ACTIVITY 1

WHAT CRITERIA CAN BE USED TO CLASSIFY ROCKS AND MINERALS?

EXPERIMENT OBJECTIVES AND CONTENT

This activity teaches students to tell the difference between rocks and minerals. They will discover certain criteria used to classify them, learn about how they form, and understand the ways they are important in everyday life.

ESSENTIAL KNOWLEDGE

MATERIAL WORLD

Matter:

- Properties and characteristics of matter in different states (solid, liquid, gas): other physical properties
- Changes in matter: chemical changes

EARTH AND SPACE

Matter:

- Properties and characteristics of the matter on Earth: classification of rocks and minerals

Techniques and instrumentation:

- Use of simple measuring instruments
- Use of simple observational instruments

Appropriate language:

- Terminology related to an understanding of the Earth and the universe
- Drawing, sketches

SUGGESTED MATERIALS

Scientific equipment:

- Magnifying glasses
- Binoculars
- Rocks and minerals samples
- Eye-droppers
- White streak plate or ceramic plate
- Compass
- Mineral hardness test kit

Household materials:

- Magnets
- Nails
- Pennies
- Glass
- Copper wire
- Vinegar

CONTEXT: SITUATIONAL PROBLEM OR RESEARCH QUESTION

One day, while walking in a park, you find a stone encrusted with small colored bits and decide to keep it for the centerpiece of your rock collection. Back at home, you decide to subject it to some tests to find out what kind of stone it is. The first thing to do is figure out if your find is a rock or a mineral. How will you go about unmasking the identity of your mysterious stone?

SUGGESTED PREPARATORY ACTIVITIES (INTRODUCTION)

The teacher leads a discussion with the students on what distinguishes rocks from minerals. The students then do some brief preliminary research to draw up a list of characteristics used to classify minerals. In order to have some specimens of rocks and minerals on hand to classify, the students bring different and varied looking rocks to class, and the teacher provides several samples of minerals.

INITIAL IDEAS AND HYPOTHESES

Here are a few examples of hypotheses the students might formulate based on their initial ideas:

Example 1
I predict that rocks and minerals can be classified according to their appearance, shape and color. I believe this because all diamonds are clear, while all stones are grey.

Example 2
I predict that minerals can be classified according to physical characteristics. I believe this because I know that certain minerals are attracted by a magnet, while others are not.

Example 3
I predict that rocks can be classified by how they are formed. I believe this because I know that rocks are not all formed the same way. I saw in a movie once that some are formed in volcanoes.

Example 4
I predict that rocks can be classified by their hardness. I believe this because I noticed that I can write on some rocks using another rock.

WORK PLAN AND EXPERIMENTATION

Here are a few examples of experiments the students can carry out to verify their hypotheses:

Example A
Students examine samples of minerals with the naked eye or with a magnifying glass. They try to classify them according to one or two visual criteria (color, color of streak, cleavage, luster, transparency). They can illustrate their results by drawing a Venn diagram, a graph or a table.

Note: A single mineral can have different colors (e.g., quartz can be pink, white, purple, etc.). The color left by the mineral on the streak plate is thus a reliable classification criterion, since the color of the streak will always be the same, regardless of the external color of the mineral.

RECORD ALL YOUR IDEAS AND OBSERVATIONS IN YOUR EXPERIMENT WORKBOOK.

Example B
Students evaluate certain physical characteristics, for example by testing a rock's attraction to a magnet.

Note: It is possible to evaluate certain chemical characteristics of the samples. For example, if a rock contains carbonates, it will bubble if a few drops of vinegar are placed on its surface. This indicates that the sample contains calcareous rock. The composition of rocks and minerals can also be examined with a magnet. If the sample is attracted by a magnet, it contains iron.

Example C
Students classify rocks according to how they were formed. They try to classify them according to one or two visual characteristics (color, presence of minerals, size of crystals, porosity, grain size, presence of fossils, texture, foliation or foliated appearance), using a magnifying glass or a stereoscopic microscope.

Example D
Students assess minerals' hardness in order to use this criterion as a classification factor. Many objects can be used to scratch minerals (fingernails, pocket knife, pennies, copper wire, glass, diamond). Students then compare their results to a real hardness chart.

EXPERIMENTAL FACTORS
To ensure scientific rigor, the students should evaluate the experimental factors that might influence the experimental results.

- Concentration of vinegar (chemical reaction)
- Consistency of pressure applied (hardness)
- Freshness of fracture in rocks (color, reactivity)
- Composition of rock
- Wear of samples
- Cleanliness of rock

DISCUSSION: SUGGESTED INTEGRATION ACTIVITIES (CONSOLIDATION)

The teacher compiles the experimental results with the students and has them design a poster that illustrates a summary of their experiment. The students then make up questions for a quiz game on the topic.

SUGGESTED ACTIVITIES FOR APPLYING KNOWLEDGE (APPLICATION)

Students interview someone working in a field related to rocks and minerals (geologist, mining engineer, geological engineer). They also research the importance of rocks and minerals by examining the news. For example, precious stones that are a source of conflict and war. To supplement the activity, the teacher could decide to go on a fieldtrip.

SCIENTIFIC CONCEPTUAL CONTENT

Rocks

A rock is an aggregate of minerals. Each type of rock is made up of the same minerals, but their concentration may vary. For example, granite is composed primarily of quartz, feldspar and mica, but their proportion may vary from one type of granite to the next. These differences are what create the different varieties within groups of rock, such as pink granite and white granite.

Minerals

Minerals are solids with specific chemical compositions and unique properties (e.g., iron, gold, silver, copper, platinum, bronze, sulfur, diamonds, graphite, pyrite, magnetite, halite, calcite, gypsum, mica, quartz, feldspar, etc.). Minerals are what rocks are made of.

Rocks classification

Rocks are classified according to how they are formed. They can be igneous, sedimentary or metamorphic. Igneous rocks are hard rocks possessing variably colored crystals. There are two types of igneous rocks: intrusive igneous rocks, which are formed from magma that slowly cools within the Earth's crust (e.g., granite), and extrusive igneous rocks, which are formed from magma that cools rapidly as it leaves the Earth's crust (porous volcanic rocks).

Sedimentary rocks are formed by the accumulation of different sized sediments. This usually occurs at the bottom of bodies of water. Most of these rocks are made up of many layers, or strata, that are often invisible to the naked eye. They sometimes also contain fossils.

Metamorphic rocks are igneous or sedimentary rocks that have been transformed by intense pressure or extreme heat. Their appearance varies greatly, ranging from glass-like to a laminate-like texture.

Properties of minerals

Minerals are identified by their properties. Key mineral properties are hardness, specific gravity, color, streak, transparency, luster, cleavage, and fracture. Some minerals, such as magnetite, which is a natural magnet, have special properties.

Hardness

Mineral hardness is determined on a scale of 1 to 10 called the Mohs scale. Minerals with a hardness of one or two can be scratched with a fingernail. A coin can scratch minerals with a hardness of three, and a nail can scratch those with a hardness of four. A penknife blade and a stainless steel knife can scratch minerals with a hardness of five and six respectively. Minerals with a hardness of seven or higher can scratch glass. Diamonds have a hardness of ten and can only be scratched by other diamonds.

Cleavage

Cleavage describes how a mineral may split, after a shock, along various planes inherent to the mineral's structure.

Luster

Luster is the appearance of the mineral's surface as it reflects light. For example, one may observe a metallic luster or a non-metallic luster.

CULTURAL REFERENCES

History

Rocks and minerals are everywhere and have been used by humans since time immemorial. The first humans used stone tools such as flint spear points and arrowheads.

Mineral resources

Quebec is rich in minerals: limestone (chalk, lime and cement), sand (cement), clay (bricks), quartz (silicon used in computer chips), copper (plumbing pipes and electrical wires), asbestos (insulation pads), graphite (pencils), nickel (coins), and halite (de-icing salts). As previously mentioned, such minerals are used the world over to make both everyday and specialized items essential to our modern way of life.

FOR MORE CULTURAL REFERENCES, VISIT THE ÉCLAIRS DE SCIENCES WEBSITE:

www.eclairsdesciences.qc.ca

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PROCESS OF ACTIVE DISCOVERY

GENERAL LEARNING PROCESS IN SCIENCE AND TECHNOLOGY (IN ELEMENTARY SCHOOL)

Context related to everyday life

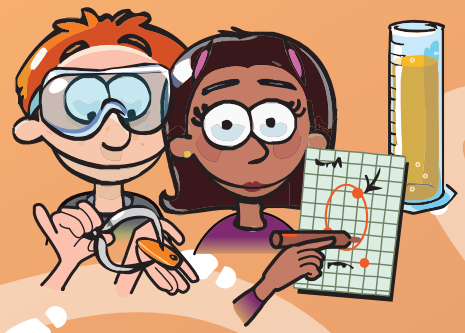
- **Situation problem** or
- **Discovery question** or
- **Need to be fulfilled**
- **Question related to the operation of an object** (how does it work?)

Initial ideas and hypothesis

My initial ideas:
- I share my own ideas.

My hypothesis:
- I predict that... I think that because…
- I imagine my prototype.
- I think it works like this…

Planning and carrying out



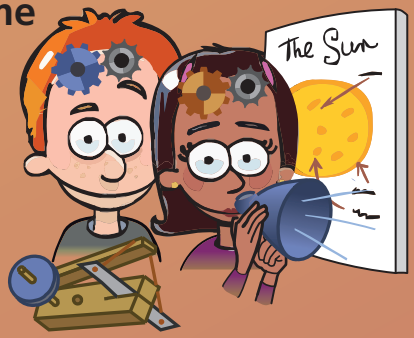
My equipment:
- I observe and handle the equipment.
- How could this equipment be useful to me?
- I choose my equipment and my materials.

Carrying out my process:
- What will the steps be?
- What precautions should I take?

My actions:
- I carry out the steps of my protocol.
- I note or draw what I observe, what I do and what I discover.

My results:
- What is my answer to the problem, question or need?

Outcome



My outcome:
- Do my results confirm my hypothesis or not?
- Are my results similar to those of the other teams?
- Can the other teams' results help me to find answers to my problem, my question or my initial need?
- What could I communicate concerning my discoveries?

New question?

What I learned:
- What do I retain from this activity?
- What could I communicate concerning my results or my discoveries?

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