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4th Grade: Rocks and Minerals
Lesson Time: 60 Minutes

Goal of Lesson: Students will be able to identify what rocks are made of. Students will use the physical properties of rocks and minerals to identify and classify them.

Big Idea: Students will learn who a geoscientist is, why they study rocks and minerals and the tools they used to classify and categorize them. Students will receive samples of various types of minerals, and, using the physical properties, identify the name of the mineral. Additionally, they will learn that minerals are the building blocks of rocks, and they will use various minerals that they identify to build two major rock types that make up the continental crust and the oceanic crust.

MN Science Standards Covered:

4.3.1.3.1 Recognize that rocks may be uniform or made of mixtures of different minerals.
4.3.1.3.2 Describe and classify minerals based on their physical properties.
4.3.1.3.1 I can explain that rocks are either made of one mineral or mixture of minerals.
4.3.1.3.2 I can list the physical properties of minerals.
I can use a streak plate to describe the color of a mineral's streak.
I can tell the difference between metallic and nonmetallic luster.
I can use the Moh's Hardness Scale to help identify the hardness of a mineral.
I can determine whether a mineral has cleavage or not.
I can use a Mineral Identification Key to identify a mineral using physical properties.

Materials: In a Geologist's Backpack

- Geologic map
- Hand Lens
- Field Notebook
- Colored Pencils
- Backpack
- Safety Glasses
- (Magnetic) Pencil
- Grain size card / scale card
- Pennies
- Magnet
- Streak plates (ceramic and glass)

(Optional materials - if volunteer is a geoscience student, they can also bring a brunton compass, safety vest, hammer, soil classification scheme, measuring tape, sledgehammer, jacob's staff, dilute HCl if they have access to these items)

Materials: Mineral Identification and Matching

- Hand Lens

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- Field Notebook
- Colored Pencils
- (Magnetic) Pencil
- Grain Size Card / Scale card
- Pennies
- Magnets
- Streak plates (ceramic and glass)

Minerals from mineral / rock kit (these are in labeled containers)

Introductions:

As the students enter for the activity, you can have them fill out and put on a name tag with their first name (if you think you need them). Welcome the students to the activity and introduce yourself. Tell them your name (wear a name tag too), what you are studying in college, what career you're interested in, etc. Keep it simple, use simple words and speak loudly. Be cheerful, upbeat and outgoing! Ask the students if anyone would like to ask a question about college or what it is like to be a student. Keep answers positive.

Activity 1: What's In an Earth Scientist's Backpack?

The goal of the exercise is to introduce the audience to the tools geoscientists use in their everyday life. The presenter should dress in geoscience gear if possible. With all of the tools in the backpack, the presenter can unload the tools one-by-one, introducing how and when each is used. Appropriate items (probably not the hammer, or the HCl) can be passed around for students to investigate. *If the classroom is a smart classroom with Google Earth, you could fly them into a location and describe a recognizable feature in place of the geologic map.

- All of the information that is gathered in the field is recorded in the **waterproof field notebook**. (Dip a page or pages into some water, or hold a page under a faucet to demonstrate how you can still write on the pages after they are wet.)
- The different rock units can be sketched in this notebook using a **pencil** and an assortment of **colored pencils**.
- Many times, geologists will need to collect rock specimens from outside in the field, and bring them back to the office and laboratory so that they can analyse them. To do this, the geologist must have a series of tools to extract the specimen, like a hammer, a sledge hammer, a chisel, **safety glasses**, and labeled sample bags.
- It is also important for the geologist to have a **compass**, to navigate in the field,
- a safety vest, so that they are visible,
- a **grain size card and scale for rock and mineral measurements**,
- a bottle of diluted **Hydrochloric Acid** to test if a rock is made of the mineral calcite ($CaCO_3$), which we can test by dripping a small amount of HCl on the rock provided in

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the backpack, (Carry this rock around and add the HCl - DO NOT let students touch the rock or acid!)

- and a **pack** to carry the samples and gear from the field back to the lab.

Optional:

- **Geologic maps** are made by geologists as they identify different rock types in a particular region. After being identified, the larger scale structures and associations of rocks form interpretable patterns, that allow geologists to decipher the complex history of the rocks and how they formed.
    - Ask Students: *What types of patterns do you see on the maps?*

  Layers: The cross-sections (most of the boxes on the map), represent side-views of what you would see if you were to cut the earth like a cake, where you could see the sides and the top of a single piece of cake. When you look at these boxes, you can see there are many layers. These are sedimentary rocks - or rocks that are made from the breakdown and transport of pieces of previous rocks. When they are done being transported, they stop, and become buried. This process happens over and over again, and so the rocks form layers that are originally horizontal.

  "U" and "Rainbow" shapes:
  There are areas where the patterns are curved into "U" shapes, and other areas where the patterns form rainbow shapes. When we make mountains on earth, we are moving the material, the land, and we are pushing two areas of land together. You might have heard that there are several "plates" that are moving along on earth's surface during a process which we call "plate tectonics". This is how we make new land, like when we collide two plates together to make mountains, or when we spread apart areas on the ocean floor, to make new ocean crust. When we push two land masses together, the rocks tend to bend and break, because they are under a lot of pressure. This is part of a process that we call "metamorphism". When these rocks bend, they form these "U" shapes and "rainbow" shapes like you see on the map example.

Activity Question:

1) Are there other supplies you can think of that a geologist might need? See what answers the students provide.

2. Everyday Use Minerals Activity

Find the labeled containers in your kit for the following and pull them out:

Talc is found in baby powder
Galena is found in batteries

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Fluorite is found in toothpaste (Fluorite is not in a container but is loose in the kit - purple crystals)
Chalk is found in colored sidewalk chalk
Halite is table salt
Native copper a is found in nd copper wire
Gypsum is found in drywall
Feldspar is found in ceramic tile
Magnetite, hematite is a taconite pellet
Quartz is found in glass (glass scratch plates)
Muscovite (from the sample mineral collection) is found is most makeup!

Activity:
We use minerals every day in our lives. Today we are going to show you examples of the minerals that you use in everyday products, like toothpaste, and batteries.

Go through uses of each mineral (listed above). After the 3rd activity you can have the students come up and observe them. Here is a helpful link that can be utilizing during the activity if desired → http://mineralogy4kids.org/minerals-your-house).

3. Mineral Identification and Matching

The following minerals will be used for this activity:

Olivine (7) # 48 from the Mineral Kit
Biotite (1-2) # 5 from the Mineral Kit
Muscovite (1-2) # 4 from the Mineral Kit
Plagioclase (6) # 2 from the Mineral Kit
Orthoclase (6) # 1 from the Mineral Kit
Quartz (7) # 7 from the Mineral Kit

Sphalerite (5)# 42 from the Mineral Kit
Galena (3) # Free Rock from Kit (Container is Labeled)
Pyrite (6) # 40 from the Mineral Kit
Calcite (3) # 6 from the Mineral Kit
Fluorite (4) # 43 from the Mineral Kit
Sulfur (2) # Free Rock from Kit (Container is Labeled)

1. You will tell the students that today they get to be real geoscientists! The experiment today will have them doing tests that will help them make observations about the type of mineral they are given.
2. We are going to talk today about what minerals are, and how we can identify them. In order to identify anything however, we first need to classify the mineral.
    a. Why do you think that is? ____ *Answer: Because it is how we can decipher how*

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things are made, or the processes responsible for their formation.

3. Minerals are the building blocks of rocks, so in order to understand geology, we must first understand what minerals are made of.

   Basic definition of a mineral = Naturally occurring, crystalline solid. Minerals are made up of elements, and rocks are made up of minerals.

   Based on this definition, individual minerals can be identified using these physical characteristics: Crystal faces, cleavage, hardness, streak, luster, color, odor, effervescence (fizzing).

- Color (Use Your Eyes) – Another way to distinguish between minerals is color, but since color alone will not distinguish an individual mineral, you must combine your observations with other physical characteristics.

- Streak (Use the ceramic plate) – Another way to distinguish between minerals is streak, which is the color of the fine mineral powder left behind on the streak plate after you scratch the mineral on the streak plate. This is not necessarily the same color as the mineral. Also, the ceramic streak plate has a hardness somewhere around 7, so minerals harder than 7 will not leave a streak.

- Hardness (Use finger nail, penny, ceramic tile and glass plate) – is the ability of a mineral to resist being scratched.

  This is measured by Mohs Hardness Scale:

  (1) Talc
  (2) Gypsum/Fingernail
  (3) Calcite/Penny
  (4) Fluorite
  (5) Apatite/Glass
  (6) Feldspar
  (7) Quartz/Ceramic Tile
  (8) Topaz
  (9) Corundum
  (10) Diamond

- Crystal Habit – The way a mineral grows or how it is shaped.

- Cleavage – How the mineral breaks along a plane. When you think of cleavage remember that it is produced when the mineral is BROKEN.

- Odor- Some minerals have an odor. Example = Sphalerite (ZnS) which smells strongly of sulfur (rotten egg smell), others have a taste (example = Halite (NaCl – salt)).

- Effervescence (fizzing)- Certain minerals like Calcite react with dilute HCl (hydrochloric acid) by effervescence or bubbling/ fizzing. If you remember the large red rock from the backpack, you could see tiny, broken pieces of shells and stems of echinoderms (organisms related to starfish). All of these tiny pieces fizz when you put the dilute HCl on them, because they are made of the mineral calcite.

4. Minerals can be identified based on their physical characteristics that we just described, such as their color, the way they grow into crystals, the way they break, their smell, and taste, their hardness, the color of the material that is left behind when scratched by a

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harder material, whether or not they are magnetic … We can perform some of these tests on minerals to determine their properties and figure out what type of mineral each is here in class.

Now, with these characteristics in mind, we have the tools necessary to classify our minerals.

5. We are going to pass out several different kinds of minerals. You will work in pairs. So your teacher or staff leader will decide how you will find your partners.
6. Your task is to make observations of the physical properties of each mineral, and try to identify the minerals you have. In order to make sure we can identify these different minerals we are also going to pass out tools to help you.
7. **TOOLS: Have one volunteer pass out one set of the tools to each partnership while the other explains the items of the toolkit below.**
    a. **Your tool kit will include:**
        i. **Your eyes, so that you can see what colors your mineral is.**
        ii. **A magnet, so that you can tell whether or not your mineral sample is magnetic.**
        iii. **Your nose, so that you can smell whether or not it has a peculiar smell (like rotten eggs).**
        iv. **Your hands, so that you can feel how heavy your mineral is compared to other samples.**
        v. **The tools you will use to determine hardness will include your fingernail, a penny, a glass plate, and a ceramic plate.**
        vi. **Mineral Observation Sheet. This sheet will ask you questions to test the different physical properties of your mystery mineral.**
        vii. **Moh's Hardness Scale Sheet.**
            1. To determine how hard your mineral is, we can use a scale, called Moh's hardness scale, where 1 is the softest, and 10 is the hardest. To see where your mineral fits on this "hardness" scale, you can use several "geologist" tools to help you. These are the penny, your fingernail, the glass plate, and the ceramic plate (tile). (Use mineral hardness sample sheet.) Please use your Hardness Scale Handout to help you. We will also walk around and help you with some of the hardness testing.
8. Tips for Determining Hardness:
    a. For reference, your fingernail has a hardness of 2.5 on this scale, a penny has a hardness of 3, a steel knife or window glass has a hardness of 5.5, and a ceramic tile has a hardness of 7.
    b. If your mineral is softer than your fingernail (2.5) you will be able to scratch it with your fingernail, and the penny (3). Some of you have examples of minerals this soft. Their names are talc, gypsum, muscovite, biotite, and calcite.

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c. If your mineral is harder than your fingernail, but softer than glass, your mineral will leave behind a powder residue on the glass plate. Some of you will have examples of minerals that fall in this hardness range, like the mineral fluorite.
d. If your mineral is harder than the glass, instead of leaving a residue, it will scratch the glass. Some of you will have minerals this hard. They include many minerals that are very important to forming rocks that make up the continental crust, and the ocean crust, such as quartz, feldspar, olivine, pyroxene, and garnet.

9. At this time the lesson leaders will go around to each student and pass out one of each mineral listed below to the pairs of students. Most of the minerals will be taken from the Burgundy Boxed Mineral Kits. The following minerals are NOT found in the kit and need to be pulled from the containers in the kit: Sulfur and Galena.

   The minerals that you will hand out from the rock kits are listed below. Many of the kids will want to look at the other minerals too since they are colorful. Feel free to leave these at the front of the classroom, along with the sheet that says what they are (based on the numbers listed on the sample), so that they can come up and look at what each are called.

10. Then, have them look at their sample, and collaborate with their partners while answering the questions listed on the Mineral observation sheet. During this step, they will need to use the geologist's tools you have passed out.
11. Take the laminated Mineral Identification Sheets and set them up along a counter or table at the front of the classroom or an area away from where the students will be doing their observations.
12. Tell the students that once they have finished with all of the observations, they need to take their observation sheets to the Mineral Identification Sheets and use their answers to identify and write the name of their mineral on their observation sheet.

Observation Sheet Questions: The observations you will make will include:

1. what color is your mineral?

   Olivine (7) green (light)
   Pyroxene (6) dark green / black
   Biotite (2.5 - 3) black
   Muscovite (2.5 - 3) light, white
   Plagioclase (6) white, tan
   Orthoclase (6) pink
   Quartz (7) milky, clear
   Sphalerite (5) green, yellow (will smell like rotten eggs (ZnS)
   Galena (3) very heavy, metallic looking, shiny
   Pyrite (6) cubic, fool's gold

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Calcite (3) clear, breaks into diamond shapes (rhombus)
Fluorite (4) green
Sulfur (2) yellow

2. Is it magnetic? Test your mineral using disc magnet from your supplies. Does the magnet stick to the rock? If your mineral is **Magnetic**, it may be the mineral magnetite, which contains **Iron (Fe).**

3. Does it have a smell? If it does, what does it smell like to you? If your mineral has **Sulfur** in it, it might smell like **rotten eggs**.

4. What do the edges of your mineral look like? Are they geometric? Or more random? (Draw a sketch to help.)

5. Is your mineral very heavy feeling in your hand even though it might be small in size? Compare it to other minerals that people at your table might have. If your mineral feels much **heavier** in your hand compared to others of similar size, it may be the mineral galena, which contains **LEAD (Pb)-** and is very dense, which is what makes it feel heavy.

How hard is your mineral sample?

What is your mineral? _____

6. After every pair of students matches their mineral based on the ID sheets, bring the group back together and have them go around the room stating the number of their mineral (if they have one) and what their guess is for their mystery mineral. Using your Mineral Key share with the students if they have guess right. If they have not, you can say “Close, but you actually had XXX.” If you know why they may have guessed what they did and why they are close, you can share that with them.