**Science Unit:** ***Renewable & Non-renewable Resources***

**Lesson 3:** ***Mining in BC***

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| School Year: | 2009/20010 |
| Developed for: | Dr. R. E. McKechnie Elementary School, Vancouver School District |
| Developed by: | Linda Hanson (scientist); Judi Burley and Theresa Lopetrone (teachers) |
| Grade level: | Presented to grade 4/5; appropriate for grades 3-7 with age appropriate modifications |
| Duration of lesson: | 1 hour and 20 minutes |
| Notes: | 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. |
| | Posters and mining handouts can be obtained from the Geological Survey of Canada bookstore in Vancouver. |

**Objectives**

1. Discover what rocks and minerals are mined in British Columbia.
2. Learn how sedimentary, igneous and metamorphic rocks are formed.
3. Practice describing and classifying rocks as sedimentary, metamorphic or igneous.

**Background Information**

Due to its position in the Canadian Cordillera British Columbia is rich in metal, mineral and coal deposits. Mining product are valued at close to $7 billion annually, with approximately $3 billion of that total coming exclusively from coal. Other major mining products in B.C. are copper, zinc, aluminum and construction aggregates (rocks such as limestone, shale, granite, etc.). Mining is only profitable in regions containing large concentrations of the desired rock or mineral. Geological processes help dictate where particular rocks and minerals are located. For example, diamonds are almost always found in deposits of kimberlite rock. By understanding how particular types of rock are formed geologists can help predict where mining companies should focus their exploration efforts.

Rocks fall into three different types: sedimentary, igneous and metamorphic. Sedimentary rocks are formed when sediments and mineral particles accumulate and become compacted and cemented together over time. Igneous rocks are formed when magma (melted mineral matter) from the earth's interior rises towards the surface, 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. The three types of rocks are constantly being created, transformed and degraded. The linkage of these processes can be explained via the rock cycle.

**Vocabulary**

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| Mineral: | Naturally formed inorganic elements or chemical compounds. Has a well defined chemical composition. |
| Rock: | Made up of one or more minerals. |
| Sedimentary rock: | Rock formed from sediments that become compacted and cemented together over time. |

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|---|---|
| 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. |
| Grain size: | Refers to the size of the particles within a rock sample. |
| Ore: | Rock possessing a high enough mineral content to make mining economically worthwhile. |
| Luster: | How shiny a rock/mineral sample is. |

**Materials**

- Standard rock kit #2 (from PME). One for each group. (or similar)
- Standard rock kit #1 (from PME). One kit for showing examples of rocks/minerals mined in BC.
- Additional samples of minerals mined in BC as available (gold, silver, zinc, lead, aluminum etc.)
- Kimberlite sample (if available)
- Pictures/posters of minerals/rocks mined in BC
- Student worksheets

## In the Classroom

**Introductory Discussion**

1. Hook: Why don't we have diamond mines in BC? Why are certain rocks and minerals only found in particular places? Have students suggest ideas.

- How do geologists and mining companies predict if an area will be a good location for a mine? Sometimes the rocks there give them clues. For example, diamonds are almost always found in deposits of kimberlite rock (show example if available). Other minerals like copper are also found in certain types of rocks (e.g. chalcopyrite, chcocite). In addition, some rocks like quartz are valuable as well. Quartz contains silica which is used to make glass.

- Today we are going to learn how rocks like quartz form and why some rocks and minerals are found in certain places. First let's talk about the difference between a rock and a mineral. (Define)

2. Now let's look at some of the rocks and minerals mined in BC. Have a list of rocks and minerals mined in BC and as many examples as possible for students to examine. If samples are not available have a poster/chart/list with pictures.

- Rocks: shale, sandstone, basalt, limestone, gypsum, limestone, pumice, shale, silica, gabbro, granite, gneiss, marble, graphite

- Metals & Minerals: copper, zinc, lead, molybdenum, silver, gold, gypsum, magnetite, barite, aluminum, jade, clay, opal,

- Other: coal, clay, sulphur, graphite

Show a map of mine locations in BC (available online or from Natural Resources Canada).

- As you can see different materials are found in different locations. As I mentioned earlier we are going to learn a little bit about that today.

3. In order to do that first we need to know how rocks are formed. There are three main types of rocks. Each is formed in a different way. Write the first letter of each on the board as a hint and ask for suggestions.

- Define/describe each of the three processes. Have a picture of the rock cycle or draw one on the board. Have students look at examples to help create the list of characteristics.

| Rock type | Process of formation | examples | properties |
|---|---|---|---|
| sedimentary | Formed from sediments that become compacted and cemented together over time. (pressure) | Coal, shale sandstone, conglomerate | Layered, relatively soft, dull (not crystalline), may contain fossils. |
| igneous | Formed when magma from the earth's interior cools and hardens. (heat) Volcanic type cools quickly, plutonic type cools slowly. | Obsidian, basalt, pumice<br><br>granite, diorite, gabbro (plutonic) | Hard, no layers, crystalline (i.e. metallic or shiny looking). Volcanic type has holes, and small grain size; plutonic type has no holes and larger grain size |
| metamorphic | Formed from pre-existing rocks due to the application of intense heat and pressure. | Quartzite (sandstone), shale (slate), gneiss (granite), marble (limestone) | Foliation – wavy or irregular layers or flat cleavage planes; larger crystal size or formation of new crystal types, folding *hardest to identify |

- Write characteristics of each on the board or flip chart to help students with the activity.
- Go through one example with students once they are back at their desks and have their worksheets (have them fill out the worksheet and examine the same sample you have).

4. Students will describe and classify rock samples as sedimentary, igneous or metamorphic.

- Each group of students will receive a set of samples to describe and identify
- Observations will be recorded individually on worksheets

5. Briefly describe the processes of science that the students will focus on: Students will focus on making and recording observations.
6. Briefly describe safety guidelines.

- The rock samples have been borrowed from the museum at UBC and we must return them. We need to treat them carefully and with respect. No hitting, breaking, smashing etc. Don't forget to return them to the trays when you are finished. We do not want to lose any samples as some of them are expensive to replace. Do not throw or drop the rock samples.
- Do not touch your face or mouth while you are handling the rock samples. 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

Students will work in groups of 4-6 (depending on class size and the number of rock kits available). Students will individually record their answers on worksheets.

1. See detailed instructions on the attached worksheet.

2. The rock kits used for this lesson were “Standard rock kit #2” borrowed from the Pacific Museum of the Earth at the University of British Columbia. Similar rock kits can be purchased from my educational suppliers including Fisher Scientific.

**Closure Discussion**

1. Discuss worksheet answers as a group. Give students time to compare in their groups first and then ask for hands up.
2. Why is mining important? What do we need it for? Have students brainstorm objects that are made of mined materials or depend on them (e.g. need nails and screws for construction).
3. What alternative materials exist? What items can/cannot be replaced with renewable resources?
4. Discuss the potential to recycle mined materials? What about those used in small quantities (e.g. in electronics)? Discuss the environmental and economic implications of recycling.
5. Introduce the environmental implications of the extraction process if time allows. This will be the focus of lesson 6.

**References**

1. Kesler, Stephen E. 1994. Mineral Resources, Economics and the Environment. MacMillan College Publishing.
2. Skinner, Brian J., Stephen C. Porter and Daniel B. Botkin. 1999. The Blue Planet: An Introduction to Earth System Science. 2nd Edition. John Wiley and Sons, Inc.
3. Strahler, Alan and Arthur Strahler. 2005. Physical Geography. 3rd Edition. John Wiley and Sons, Inc.
4. <www.bcminerals.ca> Mineral Resource Education Program of British Columbia. Accessed February 27, 2010.
5. DeGrace, John, Jay Fredericks, David Grieve, David Lefebure, Bruce Madu, Bruce Northcote and Paul Wojdak. British Columbia Mining and Mineral Exploration Overview 2008. Ministry of Energy, Mines and Petroleum Resources. Government of British Columbia. Available from: <http://www.empr.gov.bc.ca/MINING/GEOSCIENCE/PUBLICATIONSCATALOGUE/EXPLORATIONINBC/Pages/2008.aspx>.

Pamphlets/handouts available from the Geological Survey of Canada include:

1. Metals From Beneath the Crust
2. Cutting Edge (poster highlighting mining products used at the Olympics)
3. From Northern Lights to Urban Trails (Poster showing the mining products used in snowmobile production. Good pictures of the various products)
4. A Field Guide to the Identification of Pebbles (will help students classify common pebbles as sedimentary, igneous or metamorphic)

**Extension of Lesson Plan**

1. Making clay/plasticine igneous and metamorphic rocks.
2. Sedimentary rock making (using colored sand, water and white glue)
3. Fossil making

Scientist: _____

Date: _____

**What type of rock is it?**

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

**ROCK A**

What colour is it? _____

Does it have layers? (yes or no) _____

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.

**What type of rock is it?** _____

**ROCK B**

What colour is it? _____

Does it have layers? (yes or no) _____

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.

**What type of rock is it?** _____

**ROCK C**

What colour is it? _____

Does it have layers? (yes or no) _____

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.

**What type of rock is it?** _____