



SCIENTIST IN RESIDENCE PROGRAM™

Science Unit: Fossils

Lesson # 3: Intro to Rocks and Minerals

School Year: 2015/2016

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Grade level: Presented to grade 5-7; appropriate for grades 3-7 with age appropriate modifications

Duration of lesson: 1 hour

Notes: This lesson requires a collection of rocks and minerals for the students to examine. See the end notes for suggestions on where to obtain specimens.

Objectives

1. Learn the difference between minerals and rocks
2. Observe a collection of minerals and rocks, and describe different rock types
3. Identify local rock types
4. Learn what type of rocks can preserve fossils

Vocabulary

Rock	Solid made up of one or more minerals.
Mineral	A non-living, solid material; the building blocks of rocks
Crystal	A solid with a highly organized microscopic structure; often has a shape with flat surfaces
Grain	A small particle of rock
Igneous	Rock formed from cooled molten rock
Metamorphic	Rock that has undergone changes due to heat or pressure
Sedimentary	Rocks that form from pieces of pre-existing rocks or from organisms at the earth's surface

Materials

- Mineral collection
- Rock collection
- Samples of local rocks for students to identify
- Magnifying glasses
- Station sheets (Appendix A)
- Handouts: Worksheet (Appendix B), Rock observation chart (SRP_Fossils #3Worksheet.doc), Sorting chart (SRP_Fossils_Lesson 2_RockWorksheet)
- Container, vinegar, piece of limestone, shell



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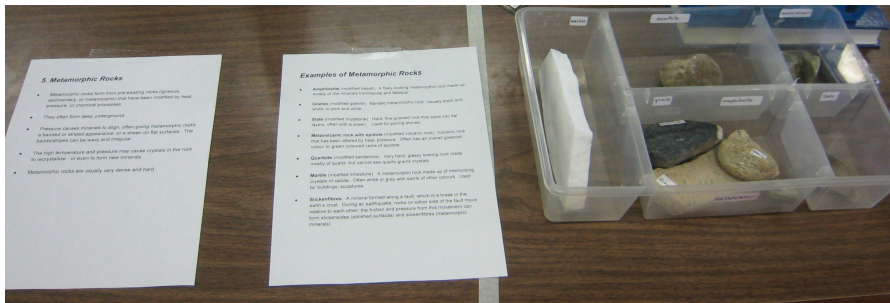
In the Classroom

Introductory Discussion

- What are rocks and minerals?
 - You can use this slideshow to introduce the concept of rocks and minerals: <https://drive.google.com/open?id=1gvSfrD9qDWK8G-f8yOZ9pIKKu28P3tByzYPwo6wrw7Q>
 - You may want to show students a few of the more beautiful minerals, as these always catch their attention
- Opening demonstration:
Show that shells and limestone effervesce (fizz) in vinegar (acid): put a shell and a small piece of limestone in a glass of vinegar, and then set this at the sedimentary rock station. Note the vinegar will eat away the limestone, so only use an expendable sample.
- Safety guidelines:
 - Students should be careful handling the rocks; some samples may be sharp
 - Students should wash their hands after handling the specimens

Science Activity/Experiment

- Set-up stations with cards (printables below) and samples (Minerals, Rocks, Crystals vs. Grains, Igneous Rocks, Metamorphic Rocks, Sedimentary Rocks). Modify to fit your collection.



- Students can work alone or in pairs.
- Hand out the lab sheet (printable below) to guide student observations and/or the rock observation chart.
- In this exercise, students are not asked to test rock hardness. This property is typically estimated with a scratch test. Even if students are told not to scratch the rocks, to rather use the rocks to scratch the test materials, the temptation is usually insurmountable, and results in ruined rocks. The rock observation chart asks students to evaluate friability (whether a rock tends to break into smaller pieces) instead. However, if you have some expendable rocks, estimating hardness is an interesting exercise.

Closure Discussion

- What are the three main types of rocks?
- How are each of these rock types formed?
- Which types of rock do you think preserve fossils?



How to Obtain a Classroom Set of Mineral and Rock Specimens

- **Gravel and stone yards.** Gravel and stone yards typically carry basalt, granite, limestone, and river rocks, which often have pebbles of different types of metamorphic rocks. For a small donation, you can fill a large ziploc with samples.
- **Stone/Tile/Countertop suppliers.** Stone/Tile and or Countertop suppliers typically carry beautiful polished granite and marble, along with more exotic igneous and metamorphic rocks. Ask if they have any broken pieces, or you may be able to buy samples for a small fee.
- **Rock and Mineral shops.** Rock and mineral shops will be happy to help you put together a class collection of rocks and minerals, and the samples will likely be bigger and more interesting - and more representative of local geology - than collections available online. In the Vancouver area, I recommend Amethyst Creations on 4th avenue.
- **Gem and mineral shows.**
- **MineralsEd Workshop.** Participating in a MineralsEd workshop (<http://www.mineralsed.ca/s/ResourceUnits.asp>) currently includes a kit with four rocks: granite, pumice, conglomerate, and slate, and one mineral (magnetite)
- **Online scientific suppliers,** such as Boreal, sell mineral and rocks kits

References

Van der Flier Keller, Eileen. 2006. A Field Guide to the Identification of Pebbles. Harbour Publishing. Online version: <http://www.pdac.ca/pdf-viewer?doc=/docs/default-source/publications---news-activities/060220-pebble-guide.pdf>

2.<<http://www.empr.gov.bc.ca/Mining/Geoscience/EducationalResources/Documents/IC1987-5-idrocks.pdf>> Van der Flier Keller, Eileen, and McMillan, William J. 1987. The Identification of Common Rocks. BC Geological Survey. [notes on how to identify common rocks found in BC]

3.<<http://www.rocksandminerals.com/hardness/mohs.htm>>. Rockman. Mohs Hardness Test. [explanation of a simple rock hardness testing method]

Extension of Lesson Plan

1. Students can bring in rocks from home and try to identify them, or set up a classroom display.
2. Students can look for rocks on a neighborhood walk and try to identify them; rocks used for landscaping are often from local gravel pits.
3. Have students conduct a hardness test on a collection of expendable rocks using their fingernails (hardness 2.5), a coin (hardness 3.0), and a knife (hardness 5.5). If you have a white, porcelain tile, students can also do scratch colour tests.

Minerals

Quick Facts

- There are over 4,000 minerals.
- Minerals are the building blocks, or “ingredients” of rocks.
- Minerals are made of one or more chemical elements, arranged in geometric patterns.
- Each mineral has unique properties, such as, colour, hardness, crystal form, how it breaks, whether it dissolves in acid, etc.
- We use minerals every day.

For example:

Salt (Sodium + Chlorine) is tasty in cooking

Graphite (carbon) is easy to remove thin layers, so we use this mineral for pencil “lead”

Copper is used for wiring, electronic devices, and plumbing

- Though there are thousands of minerals, less than 50 are commonly occurring.

Rocks

Quick Facts

- Rocks are solids made of one or more minerals. They also can be made up of animal or plant material. For example, coal is made up of plant debris.
- Rocks are divided into three categories: igneous, sedimentary, and metamorphic

Crystals vs. Grains

Quick Facts

- Crystals form when liquid rock cools over time. (As the liquid cools, the heat energy decreases, and atoms become arranged in orderly structures, or crystals.)
- Crystals have geometric forms.
- Mineral crystals can also form when water evaporates (e.g., salt crystals.)
- Grains form when an existing rock breaks apart or “erodes.”
- Grains that are carried by a river or ocean often bump into each other and become rounded and dull.

Igneous Rocks

Quick Facts

- Igneous rocks are formed by the cooling of molten rock.
- They are made up of mineral crystals. Typically, these crystals do not have room to fully form, but instead interlock with each other.
- The texture of an igneous rock depends on how fast the molten rock cooled. The more slowly the rock cools, the larger the crystals.
- Rocks that form at or close to the surface, for example in a volcano or lava flow, cool rapidly, and have small or invisible crystals.
- Volcanic rocks may also have holes (vesicles) from trapped gas bubbles.
- If liquid rock cools instantly, for example during a volcanic eruption, crystals do not have time to form. The resulting rock has a glassy texture.
- The colour of an igneous rock depends on chemistry. Molten rock with lots of Iron and Magnesium cools to form dark rocks, while molten rock with lots of Silica and Aluminum forms light rocks.
- Igneous rocks are often sparkly on fresh surfaces due to reflections from flat crystal faces.

Metamorphic Rocks

Quick Facts

- Metamorphic rocks form from pre-existing rocks (igneous, sedimentary, or metamorphic) that have been modified by heat, pressure, or chemical processes.
- They often form deep underground.
- Pressure causes minerals to align, often giving metamorphic rocks a banded or striped appearance, or a sheen on flat surfaces. The bands/stripes can be wavy and irregular.
- The high temperature and pressure may cause crystals in the rock to recrystallize - or even to form new minerals.
- Metamorphic rocks are usually very dense and hard.

Sedimentary Rocks

Quick Facts

- Sedimentary rocks are formed at the Earth's surface.
- They are made up of broken-up pieces (grains) of pre-existing rocks and/or plant and animal debris which have been cemented together.
- Sedimentary rocks often have rounded grains, from transport by wind or water.
- The texture can range from very small grains (mudstone) to sand-sized grains (sandstone) to very large grains (conglomerate).
- Sedimentary rocks can have fossils (evidence of once-living organisms).
- Sedimentary rocks are often softer, more crumbly, and more dull looking than igneous or metamorphic rocks, and can have layers of grains of different sizes.

Examples of Minerals

Calcite (*Calcium + Carbon + Oxygen*)

Common mineral, used for antacids, pigment, and building stone.
Formation of this mineral removes carbon dioxide from the atmosphere

Pyrite “Fool’s Gold” (*Iron+Sulphur*)

Often found with gold

Sulfur “brimstone” (*Sulfur*)

Used for fertilizer, medicine, anti-bacterial

Examples of Minerals - Gems and Ores

- Gems are minerals that are used for jewelry
- Ores are minerals or rocks that have elements that can be profitably mined.

Examples of Rocks

The sample of Granite is made up of four common minerals:

1. Quartz (grey coloured), the most common mineral at the earth's surface
2. Feldspar (pink and white coloured), the most common mineral in the earth's crust
3. Mica (black coloured, with hexagonal crystals)
4. Hornblende (black coloured, with needle-shaped crystals)

The ore sample is made up of three minerals:

1. Sphalerite (yellow coloured), a zinc ore
 2. Pyrite (gold coloured)
- Galena (silver coloured), a lead ore

Examples of Crystals and Grains:

Look at the quartz, feldspar, and hornblende crystals that make up the granite, then look at the quartz pebbles (grains) and sand from the beach.

- Which is shiny and which is dull?
- Which has flat faces and which is rounded?

Examples of Igneous Rocks

- Granite. Visible, interlocking crystals (grey, black, and pink and/or white) give granite a speckled look. Often used for countertops.
- Porphyry. Large crystals, often black and needle-like or white and rectangular, “floating” in a fine-grained background (matrix)
- Basalt. A grey or black volcanic rock that forms close to the surface. Crystals mostly too small to see. May have holes (vesicles).
- Pumice. Light coloured rock formed in explosive volcanic eruptions. It has a sponge-like texture due to the many holes (vesicles) formed by escaping gases, which makes it very light. Try picking it up!
- Volcanic glass (obsidian). Dark coloured volcanic rock with glassy texture (not crystalline). Fractures with very sharp edges, and can be as sharp (or sharper) than a steel knife. Used by early peoples to make tools.

Examples of Metamorphic Rocks

- Amphibolite (modified basalt). A flaky-looking metamorphic rock made up mostly of the minerals hornblende and feldspar
- Gneiss (modified granite). Banded metamorphic rock. Usually black and white, or pink and white.
- Slate (modified mudstone). Hard, fine-grained rock that splits into flat layers, often with a sheen. Used for paving stones.
- Metavolcanic rock with epidote (modified volcanic rock). Volcanic rock that has been altered by heat, pressure. Often has an overall greenish colour or green coloured veins of epidote.
- Quartzite (modified sandstone). Very hard, glassy looking rock made mostly of quartz, but cannot see quartz grains crystals.
- Marble (modified limestone). A metamorphic rock made up of interlocking crystals of calcite. Often white or grey with swirls of other colours. Used for buildings, sculptures.
- Slickensides. A mineral formed along a fault, which is a break in the earth's crust. During an earthquake, rocks on either side of the fault move relative to each other; the friction and pressure from this movement can form slickensides (polished surfaces) and slickensides (metamorphic minerals).

Examples of Sedimentary Rocks

- Sandstone - rock made up of rounded, sand-sized grains.
- Mudstone - rock made up of very small, clay-sized grains. Often shows layering. Not as hard or shiny as slate.
- Limestone - a grey, white, or pink rock formed in oceans and lakes; made up of tiny grains of calcite or animal shells. Dissolves in acid (vinegar) and can be scratched with a paperclip.
- Coquina - rock composed mostly of broken up pieces of shell which have been cemented together.

Name: _____

Intro to Rocks and Minerals Lab Sheet

1. **Minerals and Rocks** Station

Read the information and examine the samples. What is the most common mineral at the earth's surface?

2. **Crystals vs. Grains** Station

Read the information and examine the samples. Which is shiny and has flat faces? The quartz crystal or grain? Which is rounded? The quartz crystal or quartz grain.

3. **Igneous Rocks** Station

Read the information and examine the samples. Take an especially close look at the samples of GRANITE, PORPHYRY, and BASALT. Write your observations on the chart.

4. **Metamorphic Rocks** Station

Read the information and examine the samples. Take an especially close look at the samples of GNEISS, METAVOLCANIC, and QUARTZITE. Write your observations on the chart.

5. **Sedimentary Rocks** Station

Read the information. Take a close look at the SANDSTONE, MUDSTONE, and LIMESTONE. Write your observations on the chart.

Extra Questions:

1. Go to the IGNEOUS station. Large crystals mean that a rock has cooled slowly deep under the ground, and small crystals means a rock has cooled rapidly at or near the earth's surface of the earth. These are called Volcanic rocks.

So is the granite volcanic? _____

What about the porphyry, basalt, and obsidian? Are they volcanic rocks? _____

2. A fossil is evidence of a once living organism which has been preserved in rock. Go back and look at the samples of Sedimentary rocks. Can you find any samples with fossils?

Which rock type(s) have fossils? _____

Do you think it is possible to find fossils in Igneous rocks? Why or why not?

3. Go back and look at the Metamorphic Rocks. What pre-existing rocks do you think they were formed from?

Gneiss formed from _____ (granite, basalt, marble, or sandstone?)

Marble formed from _____ (granite, basalt, marble, or sandstone?)

Quartzite formed from _____ (granite, basalt, marble, or sandstone?)

4. If you have any time left, look through the pamphlet "A Field Guide to the Identification of Pebbles," and learn about some of the other types of rocks you might find locally.