Ohio Standards Connection:
Earth and Space Sciences

Benchmark D
Identify that the lithosphere contains rocks and minerals and that minerals make up rocks. Describe how rocks and minerals are formed and/or classified.

Indicator 2
Explain that rocks are made up of one or more minerals.

Indicator 3
Identify minerals by their characteristic properties.

Lesson Summary:
In this lesson, students learn about the properties of minerals and the rocks that they constitute. The central focus of the lesson is how to use characteristic properties to identify minerals. During the instructional procedures, students will use scratch plates, hardness tests and heft to identify a variety of common minerals. Students will examine rocks with magnifying lenses or stereomicroscopes to observe the mineral composition. Students will prepare presentations for the class and create edible rock models using minerals made of everyday ingredients.

Estimated Duration: Four hours

Commentary:
Students may have little background knowledge associated with this concept. It is recommended that you allow students to change their answers on Attachment D, Mineral Worksheet as you demonstrate using student volunteers, the actual properties that students have tried to identify on the test.

The term “heft” is substituted for “specific gravity” in this lesson. The concept of specific gravity is not developmentally appropriate for this grade level. However, to differentiate instruction, it may be appropriate to challenge students who demonstrate a high level of understanding of the indicator.

This lesson was field tested by teachers across the state of Ohio. Some of the teacher comments about this lesson follow:
- “The students wanted to analyze other samples and went to the library / home to find other resources to read / learn about rocks and minerals.”
- “The post-assessment is very effective because it was more open-ended than most.”
- “ALL learning styles are addressed in this activity.”
Mineral Match Up – Grade Six

Pre-Assessment:
• Prior to administering the pre-assessment, allow students to examine a quartz crystal. Have them write descriptive paragraphs in their journals. Record student descriptions on the board.
• Use descriptions from the board to develop the main properties of minerals; color, luster, hardness, heft (specific gravity), cleavage or fracture and streak. Explain to students that quartz is a mineral.
• Demonstrate how to determine key properties of minerals such as luster, streak, cleavage, heft and hardness.
• Have students record a simplified definition of mineral in their journals. (A mineral is an inorganic substance that occurs naturally on the earth. Combinations of minerals make up rocks).
• Use the quartz crystals to demonstrate the various tests for mineral properties. Complete a mineral identification sheet to key out the quartz crystal.
• Use and discuss appropriate safety procedures for working with rocks and minerals; goggles with rock hammer, cloth for covering mineral when it is broken, rules for handling sharp objects and dilute acids.
• Distribute Attachment A, Pre-Assessment to the class. After students are finished, discuss the pre-assessment so that students understand what a mineral is and understand some properties of minerals.

Scoring Guidelines:
• See Attachment B, Pre-Assessment Answers, for acceptable responses to the pre-assessment.
• If a student demonstrates understanding of the indicator use extensions and enrichment activities to supplement instruction.

Post-Assessment:
• Provide mineral samples and at least four mineral-testing stations equipped with scratch plates and streak plates so that students can complete the performance part of the assessment as quickly as possible.
• Distribute Attachment C, Post-Assessment to the class. Instruct students to complete the assessment as directed.

Scoring Guidelines:
There are 28 possible points:
• Part I is worth 24 points (one for each blank)
• Part II is worth two points. A mineral is an inorganic, naturally occurring solid material that forms part of the Earth’s crust.
• Part III is worth two points. Rocks are composed of minerals.
Students scoring at least 22 out of 25 have demonstrated an understanding of the indicator.
Mineral Match Up – Grade Six

Instructional Procedures:
Exploring Minerals
1. Prepare the mineral-testing stations so that students can practice mineral testing. Stations should have at least four minerals such as quartz (something they should already be familiar with), feldspar, calcite and magnetite or pyrite. Each station should have a rock hammer and covering cloth, dilute acid, scratch plate, glass plate, penny, steel nail and identification key. If sufficient materials are not available to experiment with cleavage and fracture, show students examples and have them predict what will happen to the piece.
2. Divide students into groups of three or four. Appoint a safety chairman and recorder, communications specialist (communicates problems to the teacher) and spokesperson (reports findings).
3. Distribute Attachment D, Mineral Worksheet, and instruct students to identify their unknown minerals using the tools available at their stations. Circulate around the room to make sure that students are using appropriate safety techniques and that they are interpreting the properties correctly.
4. Have each group report on the types of minerals it identified. Minerals should be retested if there are any discrepancies. Any minerals with unique properties should be discussed.

Exploring Rocks
5. Distribute samples of pink granite (or similar rock with visible mineral crystals) to small groups of students. Have students write paragraphs describing their observations in their journals. Have students then compare and summarize descriptions within their groups.
6. Instruct each group to write its description on the board. Then, as a class, come to consensus on a good general description.
7. Ask students if they believe the object to be a mineral. The students should note that there seem to be a number of minerals in the rock. They should be able to identify quartz and mica and perhaps feldspar, but will probably not be familiar with hornblende.
8. Have students use the knowledge they accumulated about this rock to create a working definition of the word “rock” and record in their journals.
9. Distribute a sample of gneiss and a sample of sandstone (or other metamorphic and sedimentary rocks). Repeat procedures above. Make changes in the definition of rock, if needed. Identify the rocks and the minerals that compose the individual rocks.
10. Review the definition of rock and be sure students understand that there are many different types of rocks.
11. Distribute Attachment E, Edible Rock Worksheet. Explain to students that each group is to make an edible model of one type of rock (igneous, sedimentary, or metamorphic). Plans must be approved by the teacher and some of the work will probably need to be done at home.
12. Assign a due date for the model rocks. Have students identify the minerals that compose their model and show samples. They also should identify the rock and explain what minerals they used, plus any procedures they did on the rocks.
14. Review minerals and rocks.
15. Administer the post-assessment.

**Differentiated Instructional Support:**
Instruction is differentiated according to learner needs, to help all learners either meet the intent of the specified indicator(s) or, if the indicator is already met, to advance beyond the specified indicator(s).

This lesson incorporates multiple-learning styles by varying methods of presentation.

**Extensions:**
- Schedule a jeweler and/or person involved in the mining industry to visit the classroom and talk about his/her job.
- Introduce specific density and/or Moh’s scale of hardness. Give students a group of minerals and have them draw a line scale and place each mineral where it belongs.
- Grow minerals (supersaturated sugar solution) on a string. An additional extension is to cool some of the mineral solutions quickly by putting them in the freezer and then compare outcomes.

**Homework Options and Home Connections:**
- Check food labels at home to see what types of minerals are included. Investigate the importance of minerals to the functioning of body systems.
- Begin your own rock and mineral collection.

**Materials and Resources:**
*The inclusion of a specific resource in any lesson formulated by the Ohio Department of Education should not be interpreted as an endorsement of that particular resource, or any of its contents, by the Ohio Department of Education. The Ohio Department of Education does not endorse any particular resource. The Web addresses listed are for a given site’s main page, therefore, it may be necessary to search within that site to find the specific information required for a given lesson. Please note that information published on the internet changes over time, therefore the links provided may no longer contain the specific information related to a given lesson. Teachers are advised to preview all sites before using them with students.*

*For the teacher:* Mineral samples (at least one per group of biotite mica, pyrite, quartz, feldspar, calcite, galena, magnetite, talc, gypsum, fluorite, and or muscovite mica), rock samples (at least one per group of pink granite, gneiss, sandstone), additional samples for the edible rock activity.

*For the students:* Safety goggles, rock hammer and cloth to cover sample when breaking, streak plates, glass plate, penny, steel nail, small dropper bottles of dilute acid (prepared by teacher or purchased.)
Mineral Match Up – Grade Six

Vocabulary:
- mineral
- rock
- luster
- streak
- cleavage
- fracture
- hardness
- magnetic
- property
- heft

Technology Connections:
- Use a stereo-microscope, a projection or video-microscope to examine rocks so students can see the minerals.
- Use a camera to record rock or mineral specimens and create a chart with a concept map of the relationships between the substances.
- Use the computer to develop a rocks and minerals database. Digital images of samples may be included.
- Have students explore a wide range of minerals using the World Wide Web. Many Web sites for commercial mineral dealers have excellent images of minerals and information about their properties.

Research Connections:

Marzano finds the strongest benefits to all students-regardless of ability level-when working in heterogeneous groups.

General Tips:
- The term “heft” is substituted for “specific gravity”. Introducing specific gravity at this time goes beyond the indicator.
- The object of the lesson is not to memorize the properties of specific minerals, but to help students understand that minerals do have properties.
- Have plenty of materials available so that you can keep groups small.

Attachments:
Attachment A, Pre-Assessment
Attachment B, Pre-Assessment Answers
Attachment C, Post-Assessment
Attachment D, Mineral Worksheet
Attachment E, Edible Rock Worksheet
Attachment F, Self-evaluation Sheet for Edible Rock
Mineral Match Up – Grade Six

Attachment A
Pre-Assessment

Place the appropriate number of the property next to the mineral in the tables. You may use each property more than once. Remember what you saw during the demonstration.

1. Luster:
   a. Metallic
   b. Nonmetallic (dull or greasy)
   c. Nonmetallic (shiny)

<table>
<thead>
<tr>
<th>Mineral</th>
<th>Property</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quartz</td>
<td></td>
</tr>
<tr>
<td>Pyrite</td>
<td></td>
</tr>
<tr>
<td>Feldspar</td>
<td></td>
</tr>
<tr>
<td>Talc</td>
<td></td>
</tr>
</tbody>
</table>

2. Streak:
   a. White
   b. Greenish black
   c. Green-white

<table>
<thead>
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</tr>
</thead>
<tbody>
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<td></td>
</tr>
<tr>
<td>Talc</td>
<td></td>
</tr>
</tbody>
</table>

3. Moh’s Hardness:
   a. 6 - Will scratch glass.
   b. 7 - Will scratch glass and the other three materials.
   c. 1 - Can be scratched with a fingernail.

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</tr>
</tbody>
</table>
Mineral Match Up – Grade Six

Attachment A (continued)
Pre-Assessment

4. Cleavage or fracture:
   1. Cleavage in two directions at right angles
   2. Fractures when broken
   3. It has perfect cleavage in one direction, breaks in sheets

<table>
<thead>
<tr>
<th>Quartz</th>
<th>Pyrite</th>
<th>Feldspar</th>
<th>Talc</th>
</tr>
</thead>
</table>

5. Heft:
   1. Feels heavy when compared to other minerals
   2. Feels light compared to quartz
   3. Feels about as heavy as quartz

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<th>Talc</th>
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Circle the best answer.

6. There are (hundreds, thousands, millions) of different minerals on the earth’s surface, but only (8, 25, 100) are very common.

7. Rocks are composed of minerals. (true, false)

8. If a substance is naturally occurring, it (is, is not) man-made.

9. A substance that is nonliving is called (organic, inorganic).

10. Most rocks are made of (1, 2, 5) or more minerals.

11. Rocks that cool very quickly have (large, small, no) crystals.

12. Granite is a rock made from (2, 4, 6) minerals.
1. **Luster:**
   a. Metallic
   b. Nonmetallic (dull or greasy)
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</thead>
<tbody>
<tr>
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<td>C</td>
</tr>
<tr>
<td>Pyrite</td>
<td>A</td>
</tr>
<tr>
<td>Feldspar</td>
<td>C</td>
</tr>
<tr>
<td>Talc</td>
<td>B</td>
</tr>
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2. **Streak:**
   a. White
   b. Greenish black
   c. Green-white

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3. **Hardness:**
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</tr>
<tr>
<td>Talc</td>
<td>C</td>
</tr>
</tbody>
</table>
Mineral Match Up – Grade Six

Attachment B (continued)
Pre-Assessment Answers

5. Heft:
   a. Feels heavier than quartz
   b. Feels light compared to quartz
   c. Feels about as heavy as quartz

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<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Quartz</td>
<td>C</td>
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<td>A</td>
</tr>
<tr>
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12. Granite is a rock made from (2, 4, 6) minerals.
Mineral Match Up – Grade Six

Attachment C
Post-Assessment

Name:_______________________________________

Part I:
Use the equipment provided to identify the properties associated with the unidentified minerals. Create a chart to show the properties and your results. You will include luster, streak, cleavage or fracture, hardness and any special properties.

<table>
<thead>
<tr>
<th>Mineral Properties and Identification</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Sample ___</td>
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<tr>
<td>Sample ___</td>
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<tr>
<td>Sample ___</td>
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</tbody>
</table>

Part II:
Use a complete sentence to define the word mineral. Be sure to include the terms inorganic and nature.

Part III:
Explain the relationship between a rock and a mineral.
Mineral Match Up – Grade Six

Attachment D
Mineral Worksheet

Name:____________________________________________

Materials:
Scratch plate, glass plate, penny, nail, identification sheet or mineral key, hammer, cloth.

Use the mineral identification sheet and items provided to determine the name of the mineral. Put a star * next to the properties that helped you the most to make your identification of each one.

<table>
<thead>
<tr>
<th>Name of Mineral</th>
<th>Properties</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Luster</td>
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<tr>
<td>Streak</td>
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<td>Hardness</td>
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<td>Heft</td>
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<tr>
<td>Cleavage or Fracture</td>
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<tr>
<td>Special Qualities (ex., magnetic, fizzes with acid)</td>
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</table>
Name ________________________________

**Background Information:**

Choose a rock from any category below. Investigate the minerals that make up the rock and decide what edible materials you will use to represent those minerals in your model. Briefly describe your plan in writing.

**Possible Rocks:** See me if you want to choose a different rock.

<table>
<thead>
<tr>
<th>Igneous (melted rocks) must be cooked, cake, brownies, other . . .</th>
<th>Metamorphic (squeezed and/or heated) should be partially melted and re-solidified, layers squeezed together, ice cream cake, layered sandwiched (smashed)</th>
<th>Sedimentary (particles cemented together or left after evaporation) an example might be candy pieces in peanut butter . . .</th>
</tr>
</thead>
<tbody>
<tr>
<td>Granite</td>
<td>Gneiss</td>
<td>Shale</td>
</tr>
<tr>
<td>Basalt</td>
<td>Marble</td>
<td>Limestone</td>
</tr>
<tr>
<td>Gabro</td>
<td>Quartzite</td>
<td>Sandstone</td>
</tr>
</tbody>
</table>

Name of the Rock ________________________________

<table>
<thead>
<tr>
<th>Minerals</th>
<th>What I Will Use in my Model</th>
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</thead>
<tbody>
<tr>
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Definition of a Rock: ________________________________________________

__________________________________________________________________

Does my rock fit the definition? Explain why or why not? ________________

Be ready to tell the class why you chose the rock you did, how you made it and why it fits the definition of a rock.
Mineral Match Up – Grade Six

Attachment F
Self-evaluation Sheet for Edible Rock

Name _______________________

Place a checkmark next to each part of the assignment you completed. Add up the number of checkmarks to get your score.

_______ Chose a rock.
_______ Found out what minerals are in the rock.
_______ Chose edible items to represent the minerals.
_______ Assembled the minerals to make an edible rock.
_______ Explained why my model fit the definition of a rock.
_______ Presented my information to the class.
_______ Extra credit up to 2 points. (Went beyond the project requirements.)

_______ Total (6 possible + extra credit)

6 or 6+
Outstanding Edible Rock Award

5
Very impressive.

4
Not bad. Right behind the leaders and gaining fast.

3-1
Whoops. My dog ate my homework and I had to put something together really fast.