Exploring Rocks and Minerals

# Lesson Plan

## Description

Students will learn about the role of geologists in the exploration phase of mining and learn how to identify rocks and minerals.

## Learning Outcomes

- Associate careers with the exploration and extraction of rocks and minerals
- Use tools to identify rocks and minerals
- Understand the importance of rocks and minerals to everyday life
- Identify positive and negative impacts of mining on society, the economy, and the environment

## Introduction

Rocks and minerals are all around us, but what are they? **Minerals** are inorganic substances, meaning they do not come from plants and animals. They are found on the Earth's surface and deep underground. A common mineral is salt. **Rocks** are formed when 2 or more different types of minerals stick together forming a single solid mass.

Minerals have many different uses, but often reside far underground. To extract these minerals, we need to mine them. Remember, if something isn't grown, it's mined! But how do we find where these minerals are underground?! We have to EXPLORE!

Before we can explore an area, there are several steps mining companies must take. Every company needs to earn the approval of the community before exploration and mining can begin. This is called the "Social License to Operate". Companies will often accomplish this with open and honest conversation, community engagement, donations/volunteering, job creation, and participation in community events.

Community groups can include:

- Cottager associations
- Environmental societies (conservation areas, parks, hunting and fishing, etc.)
- Residents of nearby towns and cities
- First Nation communities

Mining companies have a legal obligation to consult and accommodate Indigenous groups that have jurisdiction over the land they want to develop. Relationship agreements (e.g., impact benefit agreements or collaboration agreements) between companies and Indigenous communities have become a common practice in Canada. These legally binding agreements can set out the terms for how a company and community will work together and establish a framework for cooperation and collaboration. Agreements go beyond financial payments to compensate for potential adverse impacts and have become a means to facilitate Indigenous participation in the mining sector.

Part of the "Social License to Operate" includes environmental concerns. Learn more about environmental responsibility in mining in the "Green Mining" lesson plan associated with these modules.

With the approval of the community, and environmental policies and permitting, exploration can begin. The **Exploration** Phase is the first phase of mining. This is where a property is explored extensively, using various techniques, to see if there is mineable material present and estimate how much is there. The exploration phase is innovative, sophisticated, and uses advanced technologies. **Geologists** are very important in the exploration phase are mining. A geologist is a type of scientist who studies the Earth's land and materials. They use **surveys** to look for mineral deposits (ore bodies).

There are several steps to the survey process:

**Geophysical surveys:** Geophysics uses technology to see into the ground and is important for identifying mineral and metal deposits. This can include ground penetrating radar, magnetic & gravity surveys, seismic, and others.

**Mapping:** Geologists will walk the exploration property looking at exposed rock outcrops. They use both a GPS and manual drawing to map significant features. They identify and describe the rocks, marking or inferring contacts (where one type of rock touches another rock type) between rock types as applicable. These hand-drawn maps are usually digitized back in the office using a GIS program (ex. ArcGIS by ESRI).

**Sampling:** Rock and soil samples are collected and sent to the lab for assay analysis.

**Assays:** When samples are sent for assay, they go to a lab to be processed. The results returned show the percentages of different elements present in the sample.

**Drilling:** When areas of interest have been identified using the above methods, exploration drilling will occur. Drill rigs are often flown in, in pieces, via helicopter, and assembled on site in remote areas. Drills will target these areas and remove core (tubes of rock) from the ground.

This core is then logged by geologists. Logging involves defining the attributes of the rock (lithology (rock type), color, texture, minerals, fractures, grain size, etc.) and estimating content of mineable minerals. The core is also sampled and sent to be assayed.

**3D Modelling:** Also called resource modelling, geologists will use the information from the geophysical surveys, surface sampling, assays, and drill core to estimate the size and shape of the deposit (or ore body). Often creating computer 3D visual models of the ore body itself. For reference, popular 3D modelling software used by both geologists and engineers include Vulcan, AutoCAD, and Datamine.

**Final Survey Results:** All of the above information is combined to help optimize the mine design. The best design will extract the most ore (mineable material) with the least amount of waste and cost. At a basic level, this helps to determine whether an underground or open pit operation will be best.

## Action

**Part 1**

Introduce students to rocks and minerals and the exploration phase using the PowerPoint provided.

**Part 2**

Next, tell the students that they will be geologists today. Several minerals have been found from drilling and we need to know what they are.

If they are available to you, you can use any of the minerals found of the identification chart (bauxite, calcite, chalcopyrite, fluorite, gypsum, hematite, magnetite, microline (feldspar), muscovite (mica), pyrite, quartz, talc). Alternatively, students can also find minerals before the lesson from home and around the school (examples: drywall pieces, metal pipes (copper, aluminum, steel, etc.), clay pot pieces, pieces of gravel, any ornamental rocks that may be available from the yard or even a nearby outdoor space, pencil led (graphite), cutlery).

Materials

- Assortment of minerals
- Fingernail
- Copper (penny)
- Iron nail
- Scratch (glass) plate
- White or black ceramic streak plates

- Magnet
- Squeeze bottle with vinegar
- Mineral Identification Handout
- Mineral Identification Key
- Moh's hardness scale

Procedure

1. Run the various tests on each mineral as listed on the Mineral Identification Handout.
   - Record the colour of the mineral.
   - Record the luster of the mineral. Is it metallic or non-metallic (i.e. does it reflect light)?
   - Rub the mineral on the streak plate. Record what colour the line is.
   - Test the hardness of the mineral by scraping it with various materials. Start with your fingernail, then progress to the copper, iron nail, glass plate, and lastly the streak plate. Stop with the material that scratches the mineral. Compare the material with Moh's hardness scale and record the corresponding value.
   - Does the mineral have cleavage (yes or no)? Cleavage is the ability of a mineral to break. Look for flat surfaces, straight edges, and flat corners indicating breakage.
   - Use the magnet to test if the mineral is magnetic and record your results.
   - Test for effervescence by placing a few drops of vinegar (an acid) on the mineral. Are bubbles produced? If so, the mineral is effervescent.
2. Record the results in the table.
3. Use the Mineral Identification Key to identify the minerals and record the names in the table.

**Part 3**

Discuss with the class why minerals are important. Have the students list some of the things that minerals are used for in everyday life.

Examples:
Fluorite – toothpaste
Graphite – pencils
Lithium – batteries
Halite – salt
Nickel – stainless steel
Hematite – Indigenous peoples mixed with water to make paint
Turquoise – beads and pendants, symbol of protection for some Indigenous peoples

To make a smartphone:

- Copper

- Aluminum
- Iron
- Palladium
- Silver
- Gold
- Colbalt
- Tantalum
- Tin
- Gallium
- Indium

Remember, if it's not grown it's mined!

**Part 4**

Students will play the Mine Evolution digital game and see mining in action while competing to mine the most ore. Scores for each student can be collected on the scoresheet.

Materials:

- A laptop or tablet

Procedure:

- Each student will need a device (laptop, tablet, or mobile phone).
- Each student will need to go to www.mineevolution.ca on their device. Click "Get the Game". Students can download either the Google Play (Android devices and Chromebooks), App Store (Apple devices), or PC versions of the game depending on what type of device they are using.
- Once the game is downloaded, select "Challenges".
- Select "Mine Race" and begin playing! The tutorial will show students how to play. There is also a tutorial video and a "How to Play" document with tips and tricks on the Science North educator resources website (https://schools.sciencenorth.ca/educator-resources)

## Consolidation/Extension

Have a discussion with the class.

Impacts of mining

What are some positive impacts of mining? What are some negative impacts of mining? How does mining positively or negatively impact different groups (environment, society, industry, government, Indigenous)? Think specifically about the exploration phase and choosing where to put a mine site.

Careers

What role does a geologist play in the exploration phase of mining? What other careers are there in the exploration phase?

## Accommodations/Modifications

The mineral identification activity can be modified depending on availability of materials.

## Assessment

Teachers can monitor the student work as Assessment *for* Learning. Gather information from the students throughout the activity to gauge their level of understanding.

The handout can be collected and used as an Assessment *of* Learning if you wish to evaluate your students in a summative manner.

## Additional Resources

Indigenous Affairs - The Mining Association of Canada
How TSM Works - The Mining Association of Canada