal more of its unique qualities.
 - Use water to start.
 - You will learn other treatments that are safe and won’t damage specimens.
3. Store your specimens.
 - It is important to store collected samples in a dry place. Some specimens are fragile and need special handling.
 - Use field guides or conduct an online search to explore ways to properly store specimens.
 - Discuss your findings with your project helper.
 - Decide how to store your specimens to protect them.

Detectives in Disguise

Now that you know the things that are necessary for geologists to collect specimens in the field, it is time to explore what to do once you get to a collection site. What you bring with you is important. You'll find that your notebook is a very valuable tool. Each time you find a specimen, you should mark it in some way; make a note of what you think it might be; and notes about where you found it. This may not seem important at first, but as your collection grows, this will document details about each specimen that you might not be able to remember.

Objective

- Keep detailed notes about samples collected in the field and collecting sites

Geology Skill

- Understand how valuable it is to a collection to know the origin of the specimens

Tools

- Pencil, notebook, permanent marker, adhesive tape

DIGGING IN

When detectives are called to the scene of a crime they are equipped with their journals. They make notes of everything they see and write down questions they have. The answers to the questions will help them solve the crime. In a way, geologists are detectives when they are in the field. It is important for you to keep track of what you find and where you found it. Include adhesive tape in your toolkit and use it to label specimens as you find them. Assign each specimen a unique number and record detailed notes about where it was found, when, and any other information you may gather.

Examine the specimen pictured below. Suppose you collected it at a creek near your home in early spring. Think about some things you should enter in your notebook about this particular sample. Create your journal entry about the specimen. Include the assigned number, date, location, and notes about what you think the sample may be.

Granite



Notebook Paper for Entry

#	Date	Location	Notes

Discussing Your Results



Share with Your Project Helper



Explain why using a notebook will help you with collecting specimens.



What are some things you would like to start entering in your notebook right away?

Examination

What are the four most important pieces of information about a specimen? Why should these be entered into your notebook?

When is the right time to make notebook entries?

Using What You've Learned

How will keeping accurate records about your collection in a notebook add to its **scientific value**?

Can you think of another situation that would benefit from accurate record-keeping?



Bright Idea

Tie a pencil on a string to the rings of your notebook so you will always have a pencil when you need one.



Term to Know

Scientific value



Gem

When Mount Vesuvius erupted in 79 AD, it covered the city of Herculaneum with a layer of volcanic rock and ash 60 feet deep.



Closer Look — Being a Detective

1. If you have already collected some specimens and you have not begun to keep a record of them, begin now. Enter everything you can remember about where and when you found each one. Assign them numbers.
2. Learn how to identify your specimens. Refer to field guides or other reference books. Or you can search online for helpful websites. Your project helper can help you identify reliable sources of information.
3. Visit a rock and mineral collection and look carefully to see if there are specimens that look like the ones you have collected. A museum is a good place to start.

Back to the Basics

Minerals, rocks, and fossils all appear to be hard, solid objects found on or in the earth. How do you know what the specimens are that you have collected? A mineral, a rock, and a fossil each have special characteristics that distinguish them from each other. Let's begin with learning the difference between a mineral and a rock.

MINERAL

A mineral is **inorganic**, which means it was not formed from a living thing. Minerals occur naturally in the earth and have the same chemical makeup wherever they are found. Minerals are solid and are made up of one or more **elements**. For example, the mineral quartz is made up of the elements **silicon (Si)** and oxygen (O). Quartz is always one part silicon and two parts oxygen, giving it the **chemical formula** SiO_2 . The atoms that make up the elements of a mineral are bonded together in a specific repeating pattern. This arrangement is what forms the mineral's characteristic crystal shape.

ROCK

A rock is made up of minerals. Rocks are the building blocks of the earth. They make up the **crust**, the **mantle** and the **core** of the earth. Rocks are not the same through and through and the size of the mineral crystals in them will vary. At times you can clearly distinguish minerals that make up a rock. For others the crystals are so small, they are not visible to the naked eye.

Objectives

- Recognize the characteristics of a mineral and understand how a mineral formed
- Recognize the characteristics of a rock and understand how rocks are formed
- Identify collected specimens

Geology Skill

- Know and be able to explain the difference between a mineral and a rock

Tools

- Notebook, pencil

DIGGING IN

Look at these specimens and decide whether you think they are a mineral or a rock.

Mineral or Rock?

Calcite



Calcite is white or colorless, but **impurities** can tint it shades of yellow or gray. It has a chemical formula of CaCO_3 and can have a rhombohedral **crystal habit**.

Granite



Granite is formed from silicate melts in the earth's crust. It consists primarily of feldspar and quartz with small amounts of mica or hornblende.

Discussing Your Results



Share with Your Project Helper

Discuss how you decided which specimen was a rock and which was a mineral. Were there any specimens that you weren't sure of? Explain.

Did you check any references for help?

Examination

What are the most important differences between a mineral and a rock?

Why is it important to be able to tell the difference?

Using What You've Learned

How can you begin to separate your specimens into orderly groups?

Is there another situation in which knowing how to separate items into categories would be helpful?

Closer Look — Taking a Look at other Rocks and Minerals



1. Find two other minerals and rocks not mentioned in this activity that are common to your state. Record the characteristics of these specimens in your notebook.
2. Read about the **sedimentary** rock, coal. Why could coal never be considered a mineral? Why is coal such an important rock?
3. Read about your state mineral. Record the mineral's characteristics in your notebook.



Bright Idea

Sometimes we confuse the terms to describe rocks and minerals. Try to keep them separate in your thinking. Terms used for minerals should not be applied to rocks.



Terms To Know

Calcite, carbonate, chemical formula, core, crust, crystal habit, elements, fossil, granite, gypsum, impurities, inorganic, limestone, mantle, mineral, rock, sedimentary, silicon, translucent, transparent



Gem

Pliny the Elder (AD 23-79) thought some minerals were made of magic substances that formed in the stomachs of animals.

Gypsum



Gypsum is colorless, **transparent to translucent**, and is often stained yellow by impurities. It is soft enough to scratch with a fingernail, and it has a monoclinic crystal habit.

Limestone



Limestone is comprised of calcium **carbonate** minerals. It is often composed of skeletal fragments of marine organisms. Ancient Egyptians used this in building the pyramids.