## Rock Cycle - Basic Rock Testing - Advanced Grade 3-5 <br> BACKGROUND

Children have a natural excitement and interest in rocks. They see them everywhere. Use this connection and take advantage of student's travels throughout the state, as well as in their own community to advance their motivation to learn and discover.

We will be using the idea of rock forming processes to identify rock characteristics, thus identifying the rock. The name of the rock is secondary to the knowledge of how and where in the process it was formed. Each activity will start with an inquiry/learning segment, after which the students will revise their ideas of the material. Students should already have been exposed to the three basic rock types: igneous, sedimentary, and metamorphic. By the end of the lesson, students should understand the processes that form the three main types of rock, as well as identify characteristics of some common rocks.

Rocks are combinations of minerals found naturally on or in Earth. Rocks record the history of Earth in their structure. Earth materials can change over time from one form to another. Rocks can be identified by properties such as color, crystal size or texture, banding patterns, presence of pores, and other characteristics. Color is an easy one for students but not all that helpful. The size and shape of the particles that make up rock or lack of them, are more meaningful.

Characteristics of the three categories of rocks are used to help students identify rocks found in Montana.

1. Eroded materials, dissolved mineral, and the remains of living things are moved by water and wind and deposited as sediments. Sedimentary rock is formed when these sediments become solid material. Most were formed of sediments deposited by ancient shallow seas. Sedimentary rocks include having rounded fragments of a variety of sizes, occurring in thick layers, and-in the case of water deposited minerals-a very smooth texture. The sediments are held together by mineral cements which have testable properties. If calcite is the cement it will fizz with acid. Most limestone, some sandstone, and some conglomerates will fizz.
2. All igneous rocks were once molten rock. Their locations in Earth's crust controlled the rate at which they cooled. When magma cools before reaching the surface it cools slowly and tends to have large crystals. This is called intrusive rock, like granite. Other igneous rocks form on Earth's surface, cooling more quickly. The crystals formed are often microscopically small. These are called extrusive rock, like basalt or obsidian.
3. Metamorphic rocks have been changed by heat and pressure over time, but not enough to melt them. These rocks may have been buried under Earth's surface or have been near a heat source. They form from igneous, sedimentary or other metamorphic rocks. They are recognized by the occurrence of thin banks or layers which form as minerals in the rock rearrange themselves.

- This website contains good background on The Rock Cycle. http://www.rocksandminerals.com/rockcycle.htm


## BASIC LESSON Objective(s)

Students will be able to...

- identify types of rocks - sedimentary, igneous, or metamorphic - in this discovery lesson by examining rock characteristics and processes.


## State Science Content Standard(s)

Standard 4.2: Describe and measure the physical properties of earth's basic materials (including soil, rocks, water and gases) and the resources they provide.
A. Describe the formation of the three rock types.
B. Compare and contrast the characteristics of the three basic types of rocks: sedimentary, metamorphic and igneous
C. Identify specific samples of sedimentary, metamorphic and igneous rocks
D. Identify everyday uses of rocks
E. Classify rock samples by rock type

Standard 1. Students, through the inquiry process, demonstrate the ability to design, conduct, evaluate, and communicate results and reasonable conclusions of scientific investigations.

| Materials |  | Safety |
| :---: | :---: | :---: |
| From the Kit | Provided by Teacher | - None |
| - Fluorescent Rock Kit (smaller) <br> - Classroom collection of Rock Kit (larger) <br> - Rock Cycle Vocabulary Handout <br> - Rock Formation Handout <br> - What's this Rock - Cards and Reference Sheet <br> - Rock Cycle Overhead <br> - What's This Rock activity sheet Handout <br> - 20 Hand Lens <br> - Using Rocks - Sharon Katz Cooper <br> - Rock Cycle 3-D Model | - Taffy |  |
| Key Vocabulary |  | Mastery Questions |
| - Sedimentary <br> - Igneous |  | - See Lesson |

- Metamorphic
- Crystal Size
- Melting
- Compacting
- Eroding
- Erupting
- Weathering
- Cooling
- Layering
- Heat and pressure

A brief introduction or exposure to the three different types of rock is needed prior to this lesson.

## Rock Cycle Discovery

## Engage

In order to understand some of the rock processes, we need to talk about some action words that describe what is going on. Ask the students for words that describe what is happening (action words) in the rock cycle and list them on the board. Add additional words as needed (See Rock Cycle Vocabulary sheet for help), and circle key words they need to know. Next, hand out and have the students fill out the Rock Vocabulary sheet by matching the words with the definitions. This may be used as a pretest and then can be used later as a post-test. After everyone has had a time to fill it out, call for volunteers to state the definitions that match the words. This is a self-checking activity. Collect the vocabulary sheets so they may be used later.

Have the students look at different rock samples found in the larger rock kit. Put a sample of each rock type at different stations so there are three rocks per station - one of each type. Use the label found taped to the inside top of the rock box to determine the rock types. Please be careful of the labels on the rocks so they don't fall off. Tell the students to try to determine the type of rock. Ask "Do you think the items were made from metamorphic, sedimentary, or igneous materials?" Have them go to several stations and mark their answers on a tally sheet.

## Exploration/Explanation

This is a discovery lesson. Students will use the inquiry method, participate in learning activities, and then restructure their learning as they go. Be careful not to give in to the urge to provide all the answers before they have a chance to think and process the discussion. You will be assessing their understanding as you go.

1. We are going to be learning about processes that have been going on inside and outside Earth for all of its history. Rocks are changing all the time, but "time" in the geological sense is millions of years. By understanding the cycle that affects rock, we can look at rocks around us and try to tell their story: where they have been and what processes made them what they are now. Give students a piece of paper. Ask, "What do you think a rock cycle might look like? Take a minute and draw your idea of what a rock cycle might be." This can be done individually or as a group activity. Emphasize that this is a rough sketch, a pre-assessment to see ideas. Pick one person from each table to stand and briefly share their ideas.
*It is important for them to come up with their idea of this process so they can revise as they learn more about it. No right or wrong on this activity. *
2. Pass out the black line of Rock Formations with no labels on it. Have students compare this to their rock cycle. What things are similar? What things are different? Using their vocabulary words, discuss what processes are occurring on the rock cycle graphic? After some group responses, ask the class to come up with sentences describing what is going on in the picture. For example, "I see a place where rock looks like it is melting from the heat." Have a student try this using each word. There are three main processes in the rock cycle. These processes can happen over and over again during geologic time. Thus the idea of rock cycle. The rocks we look at today have been in many different places during their geologic history. As we look at them, we can observe their characteristics to see what they have become. Using labels, have students lightly glue the labels in the correct locations or write directly on the sheet with pencil where they think the vocabulary word should be located on the diagram. They may make some adjustments later as they revise ideas. (See \#5)
3. It's time to look at rocks. Give each table a set of three rocks - one of each type. Have students use hand lenses to spend some time observing rocks. Look at the characteristics that are most obvious. What kind of process might have caused this rock to look this way? Next, within your group, each person picks a rock and tells the others what might have happened to that rock to make it look like that. For instance, "I see a lot of layers that might have gotten there by sediment layering and pressing together." Let everyone have a turn.
4. Place a different type of rock found on the What's This Rock Cards at one of thirteen stations. These rocks are found in the large rock kit. Pass out What's This Rock? - Reference Sheet, and What's This Rock? - Cards (to be shared in groups). Pass out the What is This Rock activity sheet. Introduce (or review) the three basic types of rock forming process: igneous, sedimentary, and metamorphic. Looking at the general characteristics of each type of rock on your table, and then looking at the rock descriptions, match up the names with the rocks. Discuss with your group why the rock was placed with that label and why it doesn't belong with one of the other labels. Rotate stations. When finished, as a class, go over the correct identification of rocks. Discuss why choices were made. What rocks were difficult to identify? Why? What rocks were easy to identify? Why?
5. Pass out three different solid color taffy pieces to each person. Start by unwrapping the pieces. Say "We are going to use our taffy to demonstrate the processes that form the three basic types of rock. Who would like to try sedimentary?" If no one volunteers, go ahead and demonstrate. Flatten out three colors of rock in your palm. Lay them on top of each other to demonstrate layering. Metamorphic: Take taffy and twist and fold it to show how the heat and pressure work on rocks inside the Earth. Igneous: Place the taffy inside your hand or under your arms to represent melting. After this review activity, have students go back to their rock formation chart and see if they would like to make any changes on their label placement. As a class, now correct the rock formation chart.

Use the prepared Rock Cycle overhead found in the binder to show students another way to represent the rock cycle. Discuss similarities and differences between the two diagrams.

Use the 3-D display to show them where each rock type is found and review how each rock type is formed.

## Extensions:

- Advanced students may be given the task of creating their own master of the rock cycle.
- Technology: Using the computer, students can make a "rock field guide," or create a power point presentation about rocks or the rock cycle.
- Music: Students can make up their own rock cycle song or raps.
- Math: Graph a rock collection by weight, size, texture, color, layers, fizz, where they were found, etc.
- Art: Put up paper and have students make a wall-sized mural of the rock graphic. Place actual rocks where they are being formed.
- Writing: Students bring in their own rock and write a story about its' life and the changes it goes through to become what it is today.
- Look in the Rock Cycle Model Activity Set for more ideas.


## Assessment

- Ongoing assessment is a big part of this activity. At each step you can verbally assess, as well as monitor what students are learning. As you monitor, you can re-teach as they reframe their knowledge.
- Have students check their final placement of labels on the Rock Formation diagram. Do they need to make changes or give them a blank Rock Formation diagram, have them fill it out and then have them compare it to their original Rock Formation sheet.


## Resources

Adapted from: Utah LessonPlans
Books
If you find a rock, by Peggy Christian: ISBN 0-15-239339-0
First field guide: Rocks and minerals, by Scholastic: 0-590-5484-8
Rocks and minerals, my first pocket guide, by National Geographic ISBN 004390655650-X
Everybody needs a rock, by Byrd Baylor, ISBN 068971058
Videos
Check district video library for appropriate films to enhance the classroom experience.
Eyewitness Rocks and Minerals; Item \#1234 OR ISBN 1234567890
Bill Nye the Science Guy-Erosion
Web Sites
Bob's Rock Shop www.rockhounds.com
Mineral Information Institute www.mii.org


The determination of hardness of a mineral can be an important step toward its identification. Hardness is the resistance which the smooth surface of a mineral offers to being scratched. The test is conducted by placing a sharp point of one specimen on an unmarked surface of another specimen and attempting to produce a scratch. A diamond is the hardest of all substances and can only be scratched by another diamond.

Over a century ago, German scientist Friedrich Mohs, through a series of experiments, made up a scale of hardness which is referred to as Mohs Scale. It does not imply an exact hardness, but it is set up so that any mineral can scratch all those beneath it in the scale, or can be scratched by those above it in the scale. Since diamond is the hardest it is given the number 10; talc is the softest so it is given the number 1. Quartz is often used as a division in the scale and all those above 7 are called hard minerals.

1. Talc
2. Gypsum
3. Calcite
4. Fluorite
5. Apatite
6. Feldspar
7. Quarts
8. Beryl
9. Corundum
10. Diamond

Some familiar objects can be used in conjunction with this scale. A fingernail has a hardness of 2.5, a copper penny between 3 and 4 , a nail about 5 , common window glass 5.5 , a steel file or porcelain tile 6.5. Other minerals are sometimes substituted in the scale such as topaz for beryl since they both have a hardness of 8 .

From American Educational Products Rock kit

## Objective(s)

Students will be able to...

- use the Mohs Scale of Mineral Hardness to determine the hardness of various minerals.


## State Science Content Standard(s)

Standard 4.2: Describe and measure the physical properties of earth's basic materials (including soil, rocks, water and gases) and the resources they provide.
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D. Identify everyday uses of rocks

## E. Classify rock samples by rock type

| Materials |  | Safety |
| :---: | :---: | :---: |
| From the Kit | Provided by Teacher | - Be careful of |
| - 4 small hardness rock kits <br> - Mohs Scale handout - pictures of the minerals <br> - 8 Mohs Scale \#2 handout <br> - Rocks and Minerals Naming Game (Extension Lesson) <br> - Hand lens | - 3-4 different rocks for testing student theories and demonstrating how to run a hardness test <br> - Pieces of damp cloth for wiping the tools and rocks clean. Do not use paper towels as they will leave part of the paper behind. | sharp edges on the rock and tool. |
| Key Vocabulary |  | Mastery Questions |
| - Mineral <br> - Rock <br> - Hardness <br> - Mohs Scale of Hardness |  | - See Lesson |

## Detailed Plan

Review or teach what a mineral is prior to this activity. Since there are only four hardness kits dividing the class into groups of four and having half the class test for hardness and half the class do something else (See Extension at end of lesson) will allow more students to have a hands on experience.

Have students bring 2-3 rocks of their own to test for hardness. Ask them to bring in a variety of rock types.

## Determining the Hardness of Minerals

## Engage (Entire class)

1. Ask the students to explain how you can tell if one rock is harder than the other. Listen to their ideas, and test any of their hypotheses. A few of these tests might include chipping the rock with some sort of tool, banging the rocks together, or tapping the rocks to hear what sound they may make. Use rocks you have brought in to test their ideas.
2. Place students into four groups and provide each group with a rock kit for testing hardness. (Take out the penny, nail, glass, and porcelain plate.) Ask each group to come up with one way they can think of to test the hardness of the rocks, and to put them in order from weakest to strongest using their method. Ask them to keep their rocks in this order when they are finished so that the rest of the class can observe what everyone has done.
3. Provide them with 15 minutes for this exploration time.
4. Have the class go from station to station to observe what each of the groups have done.
5. Gather for a whole group discussion.
6. Ask the students what they did to sort the rocks by hardness.
7. Ask if size was important. Color? Shape? Smell?

## Explanation

Ask students what properties or characteristics do they think they could use to help identify a mineral. There are six: color, streak, fracture/cleavage, texture, luster, and hardness. It is the last property they will be using in this activity. Give students a brief history with visuals on the German mineralogist Friedrich Mohs and the Mohs Scale of Mineral Hardness. (See background for information and the binder for an example of Mohs Scale) Explain and demonstrate what each of the numbers mean using the rocks you brought in. Do not use rocks from the hardness kit since the students will be using it in the Exploration section.

Explain when a tool leaves a mark on a rock, it means the tool is harder and when a rock leaves a mark on the tool, it means the rock is harder. After each test demonstrate how using a damp cloth rag, removes any small particles left on the tool or rock making it easier to see if there is a scratch or groove left.

## Mohs Hardness Testing Procedure

- Begin by locating a smooth, unscratched surface for testing.
- With one hand, hold the specimen of unknown hardness firmly against a table top so that the surface to be tested is exposed and accessible. The table top supports the specimen and helps you hold it motionless for the test.
- Hold one of the standard hardness specimens in the other hand and place a point of that specimen against the selected flat surface of the unknown specimen.
- Firmly press the point of the standard specimen against the unknown specimen, and firmly drag the point of the standard specimen across the surface of the unknown specimen.
- Examine the surface of the unknown specimen. With a finger, brush away any mineral fragments or powder that was produced. Did the test produce a scratch? Be careful not to confuse mineral powder or residue with a scratch. A scratch will be a distinct groove cut in the mineral surface, not a mark on the surface that wipes away. Use a hand lens to observe the scratched surface.

Talk about safety precautions when using the tools. Be careful of sharp edges on the rock and tools.

## Exploration (Groups)

Provide the students with a Hardness Rock Kit (include the penny, nail, glass, and porcelain), a hand lens and a copy of Mohs Hardness Scale .

1. Using the Hardness Kit the students will practice testing the hardness of the known rocks. The numbers on the rocks correspond to the numbers on the scale. Have the students create a data table for each number on the Mohs Scale and record their observations. 10-15 minutes
2. Next, the students in the group will test the hardness of their own rocks. Have them record their observations in the data table and then determine the value of hardness on the Mohs Scale. 1015 minutes
3. Have the students put their rocks in order from softest to hardest. Place them on a piece of paper and label the rocks with its hardness value. 10-15 minutes
4. Give students an opportunity to walk around and observe how each group numbered their own rocks.

## Assessment

- Students will be assessed according their participation in the experiment and the group discussions.
- Students will be assessed according to their ability to use the Mohs Scale of Mineral Hardness to determine the hardness of various minerals.


## Questions

1. Ask the students what rock was the hardest. (If the teacher wishes them to know the rock by name, or wants them to be able to identify the rock in some way, then the teacher may either use masking tape to write the name on the rock, or color code each of the rocks with markers or colored circle stickers.)
2. How do you know that that rock was the hardest? (It used a tool that was highest on the scale, or it was the highest number)
3. What was the softest rock? How do you know? (It used a tool that was lowest on the scale, or it was the lowest number)
4. What was a rock that was not as soft as the softest rock, but not as hard as the hardest rock? How do you know? (It used a tool that was in the middle of the scale, or it used a middle number).
5. What did the numbers on the identification chart help you to do in this experiment? (to determine the hardness of the rock by comparing them against other rocks/numbers)
6. What are these numbers are called when they help us determine the hardness of a rock? (Mohs Hardness Scale).
7. Why we did not have any materials in class to test number 10 on the scale. (Diamond is too expensive.
8. What number do you think chalk falls on the scale? (1-soft - easily leaves a mark)

## Resources

## Adapted from

- http://lessonplanspage.com/sciencemathmusicpeartsslamdrocks-mohshardnessscale12-htm/


## EXPLORE MORE

- Great activity that combines Mohs Hardness test with other tests. http://gk-12.osu.edu/Lessons/0304/Physical\ Science/MohsHardnessTest.pdf
- Students participate in an on-going investigation of classifying rocks and minerals.
- Found In the back of the binder is an activity where the students hike (or can do a virtual hike) Mt . Helena and explore the geology of the area.
- Found in the kit: Rocks and Minerals Bingo Game. Instructions are found in the binder. This is a unique way to review a variety of terms or introduce terms. The clue is on one side of the card and the answers are on the other side. If your students do not know enough to answer the clues themselves, you can read the clues and then give them the answer. The game just transforms to a regular Bingo game.

Using the small rock kit, demonstrate to students the unique property of fluorescence in rocks. Darken the room or go to a room that is dark. Have the students gather around you. Explain that many rocks
absorb energy from light and give it off in ways that can be seen with only special lights. Have someone turn the lights off. Turn on the UV lamp and notice which rocks glow or "fluoresce". Switch the lamp to the other wavelength and notice how different rocks now glow. Discuss where on the rock they are glowing and the different colors that are present.

