Science Unit: *Geology and Plate Tectonics*

Lesson 2: *Rock Families*

School Year:	2011/2012
Developed for:	Laura Secord Elementary School, Vancouver School District
Developed by:	Linda (Hanson) Herbert (scientist); Lesley Chambers and Phil Green (teachers)
Grade level:	Presented to grade 6/7; appropriate for grades 3 – 7 with age appropriate modifications
Duration of lesson:	1 hour and 20 minutes
Notes:	This lesson is based on Lesson 3, Mining in BC, in the Renewable and Non-renewable Resources science unit, Scientist in Residence Program. http://scientistinresidence.ca/science-lesson-plans/renewable-and-non-renewable-resources/ Rock and mineral samples can be borrowed from the UBC Pacific Museum of the Earth. Reasonably priced rock kits can also be purchased from Fisher Scientific. These 50 piece kits contain numbered samples of a variety of minerals, rocks of all three types, ores of common metals and samples for conducting hardness tests. Item: Classroom collection, catalogue # S84011 Posters and handouts (many of them free of charge) can be obtained from the Geological Survey of Canada bookstore located in downtown Vancouver.

Objectives

1. Learn about the rock cycle and how sedimentary, igneous and metamorphic rocks are formed.
2. Practice describing and classifying rocks as sedimentary, metamorphic or igneous.

Background Information

Rocks can be classified into three different families: sedimentary, igneous and metamorphic. The three types of rocks are constantly being created, transformed and degraded. The linkage of these processes can be explained via the rock cycle.

The processes of weathering and erosion break down existing rocks and produce accumulations of sediments and mineral particles. If conditions are right, these sediments can become compacted and cemented together over time forming sedimentary rocks. Igneous rocks are formed when magma (melted mineral matter) from the earth's interior cools and hardens. Metamorphic rocks are formed when sedimentary or igneous rocks are subject to subsequent applications of heat and/or pressure which result in physical and chemical changes to the original rock.

Vocabulary

Weathering:	The physical or chemical destruction of rock.
Physical weathering:	The breaking down of rock into smaller pieces with no change in composition.
Chemical weathering:	The decomposition of rocks due to exposure to water or water vapor, carbon dioxide or oxygen. The rocks are changed from their original state.
Erosion:	The movement of rocks or rock particles due to natural forces (wind, water, gravity).

Minerals:	Pure, naturally occurring inorganic elements or chemical compounds. Have a well-defined chemical composition. The "building blocks" of rocks.
Rock:	Made up of one or more minerals
Sedimentary rock:	Rock formed from sediments that become compacted and cemented together over time.
Igneous rock:	Rock formed when magma from the earth's interior cools and hardens.
Metamorphic rock:	Rock formed from pre-existing rocks due to the application of intense heat and pressure.
Magma:	Hot molten rock under earth's surface.
Lava:	Magma that has been forced out onto the surface of the earth.
Intrusive igneous rock:	Formed when magma cools under the earth's surface. Usually cools slowly and results in large crystals.
Extrusive igneous rock:	Formed when magma/lava cools on the earth's surface. Usually cools quickly and results in small crystals.
Foliation lines:	Lines or cleavage planes that form in metamorphic rock due to the realignment of minerals in the parent rock (caused by heat and/or pressure).
Grain size:	Refers to the size of the particles within a rock sample.

Materials

- Rock kits (1 per group)
- magnifying glasses (if available)
- pictures/posters of local geology
- student worksheets
- pencils, pencil crayons
- pencil crayons

In the Classroom

Introductory Discussion

1. Hold up some interesting rock samples.

- Last week we learned how geologists described and tested different properties of rocks and minerals; we also practiced describing rock and mineral samples. Today we are going to use those skills to start identifying different families of rocks.
- First let's review the difference between a rock and a mineral. (Ask class for definitions)
- We know that rocks can be made up of one or more minerals, but what determines why some rocks look like this (hold up sample, e.g. obsidian) and some rocks look like this (hold up sample, e.g. granite)? Today we are going to learn how rocks like obsidian and granite form and why some rocks and minerals are found in certain places.
- Geologists classify rocks into three different families, each family or type of rock is formed in a different way. Does anyone know what the three rock families are called? (Ask class for suggestions, can write first letter of each family on the board as a hint.)
- Igneous, sedimentary and metamorphic.
- As you discuss the different families of rocks and how they are formed start drawing the rock cycle, have students draw a simple diagram along with you or have them look at the diagram in their text book (page 210 of Science Probe 7).

Rock type	Process of formation
sedimentary	Formed from sediments that become compacted and cemented together over time. (pressure)
igneous	Formed when magma from the earth's interior cools and hardens. (heat) Extrusive or intrusive. Volcanic type cools quickly, plutonic type cools slowly.
metamorphic	Formed from pre-existing rocks due to the application of intense heat and pressure.

- How is each type of rock formed? What about sedimentary, the name gives you a hint (from sediments). Draw a pile of sediments on the board. Sediments are compacted and cemented together over time and eventually solidify into a rock.
- What about igneous? Formed when magma or lava cools and solidifies. What is the difference between magma and lava? (Add to the rock cycle diagram).
- How does metamorphic rock form? The name gives you a hint. What happens when a caterpillar undergoes metamorphosis? (It changes). Metamorphic rocks are rocks that are formed when existing rocks experience additional heat and/or pressure. (Add to rock cycle diagram)
- What happens when rocks melt? (become magma) (add this set of processes to the rock cycle diagram). What about when rocks are subject to weathering and erosion?
- Now that we know how rocks are formed let's think about what each rock family might look like. Ask students for characteristics of each type of rock and list them on the board in a table. Can hold up samples to spark ideas.

Rock type	Properties	Examples
sedimentary	Layered, relatively soft, dull lustre, may contain fossils.	Coal, shale sandstone, conglomerate
igneous	Hard, no layers, metallic or shiny lustre (i.e. crystalline). Volcanic/extrusive type has holes, and small grain size; plutonic/intrusive type has no holes and larger grain size.	Obsidian, basalt, pumice granite, diorite, gabbro (plutonic)
metamorphic	Foliation – wavy or irregular layers or flat cleavage planes; larger crystal size or formation of new crystal types, folding *hardest to identify	Quartzite (sandstone), shale (slate), gneiss (granite), marble (limestone)

- Have students look at examples to help create the list of characteristics.
- Have students sort the rocks on their table into the three rock families. Walk around and discuss their decisions.
- Have students select a rock sample to use for the *What Rock Family is it?* activity.

2. Short description of other items to discuss or review.

- Remind students how scientific pictures can differ from regular pictures in both appearance and purpose. Scientific pictures/observations need to be detailed, clear and precise. Encourage them to use labels to help describe their diagrams.

3. Briefly describe science experiment/activity.

- Students will work as a group to sort their rock samples into the three rock families (some groups may also make a pile of “unknowns”, these can be discussed as a group with the scientist or as a class.
- Students will then work individually to describe and classify up to three rock samples of their choice (scientist can guide them towards appropriate choices).

4. Briefly describe the processes of science that the students will focus on: Students will focus on making and recording observations. They will then use these observations assign a rock family to each of their rock samples.
5. Briefly describe safety guidelines.

- Do not touch your face or mouth while handling the rock specimens. Wash your hands with soap at the conclusion of the experiment and especially before eating.

Science Activity/Experiment

Activity Title: What type of rock is it?

Purpose of Activity: To describe and characterize rocks as sedimentary, igneous or metamorphic.

Methods and Instructions:
Set-up prior to experiment: Rock and mineral samples can be borrowed from the Pacific Museum of the Earth at the University of British Columbia. The website lists the pre-made rock kits available for borrowing. http://www.eos.ubc.ca/resources/museum/index.html Alternatively, rock kits can be purchased from a scientific supply company (see notes at top of lesson plan).

Brief description of how students will work in groups or pairs: Students will work in groups of 4-6 (depending on class size and the number of rock kits available). Students will record their observations individually on worksheets.

1. The rock kits used for this lesson were purchased from Fisher Scientific (# S84011; ~$45 each).
2. See worksheet for detailed instructions.

Closure Discussion

3. Discuss worksheet answers as a group.
4. Discuss any samples that students had difficulty with?
5. Discuss/review characteristics of the three rock families and help determine which properties can be used to help identify rocks that have properties common to two different families. For example, layering can be seen in both sedimentary (shale) and metamorphic rocks (slate), how can we tell the difference? Have students use observations of the two samples to deduce that metamorphic rocks are usually much harder than sedimentary rocks.

References

1. Zim, Herbert and Paul Shaffer. 1957. Rocks and Minerals: A Guide to Familiar Minerals, Gems, Ores and Rocks. Golden Press.
2. Chapman, Anita, David Barnum, Carmen Dawkins and William Shaw. 2005. BC Science Probe 7. Nelson.

3. Van der Flier-Keller, Eileen. 2006. A Field Guide to the Identification of Pebbles. Harbour Publishing. [available from the Geological Survey of Canada or available to order online from Chapters/Indigo.]

Extension of Lesson Plan

1. Students can use the pebble identification pamphlets as well as their new-found knowledge to classify the rock samples they have collected.
2. Sedimentary rock making (using colored sand, and an Epsom salt solution).
3. Fossil making (using clay, sea shells and plaster of Paris).

Making sandstone (sedimentary rock)

1. Prepare an Epsom salt solution in advance (1 part Epsom salts, 2 parts water).
2. Have students create a piece of sandstone by layering colored sand (or different types of sand) in small paper cups.
3. Once they are done creating their “rocks” slowly pour the Epsom salt solution into each cup until all of the sand is well moistened.
4. Leave the cups of sand to dry for several days. They must be COMPLETELY dry. It is recommended that the teacher/scientist make several test cups of sandstone. These can be checked first which will avoid any of the students’ creations being ruined if the cups are removed too soon.
5. Once the cups of sand are completely dry have each student carefully peel away their paper cups to reveal their piece of sandstone.

Fossil making

1. Have the students cover the bottom of a small paper cup (or similar disposable item such as a small pie plate) with clay (Plastercine or damp sand can also be used).
2. Have the students can use seashells or other small objects to make imprints in the clay and then carefully fill the imprints with plaster of Paris.
3. Leave the plaster to harden for several days.
4. Have students peel away the paper cups to reveal their fossils.

Mohs Hardness Scale

Sample #	Mineral name	Hardness	Place sample here
19	Talc	**1**	
45	Gypsum	**2**	
6	Calcite	**3**	
44	Fluorite	**4**	
30	Triphyllite	**5**	
n/a	Nail/paperclip		
1	Microcline	**6**	
7	Quartz	**7**	
42	Beryl	**8**	
50	Corundum	**9**	
n/a	Diamond	**10**	

SOFT

HARD

SCIENTIST IN RESIDENCE PROGRAM

Scientist: _____

Date: _____

THE ROCK CYCLE

Draw a picture of the rock cycle.

Some labels to use: sediment, sedimentary rock, igneous rock, magma, lava, metamorphic rock, solidifies, melts, heat, pressure

WHAT ROCK FAMILY IS IT?

Describe and draw a picture of each of your chosen samples. Use the questions and your observations to help you determine what type of rock it is.

Record the sample number: _____

What colour(s) is it? _____

Does it have layers or any other pattern? _____

Look at the lustre, is it dull or is it shiny? _____

Can you see crystals in it? If so describe them (size, colour):

_____

Does it have any foliation lines or look like it has been folded?

_____

What other features does your rock have that you can describe?

_____

_____

Draw a detailed picture of your sample in the box below.

My sample is in the _____ rock family.

Record the sample number: _____

What colour(s) is it? _____

Does it have layers or any other pattern? _____

Look at the lustre, is it dull or is it shiny? _____

Can you see crystals in it? If so describe them (size, colour):

_____

Does it have any foliation lines or look like it has been folded?

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What other features does your rock have that you can describe?

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Draw a detailed picture of your sample in the box below.

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