Science & Literacy Activity

GRADES 3-5

OVERVIEW

This activity, which is aligned to the Common Core State Standards (CCSS) for English Language Arts, introduces students to scientific knowledge and language related to the properties of minerals. Students will read content-rich texts, visit the Harry Frank Guggenheim Hall of Minerals, and use what they have learned to complete a CCSS-aligned writing task, creating an illustrated text about the properties of minerals.

Common Core State Standards:
W.3-5.2, W.3-5.8, W.3-5.9
RI.3-5.1, RI.3-5.2, RI.3-5.4, RI.3-5.10

New York State Science Core Curriculum:
PS 3.1f

Next Generation Science Standards:
PE 2-PS1-1
DCI PS1.A: Structure and Properties of Matter
Different kinds of matter exist and many of them can be either solid or liquid, depending on temperature. Matter can be described and classified by its observable properties.

Materials in this packet include:

- Teacher instructions for:
  - Pre-visit student reading
  - Visit to the Guggenheim Hall of Minerals and student worksheet
  - Post-visit writing task
- Text for student reading: "What Makes a Mineral?"
- Student Worksheet for visit to the Guggenheim Hall of Minerals
- Student Writing Guidelines
- Teacher rubric for writing assessment

SUPPORTS FOR DIVERSE LEARNERS: An Overview

This resource has been designed to engage all learners with the principles of Universal Design for Learning in mind. It represents information in multiple ways and offers multiple ways for your students to engage with content as they read about, discuss, view, and write about scientific concepts. Different parts of the experience (e.g. reading texts, or locating information in the exhibit) may challenge individual students. However, the arc of learning is designed to offer varied opportunities to learn. We suggest that all learners experience each activity, even if challenging. We have provided ways to adapt each step of the activities for students with different skill-levels. If any students have an Individualized Education Program (IEP), consult it for additional accommodations or modifications.

1. BEFORE YOUR VISIT

This part of the activity engages students in reading a non-fiction text about the properties of minerals. The reading will prepare students for their visit by introducing them to the topic and framing their investigation.

Student Reading

Have students read "What Makes a Mineral?" Have them write notes in the large right-hand margin. For example, they could underline key passages, paraphrase important information, or write down questions that they have. They may also use this space for drawings or diagrams that record specific minerals and their properties.

Ask:

- What is a mineral? *(Answers may include: Minerals are the parts that make up many rocks. Minerals are crystalline solids that are found in nature.)*
- What are some of the common properties of a mineral? *(Answers may include: color, hardness, streak, luster, crystal shape, density)*
- How are the properties of quartz, talc, and pyrite different? Include specific examples from the text. *(Answers may include: Quartz, talc, and pyrite have different colors, lusters, streaks, and crystal shapes, as well as different hardness measurements. Quartz forms hard, glassy crystals that are transparent and make a white streak. Talc has a greasy luster, a white streak, and is extremely soft. Pyrite is hard, gold colored, has a metallic luster, and forms a greenish or black streak. Pyrite crystals are often box-shaped, quartz crystals are typically long and thin with a sharp tip, and talc is often found without any visible crystals at all because they are so soft.)*

They can work in pairs, small groups, or as a class. During discussion, remind students to use evidence from the text to explain their thinking, and to use specific examples, such as descriptions of specific minerals.

SUPPORTS FOR DIVERSE LEARNERS: Student Reading
- "Chunking" the reading can help keep them from becoming overwhelmed by the length of the text. Present them with only a few sentences or a single paragraph to read and discuss before moving on to the next "chunk."
- Provide "wait-time" for students after you ask a question. This will allow time for students to search for textual evidence or to more clearly formulate their thinking before they speak.

2. DURING YOUR VISIT

This part of the activity engages students in exploring the hall.

Museum Visit and Student Worksheet
Explain to students that they will be observing minerals throughout the hall, using worksheets to gather all the necessary information about the properties of these mineral specimens. Back in the classroom they will refer to these notes when completing the writing assignment.

SUPPORTS FOR DIVERSE LEARNERS: Museum Visit
- Review the Student Worksheet with students, clarifying what information they should collect during the visit.
- Have students view the hall in pairs, with each student completing their own Student Worksheet.
- Encourage student pairs to ask you or their peers for help locating sources of information. Tell students they may not share answers with other pairs, but they may point each other to places in the hall where answers may be found.

3. BACK IN THE CLASSROOM

This part of the activity is to engage students in an informational writing task that draws on the pre-visit reading and on observations made at the Museum.

Writing Task
Distribute the Student Writing Guidelines handout, which includes the following prompt for the writing task.

> Based on the article "What Makes A Mineral?", your visit to the Guggenheim Hall of Minerals, and your post-visit discussion, write an essay in which you:
>
> - Define the word mineral.
> - Describe the properties of two minerals that you learned about, including color, luster, streak, and hardness.
> - Include labeled drawings of your minerals with at least three labels.
>
> Support your discussion with evidence from your reading and the Guggenheim Hall of Minerals.

Go over the handout with students. Tell them that they will use it while writing, and afterwards, to evaluate and revise their essays.

Before they begin to write, have students use the prompt and guidelines to frame a discussion around the information that they gathered in the Guggenheim Hall of Minerals, and compare their findings. They can work in pairs, small groups, or as a class. Referring to the writing prompt, have students underline or highlight all relevant passages and information from the reading, and their notes from the hall that can be used in their response to the prompt. Instruct each student to take notes on useful information that their peers gathered as they compare findings. Students should then write their essays individually.

SUPPORTS FOR DIVERSE LEARNERS: Writing Task
- Re-read the "Before Your Visit" assignment with students. Ask what they saw in the hall that helps them understand the properties of minerals.
- Allow time for students to read their essay drafts to a peer and receive feedback based on the Student Writing Guidelines.

Student Reading:
What Makes A Mineral?

Have you ever found a rock and wondered what it was? If you were a geologist, the first thing you'd do is figure out what minerals make up the rock. After all, rocks are made of minerals — crystalline solids that form naturally within Earth.

What's the difference between a rock and a mineral? Well, a mineral is always made of the same set of chemicals or elements. For example, the mineral quartz is made of the elements silicon and oxygen. Rocks are a mixture of different minerals. Granite is rock made up of the minerals quartz, mica, and feldspar. The same mineral can occur in more than one type of rock. You can think of a rock as a cookie, and ingredients like chocolate chips, peanut butter chips, and oatmeal as different kinds of minerals. You could combine all the ingredients (minerals) to make a chocolate peanut butter oatmeal cookie (rock), or just use the chocolate chips (a mineral) to make a chocolate chip cookie (rock).

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Quartz is a mineral, a crystalline solid. Granite is a rock that is made up of many kinds of minerals, including quartz, mica, and feldspar.

So before geologists can identify a rock, they need to identify the minerals inside it. Minerals can also tell geologists how the rock formed — an important part of identifying a rock.

There are over 4,000 minerals found on Earth, and new ones are still being discovered. Minerals come in many different colors and sizes. They always form in distinct shapes called crystals. Usually, minerals form small crystals inside of rocks. But sometimes they form large crystals.

What gives a mineral its special properties, like color and crystal shape? One reason is the unique set of elements that make up the mineral. The mineral pyrite forms cube-shaped crystals because of the way the iron and sulfur atoms combine.

There are other things that can affect a mineral's appearance, such as the environment in which it formed and small amounts of other elements that are present in those environment. For example, some quartz crystals form deep inside Earth while others form closer to the surface. Even though they are both quartz, they may look different as a result. The same mineral can look different depending on where it forms and what other chemicals are present. While "pure" quartz is clear, it can be purple if it has traces of iron in it.

With so many minerals, geologists need a system to identify them. Geologists use properties, such as color, streak, hardness, and luster, to sort and classify minerals into groups. They observe a mineral's properties, record each one, and then find the mineral that matches this unique set of properties. Let's take a look at some of the properties geologists use to identify a mineral.

Color

A mineral's color is easy to describe, but it isn't always a good tool for identification. That's because sometimes the same mineral can be found in a range of colors. Quartz can be anywhere from clear or white to purple, pink, and even black! Still, geologists record a mineral's color. Later, this can help them figure out where and how the mineral formed.


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Quartz come in many colors, including clear and purple.

Streak

A mineral might come in many colors, but its streak is always the same. **Streak** is the color a mineral leaves behind if you scratch it against a black or white tile. It's a fine powder of tiny bits of the mineral. A mineral's streak can be different from its color: golden pyrite leaves a greenish-black streak. But a particular mineral's streak is always the same, no matter what its color. You could test clear, purple, and black pieces of quartz, and the streak will always be white.

Hardness

To test a mineral's **hardness**, a geologist could rub it with different objects of known hardness, such as pennies, glass, and fingernails. If the object leaves a scratch, it's harder than the mineral. If it doesn't, the mineral is harder. Hardness is measured on a scale from one to ten, from softest to hardest. Talc is a one: it's so soft, even a fingernail could scratch it. Diamond is a ten: it's the hardest mineral, so nothing leaves a scratch. A mineral will scratch another mineral that is softer. Diamonds will scratch quartz (7), quartz scratches pyrite (6), and pyrite scratches talc (1).

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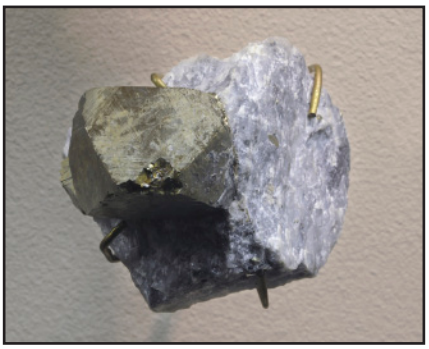
Talc is so soft that even a fingernail could scratch it.

Luster

Another way geologists tell minerals apart is luster. Luster describes how a mineral reflects light – or how shiny or dull it is. Minerals might shine in different ways. Pyrite is shiny like a metal, but quartz is shiny like glass. Some minerals don't shine at all. Talc looks pearly.



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Pyrite has a metallic luster.

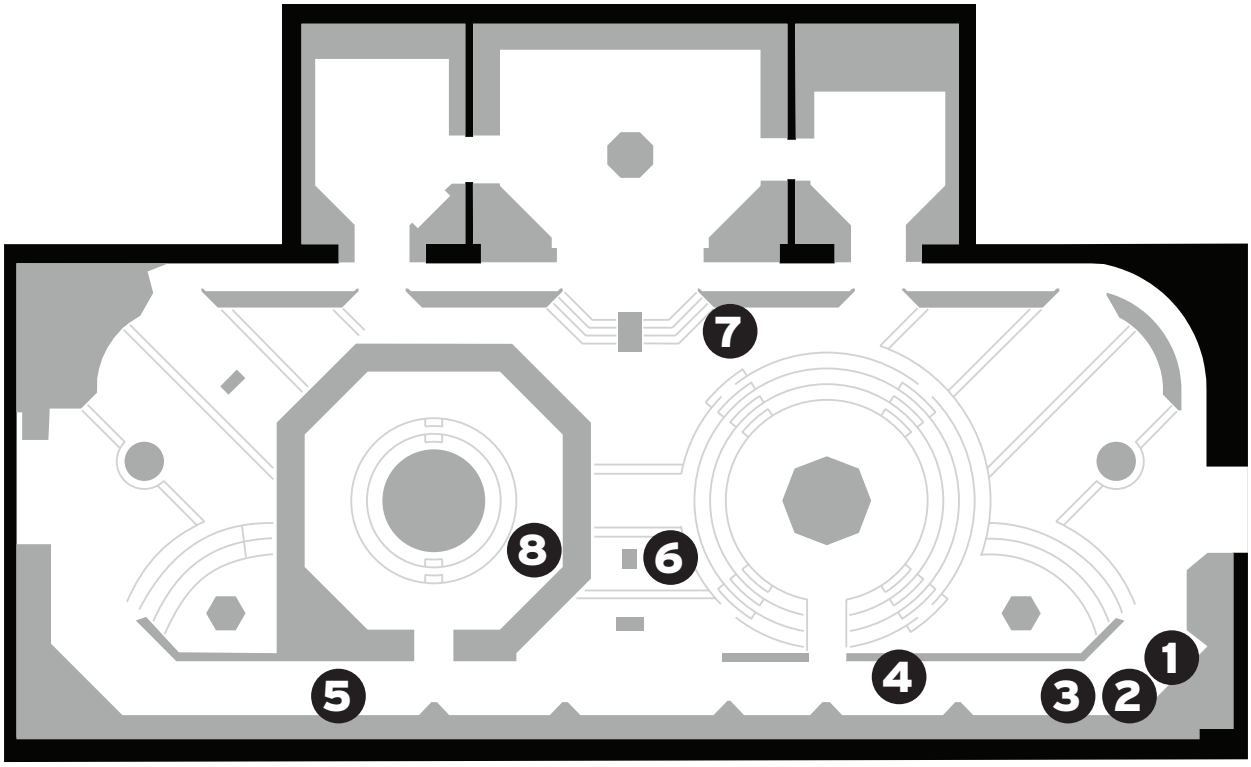
When geologists study a mineral, they record its properties in a table. Then they compare those properties with known minerals. Look at this table of three known minerals. If a geologist finds a mineral with long, clear crystals and a hardness of seven, what could it be?

MINERAL	COLOR	LUSTER	HARDNESS	STREAK	COMMON CRYSTAL SHAPE
Quartz	Clear, white, gray, black, pink, purple	Glassy, shiny	7 (hard)	White	Long, thin crystals with sharp points
Talc	White	Dull, pearly	1 (very soft)	White	Can form crystals, but often found in chunks
Pyrite	Gold, yellow	Metallic, shiny	6 (hard)	Greenish/black	Box-shaped crystals

Student Worksheet: Guggenheim Hall of Minerals

Name:

Instructions:
Visit the mineral specimens listed below. Complete the data table by recording the properties of these minerals. Some properties are impossible to measure in a museum exhibit, so they have already been added to your data table.



Use this map to find each mineral specimen.

Stop 1: Mineral #9, **Marcasite**

Stop 2: Mineral #22, **Phlogopite**

Stop 3: In the "Halides" case, **Halite**

Stop 4: In the "Pyrite" case, pick one specimen of **Pyrite**

Stop 5: In the case called "Phyllosilicates" specimen H, **Talc**

Stop 6: Illuminated from below, a giant **Topaz**

Stop 7: Three large rocks, each with many crystals of **Quartz**

Stop 8: In the case called "Evaporites," specimen # 9, **Sylvite**

Mineral	Color	Luster	Hardness	Streak	Additional Information
Marcasite			6	Dark grey to black	
Phlogopite			2	White	
Halite			2	White	
Pyrite			6	Greenish-black	
Talc			1	White or green	
Topaz			8	White	
Quartz			7	White	
Sylvite			2	White	

Compare the properties of the minerals above. Which minerals seem most similar? Explain:

What additional information do you need to help classify these minerals?

ANSWER KEY

Mineral	Color	Luster	Hardness	Streak	Additional Information
Marcasite	*Gold*	*Metallic*	6	Dark grey to black	*Tiny, boxy crystals together in a long and thin specimen*
Phlogopite	*Silver/Brown*	*Pearly*	2	White	*A large six-sided crystal with a flat front*
Halite	*White*	*Dull*	2	White	*Large boxy crystals on top of a rock*
Pyrite	*Gold*	*Metallic*	6	Greenish-black	*Many specimens, some with large boxy crystals others with smaller crystals*
Talc	*Greenish white*	*Pearly*	1	White or green	*Lots of fine cracks, looks like soap*
Topaz	*Clear and White*	*Glassy*	8	White	*A single giant crystal with a flat top and many sides*
Quartz	*Clear and White*	*Glassy*	7	White	*Many crystals of different sizes, each is pointy and has six sides*
Sylvite	*White*	*Dull*	2	White	*Large block with boxy crystals in it*

Compare the properties of the minerals above. Which minerals seem most similar? Explain:
(Marcasite seems the most similar to pyrite, halite seems similar to sylvite, talc is most similar to phlogopite, and quartz seems most similar to topaz. This is because of the properties that they share. For example, both marcasite and pyrite have metallic lusters, are gold in color, and they both have a hardness of 6. Both halite and sylvite are clear but dull, they both have boxy crystals, and they both have a hardness of 2. Topaz and quartz both have a clear or white color, are glassy in luster, and both are extremely hard. Talc and phlogopite are both soft, greasy in luster, and both have lots of thin layers or small cracks in them.)

What additional information do you need to help classify these minerals?
(I would like to test these minerals in other ways. For example, it would be interesting to put specimens in an oven to find out their melting point. I would also like to put these minerals in water to see if they dissolve. It would also be interesting to find out what chemicals make up each mineral.)

Student Writing Guidelines

Writing Prompt:

Based on the article "What Makes A Mineral?", your visit to the Guggenheim Hall of Minerals, and your post-visit discussion, write an essay in which you:

- Define the word mineral.
- Describe the properties of two minerals that you learned about, including color, luster, streak, and hardness.
- Include labeled drawings of your minerals with at least three labels.

Support your discussion with evidence from your reading and the Guggenheim Hall of Minerals.

Use this checklist to ensure that you have included all of the required elements in your essay.

- ☐ I introduced the properties of minerals.
- ☐ I defined the word mineral.
- ☐ I clearly named at least two minerals and described their properties.
- ☐ I included labeled illustrations of at least two minerals.
- ☐ All of the information I presented is relevant to the topic of minerals.
- ☐ I used information from "What Makes a Mineral?" to explain the properties of minerals in detail.
- ☐ I used information from the Guggenheim Hall of Minerals to explain the properties of minerals in detail.
- ☐ I included a conclusion at the end.
- ☐ I proofread my essay for grammar and spelling errors.

Assessment Rubric

	Scoring Elements	1 Below Expectations	2 Approaches Expectations	3 Meets Expectations	4 Exceeds Expectations
RESEARCH	**Reading**	Attempts to include text using examples, quotes, or other references.	Presents some information from reading materials but may lack accuracy or relevance.	Accurately presents information from reading materials relevant to the purpose of the prompt to inform or explain.	Accurately and effectively presents important information from reading materials to inform or explain.
	AMNH Exhibit	Attempts to include Museum exhibit content using examples, quotes, or other references.	Presents some information from Museum exhibit but may lack accuracy or relevance.	Accurately presents information from Museum exhibit relevant to the purpose of the prompt to inform or explain.	Accurately and effectively presents important information from Museum exhibit to inform or explain.
WRITING	**Focus**	Attempts to address the prompt, but is off-task.	Addresses the prompt, but focus is uneven.	Addresses the prompt with an adequately detailed response; stays on task.	Addresses key aspects of prompt in a detailed response; stays on task.
	Development	Attempts to inform or explain but lacks details.	Informs or explains by presenting some details.	Informs or explains using appropriate details.	Informs or explains by providing detailed and relevant information.
	Conventions	Lacks cohesion and control of grammar, usage, and mechanics appropriate to grade level	Demonstrates an uneven command of standard English conventions appropriate to grade level.	Demonstrates a command of standard English conventions, with few errors as appropriate to grade level.	Maintains a well-developed command of standard English conventions, with few errors. Response includes language and tone appropriate to the purpose and specific requirements of the prompt.
SCIENCE	**Content Understanding**	Content is irrelevant, inappropriate, or inaccurate.	Shows uneven understanding of disciplinary content related to the topic.	Presents generally accurate disciplinary content related to the topic.	Presents accurate and relevant disciplinary content to enhance understanding of the topic.