



4-H GEOLOGY

Level 3



4-H Geology Project Manual

Note to 4-H Member

Learning about geology is fun and may help you choose a career. “Geology” exists all around you, wherever you live. The Indiana *4-H Geology* curriculum was written for youth who enjoy studying about Earth processes and want to learn more. The first two manuals introduced you to basic geology concepts with a focus on rocks, fossils, minerals, and basic Earth processes. *Level 3* introduces more advanced geology topics. And now, rather than giving you all the information you need, you are expected to be more active in your learning. This is achieved by 4-H member activity-based self study.

The topics in this manual are introduced with a brief overview. A number of activities are then suggested to help you further explore the topics that most interest you. This approach is often called the *Experiential Learning Model*. The focus is “learning by doing.” You will learn by reading, researching, and asking questions about the focus topic. Your study will be directed to help you **experience** a learning activity, **reflect** on what you did, **generalize** what you learned, and then think about how you can **apply** what you learned to other situations. This model is shown as a cycle because learning about one topic often leads to more questions that you will want to study. Each activity is followed by questions to help you complete this cycle.

You can find geology resources at rock shows, online, in your local library or school library, or at book stores and museums. This is a good time to expand your geology reference library to include books that have topics of special interest to you. See the “Resources” section at the back of the manual for suggestions.

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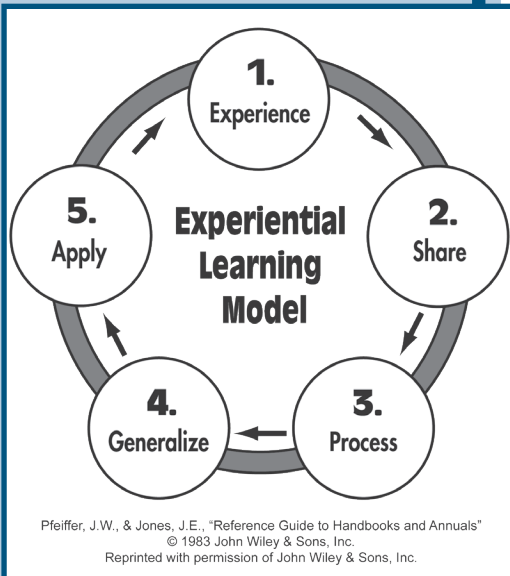


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Note to Parents and Project Leaders

The *4-H Geology* curriculum offers many educational experiences, from collecting and identifying rocks to learning how the Earth was formed. Parents and project leaders should be supportive of their children's interests, but high school aged youth should be taking the primary responsibility for their learning. The helper's guide has a variety of information to help adults work much more effectively with youth. These include:

- Ages & Stages – This article gives a summary of the general youth developmental stages and gives ideas of what to expect.
- Learning Styles for Youth – This article discusses how youth learn by different methods.
- Experiential Learning – This article gives tips on how to make the most of any activity by teaching with a variety of learning styles.

Goals of This Publication

The *4-H Geology, Level 3* manual encourages youth to

- use resources beyond this manual for in-depth study of geology topics of interest,
- keep accurate records (field notes, journal),
- expand on their understanding of and appreciation for Earth science, and
- educate others about geology through exhibits, presentations, action demonstrations, and mentoring younger 4-H members.

Review

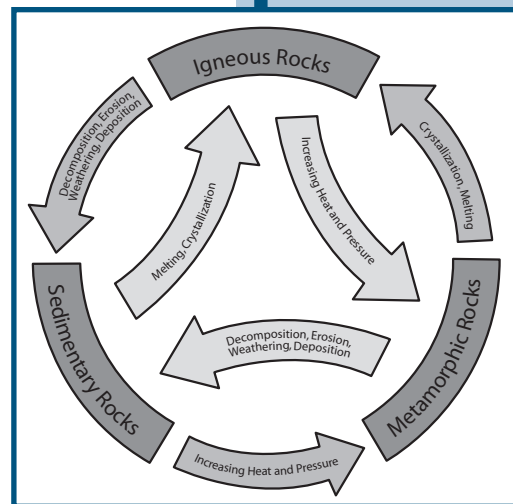
The *4-H Geology Level 1 and 2* manuals introduced you to rocks, fossils, minerals, and basic Earth processes. You should be familiar with the basic concepts described below before beginning your *Level 3* work. If these topics are not familiar to you, it is recommended that you review the *Level 1 and 2* manuals or find information about these topics in a library or on the Internet.

Level 1 topics

- Rocks and the rock cycle
- Equipment for rockhounds
- Minerals
- Fossils

Level 2 topics

- Further study and identification of rocks, fossils, and minerals
- Geologic time
- Glaciers
- Journaling
- Field trips



Safety

Always be aware of possible hazards when you are collecting rocks, fossils, and minerals. Safety suggestions:

- Don't collect alone.
- If you are not collecting on your own property, you must get permission from the property owner or manager before collecting specimens.
- Wear solid shoes and long pants.
- Wear safety glasses or goggles when breaking specimens.
- If you are collecting on a hillside, make sure there is no one below you.
- Be aware of where you are, what you are doing, and what others around you are doing.
- Always be conscious of your surroundings and potential dangers.
- Think Safely, Think Safety – at all times!

Your Field Journal

A field journal is a great place to keep a record of what you have learned and where you found your specimens. Notes that are carefully recorded let you recall things you see and hear years after the occurrence. Developing the habit of writing down your observations takes effort, but it is worth the work.

Use a notebook or bound journal for your field journal. Notes should be recorded in waterproof ink (drafting or embossing ink) or with a Sharpie®. Pencils may also be used, but may smudge, and you may be tempted to change your notes. Resist that temptation. It is important to not change the notes you take in your geology journal. If you make a mistake in your journal, just draw a line through it once. It is good to get into the habit of signing the bottom of each page of your geology notebook.

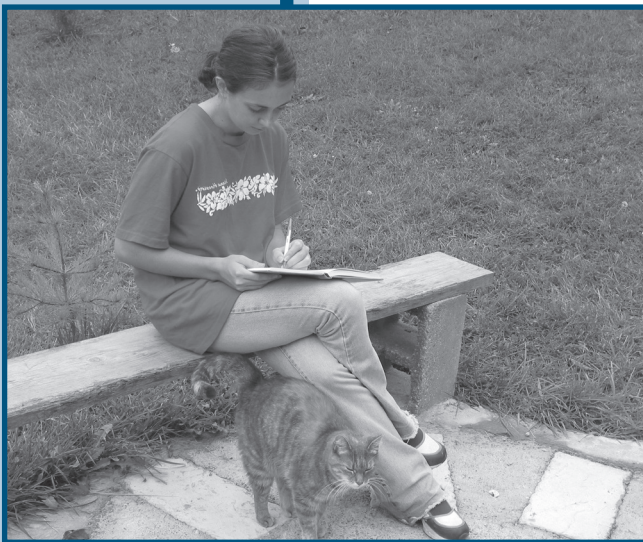
Enter your personal information at the front so your book can be returned, should it be misplaced. Your notes can be recorded in any style as long as they are clear to you. Report the date and location of your observations. Be as specific as you can with the location, including legal land descriptions or the distance and direction to the nearest crossroads. Topographic maps or Internet maps are important tools. A **global positioning system (GPS)** unit can be a great help in defining the exact location where you found a particular specimen. When collecting fossils, record as much information as you can. Search the literature to find the period, time, formation, etc. The Indiana Geological Survey has resources that can help you find this information.



Your Journal

Your journal is your personal geology diary.

Create the journal that you can use and want to keep.



Your geology journal is the best place to record geology information. Your notes are a record of what you noticed the day that you were in the field. Take notes about the geology specimens and formations that you see and geology events that you attend. Events may include visiting a rock show, museum, a program at a state park, or even a fossil dig.

The *Level 2* manual has additional information about field journals.

Rocks, Minerals, Fossils

In the *4-H Geology Level 1 and 2* manuals you began to learn about rocks, minerals, and fossils. Now, you will continue learning on your own by focusing on a specific topic. Choose one of the topics below and study all you can about it. You can find information on the Internet, in your local library; at bookstores, museums, rock and mineral shows; and from others who have studied these topics. Keep notes in your journal about what you learned and where you learned it. The “Resources” section can help you get started, but don’t stop there.

Activity 1. Personal Research

Choose one of the following topics and learn all you can about it. Study the topic by reading and researching as much as you can. The “Resources” section of this manual has many suggestions for where to start your search. See “Appendix A” for research suggestions. Visit geological sites if you can. Remember to take pictures and make notes in your field journal.

Rocks

- Study the formation of rock layers.
- Study environmental influences on geologic formations.
- Study the creation of folds or faults.
- Study differences between extrusive and intrusive igneous rocks.
- Study Indiana bedrock.
- Study differences between foliated and non-foliated metamorphic rocks.

Minerals

- Study a specific mineral family (for example: carbonates, sulfides, silicates).
- Study a crystal system (for example, a different mineral that has a hexagonal crystal system). Note that there are six basic crystal systems and specific forms within each system.
- Study one mineral of the native elements (for example: copper, gold, silver, platinum, carbon, lead, sulfur). Tell where it is found, how it occurs, etc.
- Study why some minerals will have fluorescence under long and/or short wave light. Include color photographs of your fluorescent



minerals under fluorescent light if possible, to show the difference between how they look in natural and fluorescent light.

- Study mineral colors and explain what causes different colors.
- Study minerals used to produce fertilizer (for example: potash/potassium, phosphate, sulfur, nitrogen) and explain what properties they have that make them important soil amendments.
- Study ore minerals that provide metals.
- Study minerals mined as byproducts (for example: iron, copper, uranium).
- Study ways quartz forms – explain how two pieces of quartz can have the same chemical and physical composition, but look very different.
- Study limestone.
- Study several different mineral characteristics: luster, streak, cleavage, color, fracture, opacity, magnetic properties, or electrical properties.

Fossils

- Focus on a specific animal or plant that might have lived during a specific time-period in Indiana.
- Study a phylum during a specific time (era, period, etc.). Describe the environment that its members lived in, the plants and animals that occurred, etc.
- Tell what an index fossil is. Why is it important?
- Study the evolution of a species.
- Study the formation of a specific type of fossils.
- Study one of the following: sharks, ginkgo tree, coral. Explain why these are sometimes called “living fossils.”
- Study how fossils are preserved and explain the process that causes the fossilization of the plant or animal.
- Study tracks, burrows, or other signs of past life.

Other

- Study how plate tectonics affected Indiana.
- Study subduction plate movement (causing earthquakes and volcanoes).

