

## Mineral Headband Game

### Lesson Overview

In this lesson, students will use computational thinking skills, reasoning, and prior knowledge of mineral characteristics to identify an unknown mineral: asking only “yes or no” questions.

### SC Standards Addressed

**6.S.1A.2** Develop, use, and refine models to (1) understand or represent phenomena, processes, and relationships, (2) test devices or solutions, or (3) communicate ideas to others.

**6.S.1A.4** Analyze and interpret data from informational texts, observations, measurements, or investigations using a range of methods (such as tabulation, graphing, or statistical analysis) to (1) reveal patterns and construct meaning or (2) support hypotheses, explanations, claims, or designs.

*Note: This lesson was created and implemented for a 6th Grade Earth Science class at Cathedral Academy: a private Christian school in Charleston SC, that does not follow the SC Academic Standards. However, this could be used as an introductory activity to the following 8<sup>th</sup> grade Earth Science standard (see below), since the SC 3<sup>rd</sup> grade standards are the last time students study minerals.*

- **8.E.5C.1** Obtain and communicate information regarding the physical and chemical properties of minerals, ores, and fossil fuels to describe their importance as Earth resources.

### Disciplinary Literacy Strategies

Elbow Partners, Jigsaw (*Adaptation: 8 parts instead of 4-6 – no whole group share*), Pairs Squared

### Computational Thinking

Tools:

Games

Cornerstone(s) Addressed:

- Decomposition: Student must break down the information they need into yes/no questions
- Pattern Recognition: Students must find the pattern in the information given in order to determine the mineral on their card.
- Abstraction: Students must choose what information is not relevant to their card.
- Algorithmic Thinking: Students must determine the order of information they will need in order to ask the right question at the right time.

### Lesson Plan

Time required: Three 55-minute periods

Focus Question(s):

- How might minerals be identified and distinguished from similar minerals based on their characteristics and properties?
- What might be an efficient way to identify the mineral while only asking “yes or no” questions?
- How might the internet be used as a resource to research minerals?

Disciplinary Vocabulary: Mineral, hardness, streak, color, luster, cleavage, fracture, crystal, (*there are other possibilities based on what they find in their research*)

Materials needed:

- Paper headbands
- Paper fasteners
- Rubber bands
- Mineral image cards
- Clipboards

- Colored pencils/crayons
- Internet access
- Blank mineral properties tables
- Dichotomous Key Template and Instructions – *(This will become the mineral identification key)*

### Engage

- Students pair with an elbow partner and define as many characteristics of minerals as they can within 2 minutes.
- As a class, pairs share out characteristics until all characteristics have been reviewed.
- Show the mineral cards with blank backs AND allow students time to think about how they might identify the minerals.

### Explore

- **Explain** the activity/game: *This is modified from the popular game, Hedbanz (“What am I?”).*  
**These are an overview of general directions, which will be reiterated and explained further in the elaborate and evaluate sections of this lesson.**
  - o Students will play the game with 4 – 8 other students
  - o Each student receives a headband and a mineral card kept face down so no one, NOT EVEN the student with the card, can see it.
  - o Students take turns by, one at a time, placing the mineral card on their headband WITHOUT looking at it, and placing it where all other players can see it.
  - o Each student will try to identify the mineral on their headband by asking yes/no questions to the other players. For example: players, when it is their turn, will ask the other players a question about the mineral displayed on their card which can be answered by “yes” or “no” responses.
  - o Play continues until each student/player in the group has had the opportunity to guess or determine what their mineral is.
- Students will number off, 1 to 8. Then, using an adapted Jigsaw, student expert groups will research one of the eight minerals (*see the Mineral Headband Card*) [Mica, Magnetite, Quartz, Halite, Jade Diamond, Pyrite, or Copper] – *See “Explain” below*

### Explain

- Students research their mineral – specifically the properties of that mineral with respect to the characteristics of all minerals (luster, streak, color, etc ...).
- In their expert groups, students create a chart of characteristics that can be used to identify their mineral and present it to the class.
- As each group presents, the other groups update their mineral properties tables (attached).

### Elaborate

- Students pair with their elbow partner and compare their mineral properties tables. Pairs square (*two pairs come together to be one group of four*). Together they develop one yes/no question for the game.
- Squares work together on the Dichotomous key (*see template and instructions attached*). Assist where needed (*If low reading levels - model the example given in the instructions.*)
- Provide students with a headband and a mineral card. INSTRUCT THEM NOT TO DIVULGE THE MINERAL ON THEIR CARD TO ANYONE! (*Have this posted in the room where all can see it.*)
- Put students in random groups of 4-8 (or students can create their own groups). It doesn’t matter what mineral card they have, (members of a game group can all have the same mineral card).

- Once in their game groups, have students place their mineral card in the headband of the person on their right, such that the person on the right never sees it.

### Evaluate

- Students will use the mineral identification key (*the dichotomous key they created in their pairs squared group*) to ask their classmates “yes or no” questions to help them identify their unknown mineral, on their headband. *Note: Students should have one question from their earlier group work (see elaborate).*
  - One student starts by asking a single yes/no question to their game group.
  - The student records the answer – and can either attempt to identify their mineral or they can pass to the next student. If they guess incorrectly, they must add 3 points (equivalent to 3 questions).
  - The next student repeats the process, and this continues round robin style until time is called or all students in the game group have identified their mineral.
- Students will record the questions they ask, the answers and the points. (Record the points as: 1 Question = 1 point, missed identification (wrong guess) = 3 points.) The goal is to identify the mineral asking the fewest number of questions possible (*Have the least number of points*). *NOTE: Be sure to stop the game with at least 15 minutes to reflect.*
- When time is up, students will find others in the class with the same mineral. They will share their questions/answers and identify any patterns or trends. Observations will be shared with the class.
- Students reflect individually (in notebooks or journals) on what they did well and on what they might do differently if they played another game with a dichotomous key.

### Assessment Notes:

- Students will be evaluated on their ability to ask helpful questions to identify their assigned mineral during game time. (Number of Questions asked to arrive at the correct identification).
- Students will be evaluated on their ability to create an accurate and informative key for identifying their mineral (Again, number of questions needed to arrive at the correct identification) – Or students can self and/or peer assess.

### Teacher Biographical Information

Lesson Author: Sara Brace

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Years of experience – 1

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### Resources:

Mineral Properties Table (attached w/ an example)

Dichotomous Key Template and Instructions (*Mineral Identification Key*)

Mineral Headband Cards (attached) *Note: Print on card stock then cut so that each student has a card.*

Student Research:

<https://geology.com/>

<https://www.nps.gov/subjects/geology/rocks-and-minerals.htm>

<https://www.dkfindout.com/us/earth/rocks-and-minerals/>

Hedbanz™ Original Game: <http://www.spinmastergames.com/game-detail.php?pid=p10421>

## Mineral Headband Cards

**Mica****Magnetite****Quartz****Halite****Jade****Diamond****Pyrite****Copper (Chalcopyrite)**

**Mineral Properties Table**

<b>Mineral</b>	<b>Color</b>	<b>Streak</b> Color of mineral when scratched across a streak plate	<b>Luster</b> <b>Glassy</b> – shines like glass <b>Waxy/Pearly</b> – has a dull shine <b>Metallic</b> – Shines like metal <b>Dull</b> – Not shiny	<b>Hardness – Scratched by:</b> Fingernail: <b>1-2</b> Penny: <b>3-4</b> Steel: <b>5</b> <u>Glass: <b>6</b></u> <u>Will scratch glass/steel: <b>7-10</b></u>	<b>Other:</b> Magnetic, Taste (salty, bitter, metallic, etc.), Texture, Flakes into sheets, smell/odor (rotten eggs), Cleavage and Fracture
<b>Diamond</b>					
<b>Mica</b>					
<b>Magnetite</b>					
<b>Copper (Chalcopyrite)</b>					
<b>Quartz</b>					
<b>Halite</b>					
<b>Pyrite</b>					
<b>Jade</b>					

## A COMPLETED TABLE:

Mineral Properties Table

<b>Mineral</b>	<b>Color</b>	<b>Streak</b> Color of mineral when scratched across a streak plate	<b>Luster</b> <b>Glassy</b> – shines like glass <b>Waxy/Pearly</b> – has a dull shine <b>Metallic</b> – Shines like metal <b>Dull</b> – Not shiny	<b>Hardness – Scratched by:</b> Fingernail: <b>1-2</b> Penny: <b>3-4</b> Steel: <b>5</b> Glass: <b>6</b> <u>Will scratch glass/steel: <b>7-10</b></u>	<b>Other:</b> Magnetic, Taste (salty, bitter, metallic, etc.), Texture, Flakes into sheets, Smell/odor (rotten eggs), Cleavage and Fracture
<b>Diamond</b>	Commonly Brown to Yellow – can also be any other color	Can't be streak tested – NONE or Colorless	Glassy (actually 'Adamantine' – highest luster without being a metal)	10.0 Can cut glass	Jewelry industry favors colorless Perfect octahedral cleavage in four directions
<b>Mica</b>	Colorless	White	Pearly	2.5 – 3.0	Flakes into sheets
<b>Magnetite</b>	Black	Black	Dull	5.5 – 6.5	Magnetic
<b>Copper (Chalcopyrite)</b>	Brass yellow. Tarnishes to green, sometimes iridescent	Greenish Black	Metallic	3.5 – 4.0	Tetragonal Crystals – Most widely used metal. Ore and mineral
<b>Quartz</b>	<b>Varies</b> – Pink, green, black, yellow, mixed ...	White	Glassy	7.0	Round Fracture Polished and used in construction surfaces
<b>Halite (Salt)</b>	Transparent to Yellowish Grey	White	Glassy	2.5	Tastes Salty Used in food prep/ storage and to de-ice
<b>Pyrite</b>	Golden	Black	Metallic	6.0 – 6.5	Looks like gold Commonly known as Fool's Gold
<b>Jade</b>	Usually Greenish - Varies	Colorless	Waxy	6.5-7.0	No Cleavage too brittle Used in jewelry

Example Table to show students (PPT Slide works well)

<b>Some Common Minerals and Their Properties Key</b>					
<u>Name</u>	<u>Color</u>	<u>Streak</u>	<u>Luster</u>	<u>Hardness</u>	<u>Other Properties</u>
Graphite	Black	Black	Metallic	1	Crystals are rare.
Mica	Colorless	White	Pearly	2.5-3	Flakes into sheets
Halite	Colorless	White	Glassy	2.5	Salty taste
Galena	Gray	Gray	Metallic	2.5-3	Crystal Cubes
Calcite	Colorless	White	Glassy	3	Crystalline
Magnetite	Black	Black	Dull	5.5-6.5	Magnetic
Pyrite	Golden	Black	Metallic	6-6.5	Looks like gold
Feldspar	Various	White	Glassy	6-6.5	Two cleavages
Quartz	Various	White	Glassy	7	Round fracture
Hornblende	Dark green to black	Gray	Glassy	5.5	Splintery appearance



## Mineral Identification Key

**Create Your Own Dichotomous Key**

Dichotomous keys are tools used by scientists to identify unknowns.

1. Use the minerals and the characteristics you listed to create a dichotomous key.
2. Decide on a way to divide the items into two groups.
  - Use the mineral characteristics such as cleavage, luster, color, etc.
  - Use ONE, DEFINED characteristic to decide which item is placed in which group. (Example: a group of big cats could be divided into those with long tails (one group) and those with short tails (the opposite group)).

**The two groups must be opposites of each other.**

3. Record what factor was used to make the division, and note which members of the original group belonged to each resulting group.
4. After two groups (A and B) have been created, divide the first group (A) into two more groups based again on one criterion (C and D). For example, if group A were the short-tailed cats, group C might be short tailed cats with a plain colored coat. Group D would then be short tailed cats with a patterned coat.
5. Do the same with Group B.
6. Continue to divide the groups until each item is by itself. Keep careful records of the groups that were created and the dividing criteria.
7. Looking at your records and the divisions you made, create a dichotomous key that would lead someone else to make the same distinctions you did. Begin your key by recalling the first factor you used to divide into two groups. Again, using the big cat example: The first group was created depending on tail length. So, the first question in the key should be: Does the cat have a short tail? If so, go to step 2. The second question should be the other choice: Does the cat have a long tail? If so, go to step ??? (You may need to wait until you have worked through several steps of the key to assign the second destination).
8. When your key is complete, ask someone else to use it to classify and identify the items. Does your key lead others to the same identifications you made? If not, you may need to make some changes.



**Key Template:** Use the following template to create your dichotomous key.

Title: Key to Identifying Minerals		Go To Step:
Step 1	1a.	
	1b.	
Step 2	2a.	
	2b.	
Step 3	3a.	
	3b.	
Step 4	4a.	
	4b.	
Step 5	5a.	
	5b.	
Step 6	6a.	
	6b.	
Step 7	7a.	
	7b.	
Step 8	8a.	
	8b.	
Step 9	9a.	
	9b.	

**Answer Key:** Fill in the correct answers to your key.

A. \_\_\_\_\_

B. \_\_\_\_\_

C. \_\_\_\_\_

D. \_\_\_\_\_

E. \_\_\_\_\_

F. \_\_\_\_\_

G. \_\_\_\_\_

H. \_\_\_\_\_

I. \_\_\_\_\_

J. \_\_\_\_\_