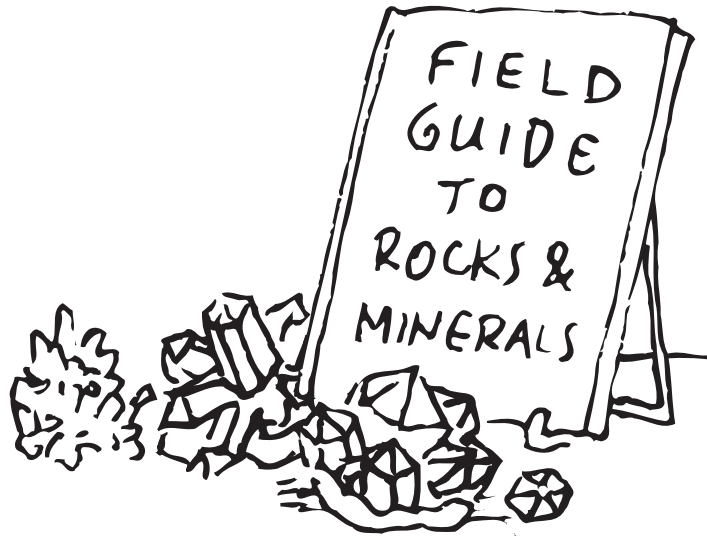


More Properties of Minerals



Big Idea

You can learn a lot about an object by carefully observing and describing its properties. Some of a rock's properties are a result of the properties of the minerals it is made of.

A QUICK LOOK

Overview

Children continue exploring the properties of their minerals from Lesson 5 by trying some tests to determine mineral hardness and streak.

Key Notes

- Read step 1 in the Preparation section to decide whether you will use the “basic” or “in-depth” approach for introducing mineral hardness.
- The final step of this lesson may extend beyond the day of the lesson. Read ahead and plan accordingly.
- If you haven't already taught it, consider doing Skill Building Activity 3 “Using Field Guides” on page 200 prior to this lesson to familiarize your class with rock and mineral field guides.
- For more information about the science content of this lesson, see the “Mineral Identification” section of the Teacher Background Information

Lesson 6

Standards and Benchmarks

As children conduct streak and hardness tests on the minerals, they work toward Science as Inquiry Standard A (Abilities Necessary to Do Scientific Inquiry): "Employ simple equipment and tools to gather data and extend the senses."

Lesson Goals

1. Learn that hardness and streak are properties used to describe and identify minerals.
2. Become familiar with some tests geologists use to assess mineral hardness and streak.

Assessment

Review children's science notebook pages 10 and 11 and talk with them about their entries to note children's level of familiarity with mineral properties. You can note your observations on Assessment 1.

You can use Assessment 4 to note how children use field guides to try to identify or learn more about their minerals.

NOTES

Rocks Assessment 1: Properties of Rocks and Minerals

Determine whether the children understand the following concepts about rocks and minerals.

Children's Names	Assessment Criteria:				
	A. Rocks differ in a wide range of properties including size, shape, color, and texture.	B. Minerals differ in a wide range of properties including size, shape, color, luster, hardness, and streak.	C. Rocks are made of minerals.	D. A rock's properties result, in part, from how it was formed.	E. A rock's properties result, in part, from the minerals it is made of.
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Assessment 1: Properties of Rocks and Minerals

Rocks Teacher Master 2

Teacher Master 2, Assessment 1

Rocks Assessment 4: Using Field Guides

Determine whether children demonstrate understanding or mastery of the following concepts and skills related to field guides and their usage.

Children's Names	Assessment Criteria:			
	A. Knows what a field guide is and what it can be used for.	B. Uses the pictures and descriptions in a field guide to try to identify or learn about specimens.	C. Makes plausible identifications of specimens using a field guide.	D. Independently chooses to use a field guide as a resource when appropriate.
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Assessment 4: Using Field Guides

Rocks Teacher Master 5

Teacher Master 5, Assessment 4

Materials

Item	Quantity	Notes
ExploraGear		
Chart: "Mohs' Hardness Scale" (optional)	1	To introduce the Mohs' scale and hardness values.
Ceramic streak plates	1 per group	To perform streak tests.
Glass scratch plates (optional)	1 per group	To perform hardness (scratch) tests.
Nails, steel (optional)	1 per group	To perform hardness tests.
Rock and mineral collection	1 mineral per child	To examine mineral properties. Children should use the same mineral they used in Lesson 5.
Classroom Supplies		
Rock and mineral field guides (optional)	As many as possible	To look up minerals.
Penny (optional)	1 per group	To perform hardness tests.
Previous Lessons		
"K-W-L" chart		From Lesson 1.
Minerals	1 per child	From Lesson 5.
"Properties of Rocks and Minerals" list		From Lessons 2 and 5.
Curriculum Items		
Book: Rocks and minerals field guide		
<i>Rocks Science Notebook, page 11</i>		
Teacher Master "Hardness Values" (optional)		
Rocks Assessment 1: Properties of Rocks and Minerals (optional)		
Rocks Assessment 4: Using Field Guides (optional)		
Skill Building Activity 3 "Using Field Guides," page 200 (optional)		

✓ Preparation

- This lesson includes two approaches for introducing the property of mineral hardness. The approaches can be taught alone or in combination. Alternately, you can present the basic approach to the class and offer the in-depth version to a subset of interested or advanced children. Review the following approaches and decide which is most appropriate for your class:
 - **Basic**—Children compare the hardness of minerals in a set by determining which ones are capable of scratching the others. This approach is outlined in the Explore section.
 - **In-depth**—Based on the Mohs’ Hardness Scale. Children test minerals against known standards to find where those minerals fall on the scale. This approach is outlined in the Further Science Explorations section.

TEACHER NOTE: Step 3 in the sharing and synthesizing discussion is an optional component that provides a cursory introduction to the Mohs’ Hardness Scale. You can do step 3 even if you don’t do the “in-depth” approach.

- Assemble the following supplies for each group:
 - Minerals used in Lesson 5
 - 1 ceramic streak plate
 - 1 glass scratch plate (needed only for the in-depth approach)
 - 1 penny (needed only for the in-depth approach)
 - 1 steel nail (needed only for the in-depth approach)
- Post the “Properties of Rocks and Minerals” list from Lessons 2 and 5 where you can add to it during the exploration.
- Choose a mineral from the ExploraGear to model how to use the field guide during the sharing and synthesizing discussion. You might want to find the mineral in the field guide prior to the lesson.

Vocabulary

hardness Ability of a mineral to resist being scratched.

streak The color of a mineral in powdered form.

✍ NOTES

Teaching the Lesson



Engage

Introductory Discussion

1. Give each group the minerals they used in the previous lesson. Tell children to find their mineral in the group's envelope or bag by comparing the letter on the label with the letter they wrote on page 10 of their science notebooks.
2. Give children time to re-read their descriptions of their minerals from Lesson 5.
3. Explain that geologists use the characteristics they included in their descriptions, as well as some others to describe and identify minerals. Tell them that today they will learn how to test for two additional mineral properties: streak and hardness.



Explore

Testing Mineral Streak

1. Tell children that an important property of a mineral is its *streak*, or what color the mineral is when it's a powder. Add "streak" to the list of properties from Lessons 2 and 5.
2. Show children how to do a "streak test" by rubbing a mineral on the unglazed side of a ceramic tile to see what color line it leaves.
 - Show the children that a streak can be rubbed off, since it is just powdered mineral. (In contrast, a scratch cannot be rubbed off. This may help them differentiate between the two indicators when they test for hardness in the next exploration.)
 - Explain that not all minerals leave a streak.
3. Give each group a ceramic streak plate and direct the children to do these steps:
 - a. Take turns using the tile to do a streak test for their mineral.
 - b. Record on page 11 in their science notebook whether the mineral left a streak and, if so, the color of the streak.

Mineral Hardness and Streak		
Date: _____		
1. Did your mineral leave a streak?	Yes	No
	(circle one)	
If yes, what color was its streak? _____		
2. List the letters of all the minerals that your mineral scratched.		
3. Write the name of your mineral. _____		
4. Write any other information you learn about your mineral (from a field guide or other resource).		
Mineral Hardness and Streak (Lesson 6)		11

Science Notebook page 11

Ordering Minerals by Hardness

1. Tell children that another important property of a mineral is its hardness. Ask for ideas about how they could test how hard a mineral is.
2. Explain that geologists test hardness by scratching minerals with other minerals or with tools to see whether they leave a mark. **Explain that a harder mineral or tool will scratch a softer mineral, but a softer mineral will not scratch something harder than itself.** Demonstrate the following using two minerals:
 - How to use one mineral to try to scratch another, and vice-versa.
 - How the harder mineral leaves a mark on the softer mineral, but not the other way around.
 - Scratches do not rub off. If a mineral leaves a mark that can be rubbed off, it is not a scratch, but more likely a streak, or a bit of the softer mineral that has crumbled off.
3. Enlist the help of the class to determine which of the two minerals you tested is harder and which is softer.
4. Within their groups, have the children compare the hardness of their mineral samples with a scratch test.
5. Have each child list, by letter label, which minerals their mineral sample scratched in their science notebooks. Suggest that they try ordering the minerals in their group from softest to hardest.

NOTES

If desired, this activity can be done in combination with the Mohs' scale activity in the Further Science Explorations section, below. Or, you can substitute the first Further Science Exploration for this activity.

 **NOTES**

During the discussion, refer to the “K-W-L” chart created in Lesson 1. Ask the children if they can answer any of their questions or if they have any new questions they want to add to the chart.

 **Reflect and Discuss****Sharing and Synthesizing**

1. Have children talk about testing their minerals. Prompt discussion with questions such as the following:
 - Did all the minerals have a streak? Was the color of the streak always the same color as the mineral?
 - Was it difficult to figure out which mineral was the hardest and which mineral was the softest?
2. Show children a sample mineral and read aloud parts of its description from the mineral section of the field guide. As you share:
 - Point out that the field guide is divided into a rock section and a mineral section.
 - Focus on parts of the description that correspond to properties the children described.
 - Highlight terminology used in the book (and by geologists).
3. (Optional) Regardless of which approach you followed to introduce mineral hardness (basic or in-depth), you may want to talk to children about the hardness rating that is provided in the field guide for the sample mineral. If so, tailor the following steps according to the information you already shared with the class during the exploration:
 - a. Show children the “Mohs’ Hardness Scale” chart and tell children that geologists use this scale to compare the hardness of minerals and help identify them.
 - b. Explain that the Mohs’ scale goes from 1 to 10, with 1 describing the softest mineral (talc) and 10 describing the hardest (diamond).
 - c. Have children consider the hardness rating listed in the field guide for your sample mineral. Do they think it is soft, medium, or very hard?

TEACHER NOTE: The most important concept for children to understand is simply that minerals differ in hardness. You can decide whether to introduce the Mohs’ Hardness Scale to your class and, if so, in how much detail.

4. Conclude the lesson in one of the following ways. (If you have not introduced the Mohs' Hardness Scale at all, use the first option.)
 - Tell each child the name of their mineral and have them write it on science notebook page 11. Encourage children to go to the Science Center sometime after the lesson to read the description of their mineral in the field guide and compare it to their own description. They can write any additional information that they learn in their science notebooks.
 - Have the children use their observations and the information they collected to try to identify their mineral samples. Encourage them to use field guides, the "Mohs' Hardness Scale" chart, and the Teacher Master "Hardness Values" to collect additional information.

TEACHER NOTE: The final step may extend beyond the day of this lesson. Encourage children to confer with others who have the same mineral sample and to do additional scratch testing with other minerals, as needed. Invite them to discuss and check their answers with you when they think they have made an identification. Focus on the identification process, rather than whether the children actually make a correct identification.

MANAGEMENT NOTE: After you complete this lesson, establish a circulation list for the field guides. Allow children to use one or more guides during quiet reading time, if they finish assigned work early, or any time the Science Center is available. Have them pass the guides to the next person on the list when they finish with them.

Ongoing Learning

Science Center

- Encourage children to compare their mineral descriptions with those in the field guide or to try to identify their mineral, if it is still unknown. See step 4 of the sharing and synthesizing discussion for more information.
- Invite children to continue to describe and try to identify other minerals and to record their results on blank copies of science notebook pages 10 and 11. Make the ceramic streak plate available for streak tests, as well as any tools you introduced for scratch tests.
- Post the "Mohs' Hardness Scale" chart for further reference.



Talk with children about their science notebook entries and as they use the field guides to determine what they understand about mineral properties, as well as to assess their ability to use field guides as a resource.

Mineral	Hardness Value or Range
Biotite	2.5–3
Calcite	3
Feldspar	6–6.5
Fluorite	4
Graphite	1–2
Hematite	5.5–6.5
Magnetite	6
Muscovite	2–2.5
Pyrite	6–6.5
Quartz	7
Talc	1

Teacher Master 20

Materials: *Field guide, minerals, ceramic streak plate, scratch test tools (optional), pencils, "Mohs' Hardness Scale" chart, blank copies of science notebook pages 10 and 11, "Describing a Mineral"*

This exploration can be done instead of, or in addition to, the hardness activity in the Explore section of the lesson.

Extending the Lesson

Further Science Explorations

Assessing Mineral Hardness Using Tools and the Mohs' Scale

1. Explain that geologists use the Mohs' Hardness Scale to compare the hardness of minerals and to help identify them. Show them the "Mohs' Hardness Scale" chart and emphasize the following information:
 - The range on the scale is 1 to 10. 1 describes the softest mineral (talc) and 10 describes the hardest (diamond).
 - A variety of other objects or materials also have hardness values on the scale. For example, a fingernail is rated about 2, a penny about 3, glass about 5.5, and a steel nail about 6.5.

Mohs' Hardness Scale		
Hardness	Index Mineral	Test
1	talc (TALK)	Will not scratch fingernail.
2	gypsum (JIP-sum)	Will barely scratch fingernail.
3	calcite (KAL-site)	Will scratch fingernail but not copper penny.
4	fluorite (FLOOR-ite)	Will scratch copper penny but not glass.
5	apatite (AP-uh-tite)	Will scratch copper penny but not glass.
6	Orthoclase feldspar (ORE-thoh-klaze)	Will barely scratch glass but not steel.
7	quartz (KWORTZ)	Will barely scratch steel.
8	topaz (TOE-paz)	Will scratch quartz.
9	corundum (kohr-UN-duhm)	Will scratch all minerals except diamond.
10	diamond (DIE-mund)	Hardest of all minerals. Will scratch all other minerals.

2. Give small groups the following items and mention the material that the penny, nail, and scratch plate are made of:
 - 1 mineral per child
 - 1 penny (the outside is copper)
 - 1 nail (steel)
 - 1 scratch plate (glass)

+ **SAFETY NOTE:** Tape the scratch plates to the desktops or tables so they can't be dropped or broken.

3. Use a sample mineral to demonstrate how geologists test mineral hardness—by scratching a mineral with other minerals or with tools to see if they leave a mark.
 - a. **Explain that a harder mineral or tool will scratch a softer mineral, but a softer mineral will not scratch something harder than itself.**
 - b. Show children how to use the tools and a fingernail to test your sample mineral. Tell them that the goal is to find out whether each tool scratches the mineral or the mineral scratches the tool.
 - c. Based on your results, enlist the class's help to determine whether your sample mineral is harder or softer than your fingernail and each of the tools.
 - d. Let the children help you figure out what value your mineral has on the Mohs' scale, or what range of values it is in.

TEACHER NOTE: Make it clear that children should not try scratching the minerals with the glass (since it is taped down); the proper technique is the reverse (to scratch the glass with the minerals).

4. Have the children test whether their mineral sample is harder or softer than their fingernail, the penny, and the glass, and then try to determine its approximate value on the hardness scale. Assist children with this "puzzle," as needed.
5. Encourage children to scratch test their minerals with minerals of known value on the hardness scale to further refine their approximation of their mineral's hardness value. (Many minerals of known value are provided in the ExploraGear.)

TEACHER NOTE: Show children the Teacher Master "Hardness Values" so they can check their results and re-test, if necessary.



mathematics connection

Figuring out a mineral's approximate value on the Mohs' scale by comparing it to other items of known values provides a good mathematics and logic challenge! Help children find systematic ways to arrive at an answer and then verify that their answer makes sense.

Mineral Hardness “Line-up”

1. Have the children in each group line up according to the hardness of their mineral sample.
2. Ask one child to read the label on their mineral sample and then have all the other children in the class with the same mineral (same letter on the label) raise their hands. Create a line with string between the children with the same mineral samples. (Make sure children stay in their places in line). Do the same thing with all the other minerals.
3. Encourage the children to figure out what it means if the strings cross. (*The hardness results are different; have them check and see if they can figure out the right order.*)
4. Discuss that sometimes things need to be repeated to get the right answer and that more data sometimes helps you find the right answer.

Fool’s Gold

1. Pass around the pyrite from the ExploraGear and ask the children what they think it is.
2. Ask them if they’ve ever heard of fool’s gold.
3. Tell them that the mineral they are looking at is pyrite, which many people mistake for gold, and that this is how it got the nickname “fool’s gold.”

TEACHER NOTE: You might want to show children pictures of gold and pyrite in a field guide.

4. Explain that one way you can tell it is pyrite and not gold is that it leaves a greenish black streak on a ceramic streak plate. Do a streak test with the pyrite.
5. Ask the children why someone might want to know if a mineral is gold or pyrite.

Mineral Crystals

Minerals form as crystals. Another interesting and important property of minerals is the characteristic shape of their crystals. It is easy to “grow” mineral crystals from a variety of common powdered minerals, such as rock salt, alum, Epsom salt, or borax, and children will be interested in using magnifiers to observe and compare the size and shape of the crystals that form. If you are interested in extending your study of mineral properties by talking to children about crystals and crystal shape, you can find directions for growing mineral crystals in many books about rocks and minerals, as well as on the Internet. (See the Science Library and Web Links section on pages 34-41 for suggestions.)

+ SAFETY NOTE: Because boiling water is required to “grow” crystals from powdered minerals, we recommend that you prepare the mineral crystals at home and bring them to the classroom for the children to observe. Safety goggles should be worn when preparing and observing mineral crystals.

Planning Ahead

For Lesson 8

Look at the materials list and begin collecting present-day objects to compare to fossils. You will need one or more chicken or beef bones and fish bones.



Date: _____

Mineral Hardness and Streak

1. Did your mineral leave a streak? Yes No
(circle one)

If yes, what color was its streak? _____

2. List the letters of all the minerals that your mineral scratched.

3. Write the name of your mineral. _____

4. Write any other information you learn about your mineral (from a field guide or other resource).

Teacher Master 2, Assessment 1

Rocks Assessment 1: Properties of Rocks and Minerals

Determine whether the children understand the following concepts about rocks and minerals.

Assessment Criteria:					
	A. Rocks differ in a wide range of properties including size, shape, color, and texture.	B. Minerals differ in a wide range of properties including size, shape, color, texture, hardness, and streak.	C. Rocks are made of minerals.	D. A rock's properties result, in part, from how it was formed.	E. A rock's properties result, in part, from the minerals it is made of.
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Assessment 1: Properties of Rocks and Minerals Rocks Teacher Master 2

Teacher Master 5, Assessment 4

Rocks Assessment 4: Using Field Guides

Determine whether children demonstrate understanding or mastery of the following concepts and skills related to field guides and their usage.

Assessment Criteria:				
	A. Knows what a field guide is and what it can be used for.	B. Uses the pictures and descriptions in a field guide to try to identify or learn about specimens.	C. Makes plausible identifications of specimens using a field guide.	D. Independently chooses to use a field guide as a resource when appropriate.
Children's Names				
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Assessment 4: Using Field Guides Rocks Teacher Master 5

Teacher Master 20

Hardness Values

This table shows the hardness value, or range of values, on the Mohs' Hardness Scale for each mineral in the kit.

Mineral	Hardness Value or Range
Biotite	2.5–3
Calcite	3
Feldspar	6–6.5
Fluorite	4
Graphite	1–2
Hematite	5.5–6.5
Magnetite	6
Muscovite	2–2.5
Pyrite	6–6.5
Quartz	7
Talc	1

Teacher Master: Hardness Values (Lesson 6) Rocks Teacher Master 20