Science & Literacy Activity

GRADES 6-8

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 mineral properties. 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 mineral properties.

Materials in this activity include:

- Teacher instructions for:
  - o Pre-visit student reading
  - o Visit to the Guggenheim Hall of Minerals and student worksheet
  - o Post-visit writing task
- Text for student reading: "Mineral Match"
- Mineral properties table
- Answer key for mineral properties table
- Student Worksheet for the Guggenheim Hall of Minerals visit
- Student Writing Guidelines
- Teacher rubric for writing assessment

Common Core State Standards:
WST.6-8.2, WST.6-8.8, WST.6-8.9
RST.6-8.1, RST.6-8.2, RST.6-8.4, RST.6-8.7, RST.6-8.10

New York State Science Core Curriculum:
PS 2.1e

Next Generation Science Standards:
PE MS-PS1-1
DCI PS1.A: Structure and Properties of Matter
Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals).

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 mineral properties. The reading will prepare students for their visit by introducing them to the topic and framing their investigation.

Student Reading
Have students read "Mineral Match." 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. As they read, they should write the names of each specimen under its picture on the second page. If it is not possible to create color handouts, use a computer projector to display the specimen photos as a reference for students.

Have students complete the included mineral properties table to compare and contrast properties of the minerals from the reading. Note that not all of the information to fill in the table is available in the reading; some is filled in already, and some will be gathered during the visit to the Guggenheim Hall of Minerals. Refer to the Answer Key to see where students will find the information for each empty box.

Ask students: "What is a property?" In pairs, small groups, or as a class, have students discuss the meaning of the word "properties," as used in the reading, and how the chart they created supports their definition. Have them write their definitions in the space at the bottom of the properties chart.

Lastly, referring to the chart, ask students why the student in the reading didn't test the streak of the non-metallic minerals to sort them. *(A: Since the streak of all of the non-metallic minerals was the same – white – this property was not useful in sorting the 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 & Student Worksheet
Explain to students that they will be focusing on the Mineral Properties exhibit in the Guggenheim Hall of Minerals (refer to the map in the Educator's Guide), and using worksheets to gather all the necessary information about mineral properties. Back in the classroom they will refer to these notes when completing the writing assignment. They should also bring their mineral properties tables to complete.

In question 2 on the worksheet, note the following correct answer: Describe how atoms are organized into crystals: *(A: Crystals are orderly arrangements of atoms into identical units in 3 dimensions.)*

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 "Mineral Match," your visit to the Guggenheim Hall of Minerals, and your discussions, write an essay in which you explain how crystals are organized, how they can differ, and how the properties of the resulting minerals can also differ from one another.
>
> Be sure to include:
> - Definitions of the words "mineral," "crystal," and "properties."
> - Examples of two kinds of mineral properties.
> - Examples of two minerals for each property (at least four in all).
>
> 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 discuss 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, their properties charts, 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 write their essays individually.

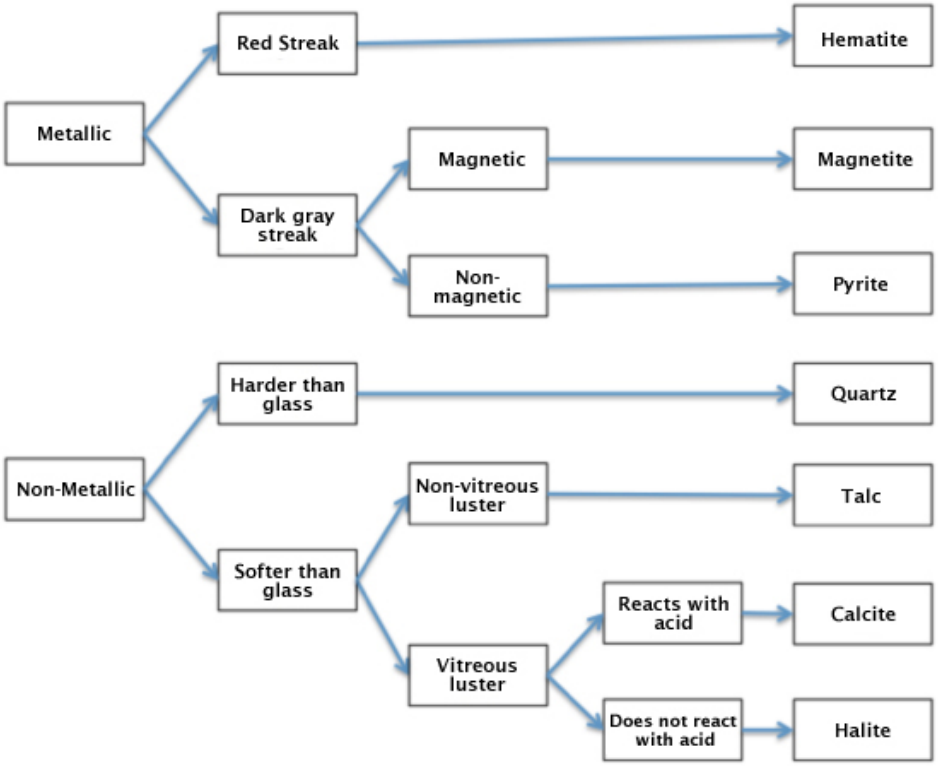
SUPPORTS FOR DIVERSE LEARNERS: Writing Task
- Re-read the "Before Your Visit" assignment with students. Ask what they saw in the hall that helps them understand the properties of minerals.
- Allow time for students to read their essay drafts to a peer and receive feedback based on the Student Writing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

Student Reading:
Mineral Match

Uh, oh. It's the day before your science class's geology presentations – and you just knocked over a classmate's display. Fortunately, she's not here today to see her mineral samples and labels scattered on the floor. To top it off, you spilled water all over her data table, washing some of the data away!

Now you need to match the labels to the mineral samples before the end of class. All you have to go on is her report:

> ***All minerals are natural, nonliving solids that form crystals. Minerals are the building blocks of rocks. A mineral is always made of the same set of elements. And each type of mineral has a unique set of properties.***
>
> ***This flow chart shows how I used properties to identify my eight minerals. Some share the same properties, but no two are alike!***

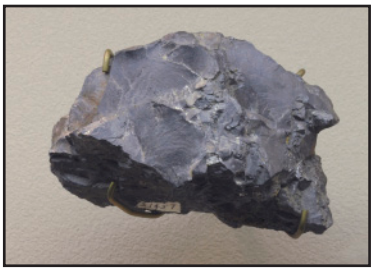


No problem, you think. You'll use the flow chart to figure out which one is which. Before you begin, you spread out the seven mineral specimens on a piece of paper and letter each one to keep track.

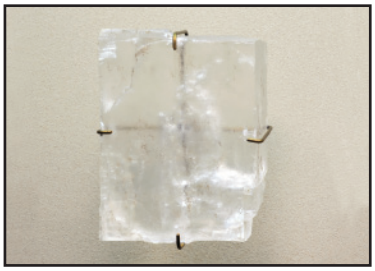
A

B

C



D



E

F

G

Step 1: Metallic or non-metallic?
The flow chart starts by sorting minerals into "metallic" and "non-metallic," so you decide to do the same. You know that "metallic" and "non-metallic" refer to the mineral's luster, so you hold up each specimen and observe how it reflects light. A few of the specimens are shiny, but only A, B, and D are shiny like metal.

Step 2: Streak for metallic minerals?
Okay, you have three metallic minerals. Next, you test the streak of all three. You rub each one against a white tile. Minerals A and D leave a dark gray line or streak, but mineral B's is dark red. This means mineral B is hematite!

Step 3. Which one is magnetic?
One metallic mineral down, two to go. The next step is to figure out which one is magnetic. Well, you think, if something is magnetic, a magnet will stick to it; so you try touching a magnet to Mineral A. Nothing happens, so this mineral must be pyrite. Now you try with mineral D. This time, the magnet sticks to it is if it were a fridge. You found magnetite!

Step 4: Which non-metal is harder than glass?
Okay, four minerals left: the non-metallic ones. Going by the flow chart, you need to determine if each mineral is harder or softer than glass. You find a piece of glass, which you know has a hardness of 5.5, and rub the glass against each mineral. The glass leaves a scratch on each one except mineral F. For good measure, you take the mineral and rub it against the smooth side of the glass. It leaves a scratch, so it must be harder than glass. Its hardness is greater than 5.5. Mineral F must be quartz!

Step 5: Which non-metallics have a vitreous luster?
Three non-metallic minerals to go! Now you need to sort them by luster—which ones have a "vitreous" luster and which do not. "Vitreous" means glassy, so you hold up each mineral to see which one shines like glass. Minerals E and G reflect light like glass, sparkling as you turn them in your hand. These must be the remaining vitreous, or glassy, minerals. Mineral C is different — it's dull and pearly. You found talc!

Step 6: Which non-metallic responds to the acid test?
Whew! Only two more minerals without labels. The final step is to figure out which one reacts with acid. You know just what to do. Wearing safety goggles and gloves, you place a drop of hydrochloric acid (HCl) on mineral E. Nothing happens — on this mineral, the acid could have been a drop of water. You try again with mineral G. This time, tiny bubbles form and fizz — the sign of calcite! Sure that the acid test worked, you know the other mineral is halite.

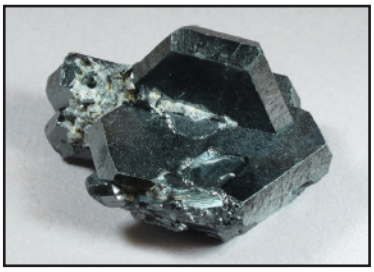
The bell rings just as you place the last two minerals and labels on the display. You did it! In six steps, you identified seven minerals.

Mineral Properties Table:
Use the properties you've read about to fill in the rest of the data table as much as you can. When you get to the exhibition, look for halite, pyrite, and quartz to help you complete the "Other Properties" column of the table.

MINERAL	LUSTER	STREAK	HARDNESS (<, >, = 5.5)	OTHER PROPERTIES
Hematite			=5.5	Can be gray, black or red
Magnetite			>5.5	
Pyrite			>5.5	
Calcite		white		
Quartz		white		
Halite		white		
Talc		white		Can be white, green, gray, brown, or colorless. Talc is the softest known mineral

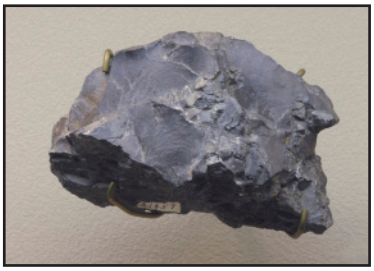
ANSWER KEY

A – Pyrite

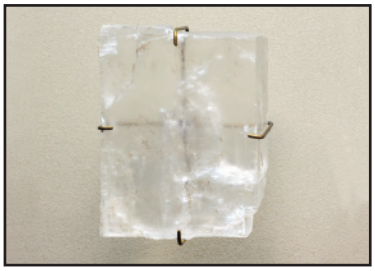


B – Hematite

C – Talc



D – Magnetite



E – Halite

F – Quartz

G – Calcite

ANSWER KEY

Mineral Properties Table:
Use the properties you've read about to fill in the rest of the data table as much as you can. When you get to the exhibition, look for halite, pyrite, and quartz to help you complete the "Other Properties" column of the table.

MINERAL	LUSTER	STREAK	HARDNESS (<, >, = 5.5)	OTHER PROPERTIES
Hematite	*Metallic*	*red*	=5.5	Can be gray, black or red
Magnetite	*Metallic*	*Dark gray*	>5.5	*Is magnetic; a magnet will be attracted to it*
Pyrite	*Metallic*	*Dark gray*	>5.5	*Forms cubic crystals***
Calcite	*Non-metallic; vitreous*	white	*<5.5*	*Fizzes in HCl*
Quartz	*Non-metallic; vitreous*	white	*>5.5*	*Forms six-sided crystals***
Halite	*Non-metallic; vitreous*	white	*<5.5*	*Soluble in H2O***
Talc	*Non-metallic; pearly*	white	*<5.5*	Can be white, green, gray, brown, or colorless. Talc is the softest known mineral

** = information available in Hall of Minerals

Student Worksheet

Visit the Properties of Minerals section of the Guggenheim Hall of Minerals to complete this worksheet.

1. Find examples of the minerals from the pre-visit reading, and fill in the "Other Properties" boxes for the following minerals, using information from the exhibit cases: pyrite, quartz, and halite.

2. Look at the Atoms, Space lattices, and Crystals case to complete the following:

Describe how atoms are organized into crystals:

Sketch and label a mineral with a cubic crystal structure.

Sketch and label a mineral with a hexagonal crystal structure.

3. In each of the three following cases, pick two minerals, sketch and label them, and describe how the properties that are demonstrated in that case differ:

Physical properties case, mineral SPECIMEN 1:	**Physical properties case, mineral SPECIMEN 2:**

Describe how the physical properties of these two specimens differ:

Chemical properties case, mineral SPECIMEN 1:	**Chemical properties case, mineral SPECIMEN 2:**

Describe how the chemical properties of these two specimens differ:

Optical properties case, mineral SPECIMEN 1:	**Optical properties case, mineral SPECIMEN 2:**

Describe how the optical properties of these two specimens differ:

Student Writing Guidelines

Based on the article "Mineral Match," your visit to the Guggenheim Hall of Minerals, and your discussions, write an essay in which you explain how crystals are organized, how they can differ, and how the properties of the resulting minerals can also differ from one another.

Be sure to include:
- Definitions of the words "mineral," "crystal," and "properties."
- Examples of two kinds of mineral properties.
- Examples of two minerals for each property (at least four in all).

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 topic of mineral properties.
- ☐ I defined "mineral," "crystal," and "properties."
- ☐ I included a labeled illustration of four minerals and their properties.
- ☐ I used information from "Mineral Match" to explain mineral properties in detail.
- ☐ I used information from the Guggenheim Hall of Minerals to explain mineral properties in detail.
- ☐ I used academic, non-conversational tone and language.
- ☐ 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 present information in response to the prompt, but lacks connections to the texts or relevance to the purpose of the prompt.	Presents information from the text relevant to the purpose of the prompt with minor lapses in accuracy or completeness.	Presents information from the text relevant to the prompt with accuracy and sufficient detail.	Accurately presents information relevant to all parts of the prompt with effective paraphrased details from the text.
	AMNH Exhibit	Attempts to present information in response to the prompt, but lacks connections to the Museum exhibit content or relevance to the purpose of the prompt.	Presents information from the Museum exhibit relevant to the purpose of the prompt with minor lapses in accuracy or completeness.	Presents information from the Museum exhibit relevant to the prompt with accuracy and sufficient detail.	Accurately presents information relevant to all parts of the prompt with effective paraphrased details from the Museum exhibit.
WRITING	**Focus**	Attempts to address the prompt, but lacks focus or is off-task.	Addresses the prompt appropriately, but with a weak or uneven focus.	Addresses the prompt appropriately and maintains a clear, steady focus.	Addresses all aspects of the prompt appropriately and maintains a strongly developed focus.
	Development	Attempts to provide details in response to the prompt, including retelling, but lacks sufficient development or relevancy.	Presents appropriate details to support the focus and controlling idea.	Presents appropriate and sufficient details to support the focus and controlling idea.	Presents thorough and detailed information to strongly support the focus and controlling idea.
	Conventions	Attempts to demonstrate standard English conventions, but lacks cohesion and control of grammar, usage, and mechanics.	Demonstrates an uneven command of standard English conventions and cohesion. Uses language and tone with some inaccurate, inappropriate, or uneven features.	Demonstrates a command of standard English conventions and cohesion, with few errors. Response includes language and tone appropriate to the purpose and specific requirements of the prompt.	Demonstrates and maintains a well-developed command of standard English conventions and cohesion, with few errors. Response includes language and tone consistently appropriate to the purpose and specific requirements of the prompt.
SCIENCE	**Content Understanding**	Attempts to include science content in explanations, but understanding of the topic is weak; content is irrelevant, inappropriate, or inaccurate.	Briefly notes science content relevant to the prompt; shows basic or uneven understanding of the topic; minor errors in explanation.	Accurately presents science content relevant to the prompt with sufficient explanations that demonstrate understanding of the topic.	Integrates relevant and accurate science content with thorough explanations that demonstrate in-depth understanding of the topic.