

Exploring Rocks and Minerals

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Subject: Earth Science

Grade Level: Elementary (3-5) and Middle School

Standards: Next Generation Science Standards (www.nextgenscience.org)

5-PS1-3 Make observations and measurements to identify materials based on their properties.

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

Schedule: Two-45 minute lessons

CCMR Lending Library Connected Activities:
Classification



<p><u>Objectives:</u></p> <p>Learn about simple observable characteristics/properties (color, streak, hardness) used to identify rocks and minerals.</p>	<p><u>Vocabulary:</u></p> <p>Element Absolute Mineral Hardness Streak</p>
<p><u>Students Will:</u></p> <ul style="list-style-type: none"> - Explore the properties of some common minerals - Identify a mineral based on its properties. - Provide descriptions based on observable properties of each rock or mineral - Gain experience with classification and identification - Make educated guesses and try to identify the rocks and minerals - Research some basic information on a rock and mineral. 	<p><u>Materials:</u></p> <p><u>Each Student Pair</u></p> <ul style="list-style-type: none"> ___ Rock & Mineral Samples (2 ea) ___ Mineral Identification Guide <p><u>For Each Station</u></p> <ul style="list-style-type: none"> ___ Station Directions <p><u>Streak Station</u></p> <ul style="list-style-type: none"> ___ Streak Plates (unglazed pieces of porcelain) <p><u>Magnetism Station</u></p> <ul style="list-style-type: none"> ___ Magnets ___ Paper Clips <p><u>Chemical Station</u></p> <ul style="list-style-type: none"> ___ Acid (3% HCl) ___ Black light <p><u>Optical Properties Station</u></p> <ul style="list-style-type: none"> ___ Flashlight ___ Magnifying Glasses <p><u>Hardness Station</u></p> <ul style="list-style-type: none"> ___ Pennies ___ Glass Microscope Slides ___ Steel Nails ___ Emory Cloth <p><u>For Teacher</u></p> <ul style="list-style-type: none"> ___ MSDS for Hydrochloric Acid ___ Mineral Sample ID Sheet
<p>Safety</p>	<p>Students should use caution when handling the weak HCl solution and wash their hands after handling Galina (it contains lead).</p>



Science Content for the Teacher:

In a laboratory, scientists can figure out exactly what a rock is made of by conducting complicated tests with expensive equipment, using x-rays and electron microscopes. However, trying a few simple tests can often identify rocks and minerals. Once a person becomes experienced in this field, she or he can usually identify a mineral by observing it and taking into account some of its specific features.

Today, we'll look at rocks through the eyes of a scientist, and try to identify a few rocks and minerals using some of these simple tests. To do this, we'll work in groups (just like scientists do), and record our observations.

Color

Color might be the first thing you notice about a rock or mineral. Some minerals always have the same color (like gold), while other minerals (like quartz and calcite) come in all colors. The presence and amount of certain elements can determine a rock's color. If all pieces of a certain mineral are the same color, then that kind of mineral contains an essential element that causes their color. A good example of this is malachite, which has a strong blue and green color because copper is included in its atomic structure.

What about minerals that come in many colors? These contain very small amounts of additional elements that cause the coloring. For example, pure quartz is colorless, while amethyst (a special kind of quartz) has a purple color caused by traces of iron. The more iron that is present, the stronger the pink color will be. Here is a list of some elements that can add color to minerals:

<u>Element</u>	<u>Color</u>
Copper	Bright blue or green
Manganese	Pink
Iron	Dark red or brown
Uranium	Bright yellow or green

There are other reasons that can explain why a mineral has a certain color. The way in which the atoms are arranged in a material can also affect the color that we see. Diamond is colorless and transparent, but graphite is black...but both are made only of the element carbon!



How to use color as an identification mark

Color alone will not normally identify a mineral, but it can be a very helpful factor. Many minerals come in a great diversity of colors, and many different minerals have similar color.

Together with color, a crystal shape can identify most of the better known minerals. It is best to observe the mineral in strong light, preferably by daylight. Make sure that the surface of the mineral is clean.

Streak

Another useful property for mineral identification is observing the color of a crushed mineral's powder. Scientists call this the mineral's streak.

Almost every mineral has an inherent streak color, no matter what color the actual mineral is. For example, calcite occurs in many different colors, shapes, and varieties. But every single variety of calcite has a white streak. Sometimes two minerals with the same color have a different streak. A fine example where streak is very useful is a distinguishing gold (yellow streak) from chalcopyrite (black streak).

Most light colored, nonmetallic minerals have a white or colorless streak, as do most transparent minerals. The streak test is most useful for identifying dark colored minerals, especially metals.

How to use streak as an identification mark

When testing for streak, the mineral must be crushed to determine the color of its powder. The color of the powder is the color of the streak. Instead of actually crushing a mineral to determine the streak, it is much simpler to swipe the mineral across a streak plate. A streak plate is an unglazed piece of porcelain, such as the underside of a ceramic tile. Because the color of the streak plate is white, the color of the mineral trace is easy to see. A mineral with a white or colorless streak will not leave a visible streak on a streak plate.

To test the streak, swipe the mineral against the streak plate, but not hard enough to damage it. The color of the powder that results on the streak plate is the streak color.



Hardness

Hardness plays a major role in identifying a mineral, and is defined by how well a substance will resist scratching by another substance. For example, if a piece of slate scratches a piece of shale, and the shale does not scratch the slate, then the slate is harder than the shale. If two different minerals both scratch each other, then their hardness is equal or very similar.

A scale to measure hardness was devised by Austrian mineralogist Friedrich Mohs in 1822, and is currently the standard scale for measuring hardness. The scale consists of numbers one through ten; 1 being the softest and 10 being the hardest. Each number represents a different mineral—each harder than the previous. The 10 minerals are:

<u>Mineral</u>	<u>Moh's Scale</u>
Talc	1
Gypsum	2
Calcite	3
Fluorite	4
Apatite	5
Fledspar	6
Quartz	7
Topaz	8
Corundum	9
Diamond	10

All minerals fit in this scale, since talc is the softest known mineral and diamond the hardest. To demonstrate how to use the scale, understand the following example: Suppose a mineral scratches fluorite, but not apatite, then it has a hardness between 4 and 5.

Several common household items have a fixed hardness, and can be used to test for hardness:

<u>Item</u>	<u>Hardness</u>
Fingernail	2.5
Copper Penny	3
Knife Blade	5.5
Glass	5.5
Steel File	6.5
Streak Plate (Floor Tile)	6.5



Although Moh's scale is very useful, it is not linear. The minerals chosen were only selected because of their popularity. Number 10 on the scale (diamond) is 140 times harder than number 9 (corundum), whereas 4 (fluorite) is only 1.11 times harder than 3 (calcite). A proportional measurement, called absolute hardness, was more recently devised, but is only used by scientists who need accurate results.

How to use hardness as an identification mark

Hardness can be easily detected by swiping an unknown mineral with a known material, like streak plate or a glass microscope slide. The swipe should be strong enough to make a scratch, but not so much as to damage the mineral. To get the most accurate results, swipe a sharp edge against a smooth surface.

When you scratch a mineral, the mark you leave in it is permanent. Powder of the softer mineral will come off, and it will cover the scratch area. Brush it away to see if the mineral really got scratched or if the powder of the softer mineral left a scratch-like marking instead. When minerals of similar hardness are scratched together, it is difficult to tell which mineral (if not both of them) is really getting scratched.

Mineral Properties and Identification Procedures:

"Hardness: Mineral Properties - The Mineral and Gemstone ..." 2011. 6 Apr. 2016
<<http://www.minerals.net/resource/property/hardness.aspx>>

Preparation:

1. Photocopy print materials (*Activity Sheet 1*) for each student.
2. Set up stations around the room for rock identification.
 - a. *Streak*: streak plates (unglazed porcelain)
 - b. *Hardness*: glass microscope slides, pennies, nails, emery cloth
 - c. *Magnetism*: magnets, paperclips
 - d. *Chemical Properties*: acid (3% HCl), black light
 - e. *Optical Properties*: flashlight



Classroom Procedure:

Engage (Time: 10 mins)

Show the class an interesting type of rock and ask them to describe it. Which properties of the rock would they use? Now, have them pretend they are scientists trying to identify the rock. Would they use the same types of descriptions and properties this time? If not, what would they use?

Now read through the “Rocks and Minerals: Finding Clues like a Scientist” with the students. Discuss the characteristics and tests that scientists use to identify rocks and minerals. Define vocabulary terms.

Explore (Time: 35 mins)

Have students pair up. Give them two numbered rock samples. Tell students that they are scientists trying to identify these samples using a series of tests at the various stations around the room. Each station also has several questions associated with it to aid students in their explanations; have students record their findings and the answers to these questions on their activity sheet. The stations are as follows:

- ***Streak:*** When a mineral is rubbed firmly across an unglazed tile of white porcelain (a streak plate), it leaves a line of powder, called the streak. The color of the streak varies from mineral to mineral. However, different colored samples of the same mineral always leave the same color streak. For example: violet, pink, and brown quartz all leave a white streak.
- ***Hardness:*** A mineral’s hardness can be measured through the ability of a harder material to scratch a softer material. For example, Talc is so soft you can scratch it with your fingernail. A diamond is so hard it will scratch all other materials. The Mohs’ hardness scale places ten common minerals on a scale from one to ten. One is the softest, ten the hardest.
- ***Chemical Properties:*** Rocks and minerals are made of different compounds that will react in predictable ways that can help identify them.
- ***Magnetism:*** If a mineral is magnetic, a magnet will stick to the mineral. Magnetism is caused by the presence of iron and is useful in identifying iron oxides.
- ***Optical Properties:*** We can identify some materials by looking at how they interact with light. Different materials also “bend” light differently. This is called refraction. A mineral is sometimes characterized by its luster. Luster refers to how much light the sample reflects.



Ask students to record their observations and descriptions in their Rocks and Minerals Identification Notebook. They will be using this later to present the properties of their unknown sample. Have them use the Mineral Identification Guide to try and identify the rock. They should also list any reasons/evidence for their guess. Assist as necessary.

Explain (Time: 15 mins)

Have students present their unknown mineral and describe its properties, specifically those that lead them to identify it. Have them identify their rocks and tell them if they were correct.

Extension Activities:

Have students find out information about their mineral. Where does the name come from? Where is it commonly found? Does it have a use?

Challenge students to look up different elements they did not learn about and identify them using the tests they learned about in class.

Challenge students to crush the minerals to determine the color of their powder, or streak.

Challenge students to find out one or two other properties commonly used to identify minerals.

Resources:

"The Rock Cycle Diagram - Annenberg Learner." 2007. 6 Apr. 2016
<<https://www.learner.org/interactives/rockcycle/diagram.html>>

"Mineralogy4Kids: Home." 2011. 6 Apr. 2016 <<http://www.mineralogy4kids.org/>>

"Rocks and Minerals - Science for Kids." 2012. 6 Apr. 2016
<<http://www.sciencekids.co.nz/sciencefacts/earth/rocksandminerals.html>>

"Kids Love Rocks | rocks and minerals for kids." 2010. 6 Apr. 2016 <<http://www.kidsloverocks.com/>>



Assessment:

The following rubric can be used to assess students during each part of the activity. The term “expectations” here refers to the content, process and attitudinal goals for this activity. Evidence for understanding may be in the form of oral as well as written communication, both with the teacher as well as observed communication with other students. Specifics are listed in the table below.

- 1= exceeds expectations
- 2= meets expectations consistently
- 3= meets expectations occasionally
- 4= not meeting expectations

	Engage	Explore	Explain
1	Shows leadership in the discussion and offers creative ideas reflecting a good understanding of rocks and minerals.	Completes work accurately while providing an explanation for what is observed.	Provides an in-depth explanation of findings. Fills out worksheet clearly.
2	Participates in the brainstorm and shows an understanding of rocks and minerals.	Completes work accurately.	Provides clear explanation of findings. Fills out worksheet clearly.
3	Contributes to the brainstorm, but shows little understanding of rocks and minerals.	Makes some mistakes with the procedure.	Provides a limited explanation of findings. Fills out some of the worksheet.
4	Does not participate in brainstorm. Shows no understanding of rocks and minerals.	Does little to complete the procedure.	Is not clear in explanation of findings. Does not fill out worksheet.

