From Earth to Sky

A Teacher's Guide to Regina's GEOrock Garden

The GEOrock Garden at Campbell Collegiate, Regina

Supported by: Canadian Geological Foundation
and
Saskatchewan Geological Society

April, 2004

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Contents

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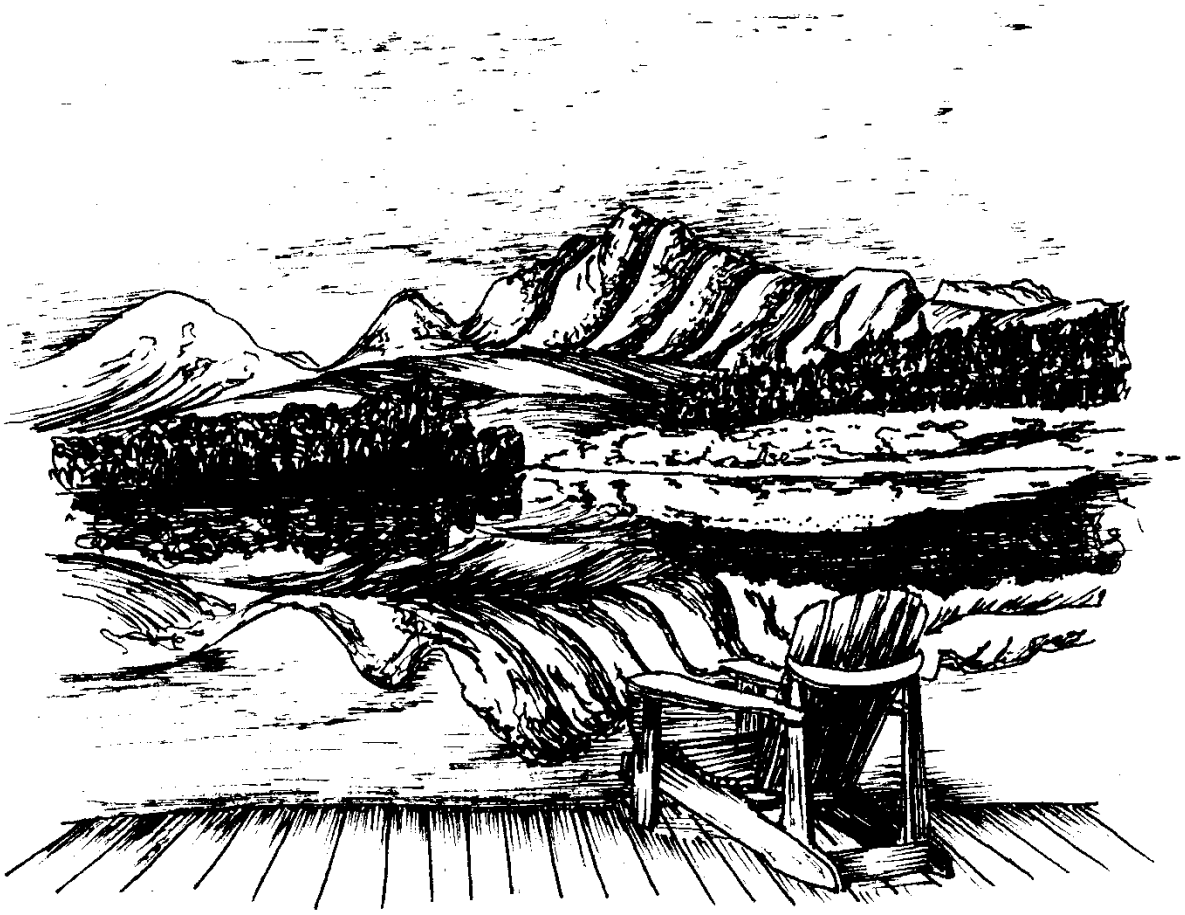
Introduction



Overview of This Booklet

Background

Saskatchewan's first GEOrock Garden is located in the front courtyard of Campbell Collegiate at 102 Massey Road, Regina. The GEOrock Garden consists of 32 rocks of various sizes and composition. It is specifically designed to be used by students and teachers to learn more about geology and other aspects of the natural world.

Purpose of This Booklet

This teacher's guide presents ideas for activities related to the GEOrock Garden. The activities are multidisciplinary. Some focus on the rocks themselves – on their origins and composition, on the role they play in the natural world. Some activities show how the rocks can be used as a stimulus for creative work such as writing. Still other activities illustrate the ways in which people have used rocks as building materials or for symbolic purposes.

Although the activities in this booklet were developed with Regina's GEOrock Garden in mind, most can be done in any school. Use a rocky field, a farmer's rock pile, or a gardener's rock garden as a substitute for the GEOrock Garden.

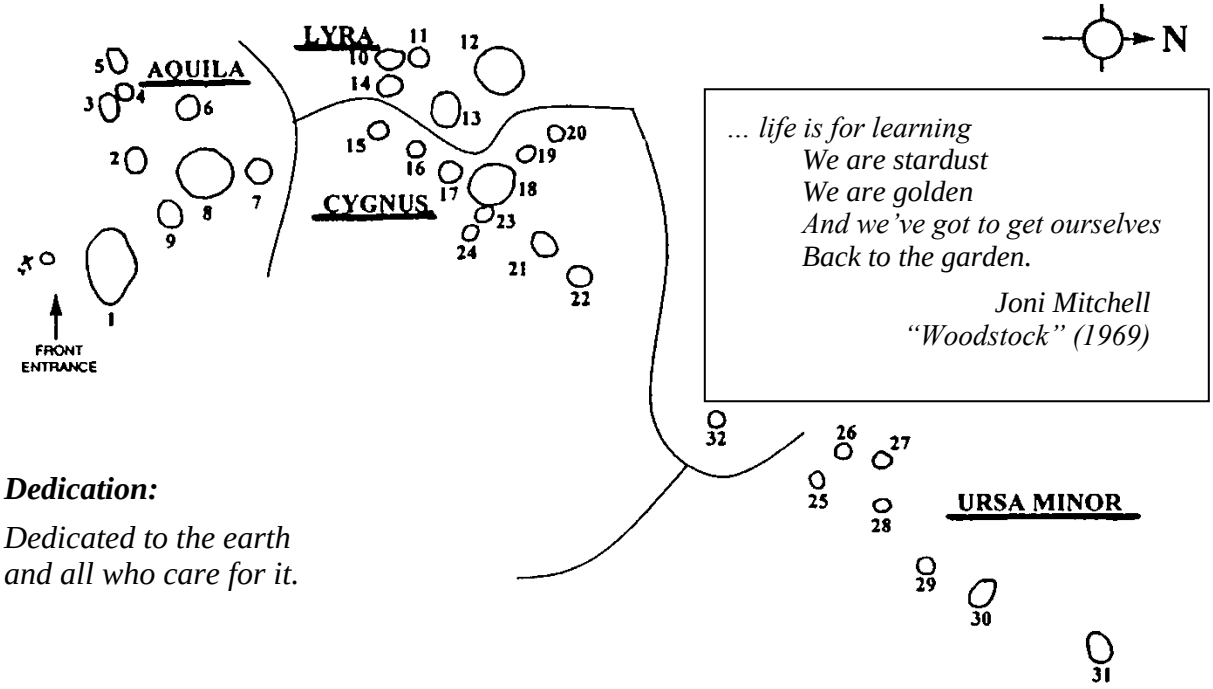
The activities and student worksheets in this booklet were designed for students from Grades 4 to 8. However, most activities can be adapted so they are suitable for younger or older students.

Organization of This Booklet

This booklet is organized into three sections:

- **Preliminary Activities** – These activities can be done in the classroom before a visit to the GEOrock Garden. They are designed to teach students about the composition and formation of rocks. Students will need some preliminary classroom preparation in order to get maximum benefit from their visit to the GEOrock Garden.
- **On-Site Activities** – These are activities that can be done at the GEOrock Garden. Select the ones that are appropriate for your class. More activities are provided than can be completed in a single visit to the GEOrock Garden.
- **Follow-Up Activities** – These activities can be done after the visit to the GEOrock Garden. They will enrich and enhance students' appreciation of rocks.

Regina's GEOrock Garden at Campbell Collegiate



... life is for learning
We are stardust
We are golden
And we've got to get ourselves
Back to the garden.

Joni Mitchell
"Woodstock" (1969)

Dedication:

Dedicated to the earth
and all who care for it.

A Guide to the Rocks:

Aquila

1. Metamorphosed conglomerate
2. Cross-Bedded Sandstone
3. Pillowed metabasalt
4. Microgranite
5. Veined amphibolite
6. Pegmatite
7. Amphibole gneiss
8. Stromatolitic dolostone [Altair]
9. Layered metagabbro

Lyra

10. Coral dolostone
11. Foliated granite
12. Migmatitic gneiss [Vega]
13. Metavolcanic breccia
14. Felsic gneiss

Cygnus

15. Burrowed dolostone
16. Burrowed dolostone
17. Diorite
18. Burrowed dolostone [Sadr]
19. Ptygmatic gneiss
20. Metabasalt
21. Pyritic quartzite
22. Fossilferous dolostone [Deneb]
23. Diabase
24. Garnetiferous gneiss

Ursa Minor

25. Feldspar porphyry
26. Xenolithic granite
27. Pegmatic gneiss
28. Veined metagabbro
29. Porphyritic diabase
30. Folded gneiss
31. Xenolithic granite [Polaris]

Rogue

32. Metagabbro

The story of most of the boulders in the GEOrock Garden began more than one-and-a-half billion years ago when they originated as molten rock deep in the earth or as sediments eroded from mountain ranges and deposited in rivers and oceans. Buried thousands of metres deep, many of these rocks were changed by heat and pressure (metamorphosed) and by the flow of fluids through them. Other rocks (the dolostones) are only about 400 million years old and were formed from limey deposits in tropical seas wherein life forms, now seen as fossils, abounded. Uplift and erosion left the rocks exposed to plucking by glaciers that moved across the land from northern Saskatchewan and Manitoba as recently as 20,000 years ago. Large chunks of rock held in the glaciers were shaped by the pressure and movement of ice and water.

Eventually, these rocks came to rest at the site of the Dome Construction aggregate quarry east of Moose Jaw.

As part of the quarry operation, all large boulders were placed together for eventual crushing. This artificial boulder field was a useful teaching tool because it included a wide variety of rock types. However, it was too dangerous for students to visit because of quarrying operations.

Therefore, the most interesting rocks were moved to Regina. The move took place in August 1998. It involved a crane and its operators, three flatbed trucks and their drivers, several teachers, a geologist and an artist. The actual move took about 14 hours.

The boulders were placed in the front courtyard of Campbell Collegiate. To acknowledge the latest step in their movement through the universe, they were arranged in the form of the four summer-sky constellations: Aquila, Lyra, Cygnus and Ursa Minor, with three of the five largest boulders closely reflecting the Summer Triangle. Thus, the rocks create a tactile and beautiful link with their beginnings.

Preliminary Activities

Learning About Minerals – Teacher Sheet

Purpose

- To enhance students' knowledge of minerals

Grade Level – Grades 4 to 8.

Background

Since rocks are composed of minerals, it is important that students know something about minerals before they begin examining and discussing rocks.

In this activity, students examine the properties of pre-identified mineral samples. Although students might eventually work with unknown samples, it is helpful if they start out with pre-identified samples.

Materials Needed

- mineral samples
- clean, white, unglazed tiles (1 for each group of 2 or 3 students) (Most home supply stores will give broken tiles away free to teachers. You can use the back of a glazed tile.)
- materials to test for hardness (one set for each group of 2 or 3 students)
  - penny
  - iron rail
  - piece of glass
  - steel nail
  - steel file
  - sandpaper (corundum)

Instructions

- Give each group of students three or four mineral samples and tell them the name of each sample. Lead students through the activity step-by-step for the first sample they work with. After the groups have done one sample following your step-by-step instructions, they can do samples two and three on their own.

Learning About Minerals – Student Sheet

Name _____ Date _____

Background

Most rocks are made out of a mixture of minerals, so it is important to know about minerals before you start working with rocks.

Minerals are made up of chemical elements or compounds (combinations of elements) found naturally in the earth. Iron, quartz, sulphur, mica and feldspar are common minerals. Gold, silver, ruby and diamond are rare minerals.

There are many thousands of minerals, but just five minerals combine in different ways to form most rocks. These five minerals are:

- calcite
- feldspar
- hornblende
- mica
- quartz

Ways to tell one mineral from another include looking at each mineral's:

- lustre – amount of shine
- cleavage – the way the mineral breaks
- crystal shape – the size and shape of crystals within the mineral
- colour and streak – the colour of the mineral
- hardness – the hardness of the mineral

This activity will help you identify different minerals.

Materials

You will need the following materials for this activity:

- three or four mineral samples – your teacher will give you these and tell you their names
- materials to test for hardness:
  - penny
  - iron nail
  - piece of glass
  - steel nail
  - steel file
  - sandpaper

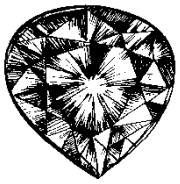
Instructions

Work in groups of two or three. Follow the steps below for mineral sample #1.

Name of mineral sample: _____

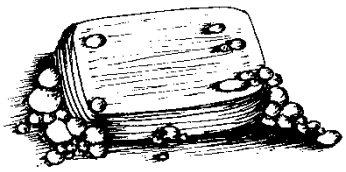
Lustre

Lustre is the amount of shine a mineral has. Some minerals are very shiny and glassy, others are greasy, waxy, earthy or pearly looking. Some have a metallic shine.



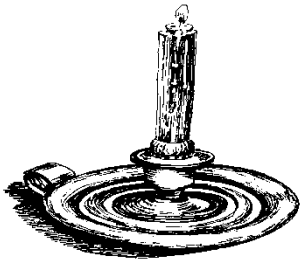
- Glassy – like a gem in a piece of jewelry or a shiny glass dish

- Greasy – like soap or grease

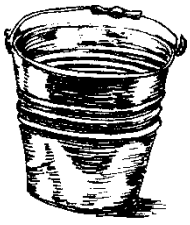


- Pearly – like the pearls in a necklace

- Earthy – like a clay flowerpot or sun-baked clay



- Waxy – like a candle



- Metallic – like a key, a piece of metal jewelry, a tin can or plate

Look at the sample. Is it glassy, greasy, pearly, earthy, waxy or metallic in appearance?

_____

Cleavage

Cleavage is the way a mineral breaks when hit with a hammer. Four common cleavage patterns are:

Common Rock Cleavage Patterns

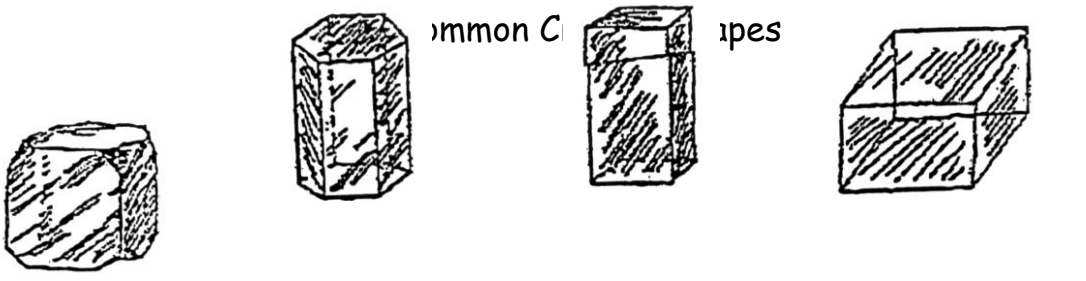
flaky step-like cubic rhombic

Source: Nowlan, Godfrey, & Ross, Beverly. (1999). *Rocks and Minerals*, developed for Making Connections Workshops, Calgary Science Network. Used with permission.

Can you see the cleavage pattern in your mineral samples. If you can see the cleavage pattern in your mineral sample, draw it here. If you can't see the cleavage pattern, your teacher will give you this information.

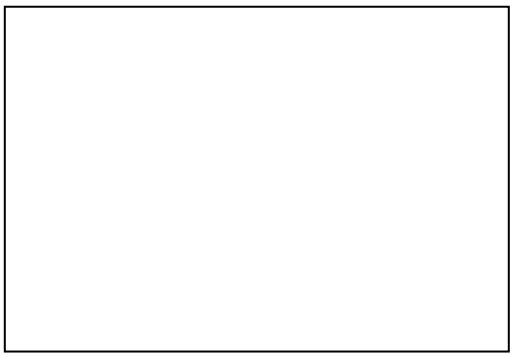
Crystal Shape

This is the shape of the crystals within a mineral. You can usually see the shape of the crystals when you look at the surface of a lump of mineral. Four common crystal shapes are:

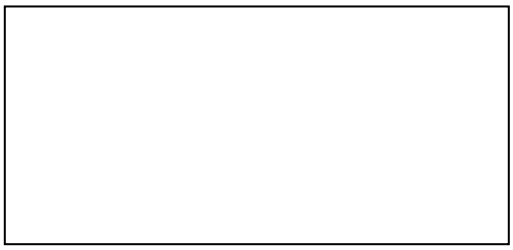


cubic hexagonal tetragonal rhombic

Source: Nowlan, Godfrey, & Ross, Beverly. (1999). *Rocks and Minerals*, developed for Making Connections Workshops, Calgary Science Network. Used with permission.



Look at the surface of your mineral sample. What crystal shape do you see: cubic, hexagonal, tetragonal or rhombic? Name the crystal shape and draw it here.



Colour and Streak

Most minerals vary in colour. Some can be almost any colour. For example, quartz can be brown, white, pink, clear, purple, yellow or black. Thus, colour is not always a reliable way to identify a mineral. However, when a mineral is powdered, its colour is always the same. To powder a mineral, rub a piece of the mineral across a piece of unglazed white tile. (The mark the mineral makes is the mineral's streak.)

Look at the mineral sample. What colour is it? _____

Rub a piece of the mineral across a piece of unglazed white tile.
What colour is the streak?

_____

Hardness

Some minerals are very hard, others are soft. About 200 years ago, a scientist called Friedrich Mohs developed a scale (called the Mohs' Hardness Scale), which ranks the hardness of minerals from 1 to 10. Talc is the softest mineral and so is at the lowest end of the scale (1). Diamond is the hardest mineral and so is at the top end of the scale (10). Mohs' Hardness Scale is shown below, along with one example of each hardness of mineral.

Hardness	Mineral	Can be scratched with
1	Talc	Soft pencil lead
2	Gypsum	Fingernail
3	Calcite	Penny
4	Fluorite	Iron nail
5	Apatite	Glass or pocket knife
6	Feldspar	Steel nail
7	Quartz	Steel file
8	Topaz	Sandpaper (corundum)
9	Corundum	No common items
10	Diamond	No common items

Scratch your mineral sample with a soft lead pencil. If the mineral does not scratch, try scratching it with your fingernail, etc. What material can you scratch your mineral with?

_____

What hardness is your mineral sample?

_____

Repeat

After you have examined the first mineral sample, repeat the same process for samples two and three. Write your conclusions on a separate sheet of paper or a new worksheet.

How Are Rocks Formed? – Teacher Sheet

Purpose

- To demonstrate that rocks are formed in different ways
- To illustrate that most rocks are mixtures of other substances

Grade Levels – Grades 4 to 8.

Materials Needed

- samples of sedimentary, igneous and metamorphic rocks

Sedimentary Rocks

- large clear jars or plastic cups
- sand, soil, small pebbles, iron filings, marbles, small bits of wood (be sure the items used for sediments are quite varied in size, shape and composition)
- water
- long spoons or stirring sticks
- alum (Some sediments are slow to settle. You can speed up the process by adding a teaspoon of alum to each jar of water and sediments.)

Igneous Rocks

- chocolate chips
- coloured sprinkles

Metamorphic Rocks

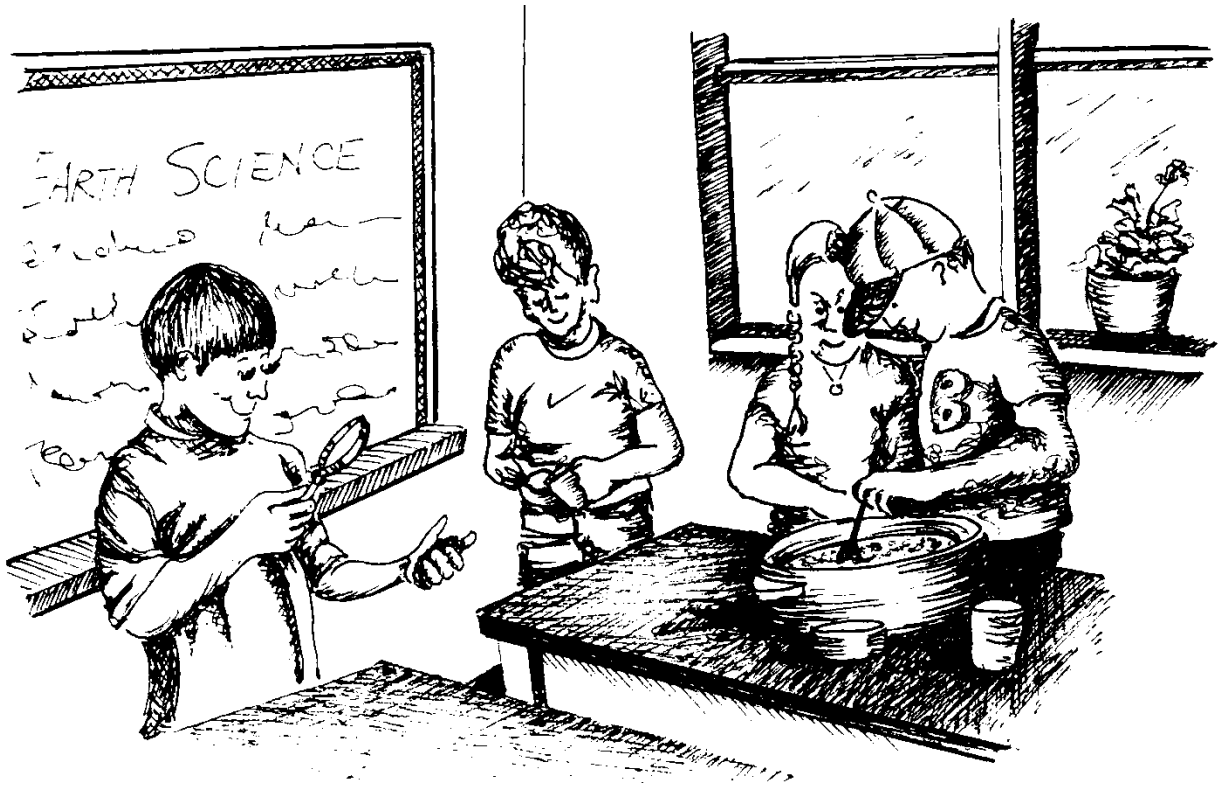
- at least two different colours of modeling clay

Instructions

- Emphasize to students that most rocks are mixtures of other rocks and fossil remains of plants and animals, and that the way a rock is formed affects its nature.
- Explain how each type of rock is formed and lead students through the experiments.
- At the end of each experiment, show samples of actual rocks that were created through the process demonstrated.
- If desired, this activity could be done over three class periods, one class period for each type of rock.

How Are Rocks Formed? – Student Sheet

Name _____ Date _____



Experiments in your classroom will show how rocks are formed.

Background

Rocks are made of minerals. Most rocks are a combination of two or more minerals. But rocks that contain the same minerals can look different because rocks are formed in different ways.

Three Types of Rocks

There are three types of rocks: sedimentary, igneous and metamorphic rocks. Each of these types of rocks is formed in a different way.

Sedimentary Rocks

Sedimentary rocks are formed when mud, sand and gravel are carried along by rivers and streams. This mud, sand and gravel is called sediment. Eventually, these sediments settle in piles on the bottom of lakes, rivers and oceans. The bodies of plants and animals can get mixed into the piles and become fossils. It often takes millions of years for the piles of sediments to harden and become rocks. Often new layers of sediments are laid down on top of existing ones, so many sedimentary rocks have a layered look. When you think about sedimentary rocks, imagine a tall sandwich with many layers of filling. When you cut through a sandwich you can see the layers. When you cut through a sedimentary rock you often see layers.

Sedimentary Rocks

conglomerate sandstone shale limestone

Source: Nowlan, Godfrey, & Ross, Beverly. (1999). *Rocks and Minerals*, developed for Making Connections Workshops, Calgary Science Network. Used with permission.

Common types of sedimentary rocks are:

- **Conglomerate** – Made of round pebbles that are cemented together with sand or clay. You can see the pebbles in a bigger rock.
- **Sandstone** – Made of grains of sand cemented together. You can often see different coloured grains in sandstone. It feels like sandpaper when you rub it. May be brown, grey, white, red, yellow, greenish.
- **Shale** – Made of clay, mud or silt. Made of many very fine layers that split easily. Usually black or dark brown.
- **Limestone** – Made of the shells of water creatures that lived long ago. Very soft in texture. Usually white or whitish grey. Chalk is made out of limestone.

Experiment

This experiment shows how **sedimentary rocks** are formed.

- Collect some sand, soil, and small pebbles of different sizes.
- Fill a large clear plastic jar or cup one-third full of the materials you collected.
- Add water so that the jar or cup is nearly full.
- Stir well.
- Put the jar or cup where it will be undisturbed.

- Observe the jar at the end of class.
  Draw what you see.

  What sediments are still floating in the jar?

  _____

  _____

  What sediments have settled to the bottom of the jar?

  _____

  _____

- Observe the jar next class.
  Draw what you see.

  What sediments are still floating in the water?

  _____

  _____

  What sediments have settled to the bottom of the jar?

  _____

  _____

Describe any layers that you see.

_____

_____

What would happen if your jar of sediments sat for a million years?

_____

_____

Observation

Look at samples of real **sedimentary rocks**.

Do you see any evidence that the rock is made of grains of sand or pebbles cemented together? Describe and draw what you see.

_____

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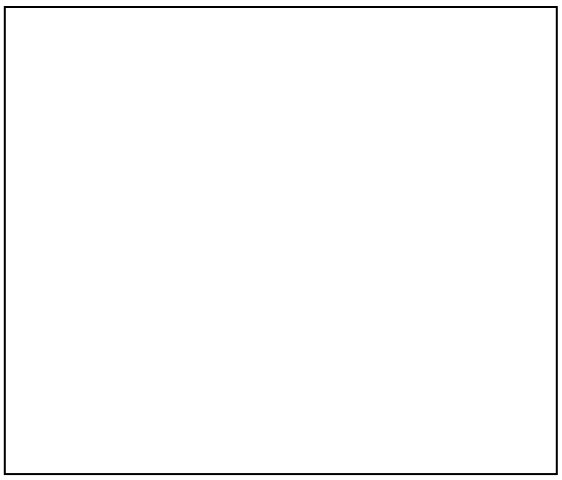

Do you see layers or bands in the rock? Describe and draw what you see.

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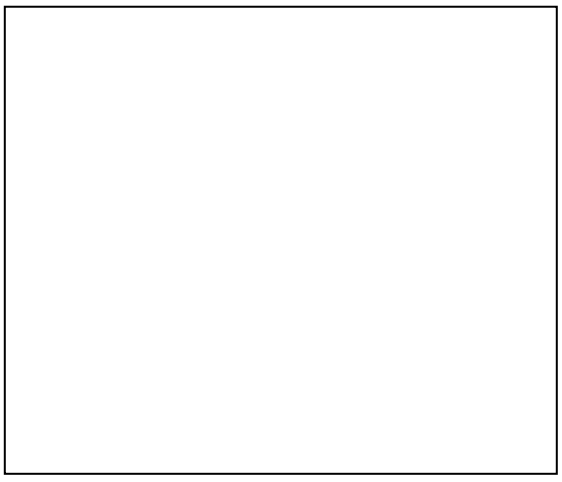

Do you see big or small flecks of several colours in the rock? Describe and draw what you see.

_____

_____

_____

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_____

Igneous Rocks

Igneous rocks are formed when molten rock cools and hardens.

- Sometimes this molten rock gets pushed up through the earth's surface and hardens on the surface. This often happens around volcanoes. Igneous rocks that form above the ground are called extrusive rocks.
- Other times the molten rock hardens underground. Igneous rocks that form underground are called intrusive rocks. Intrusive rocks usually have large crystals.

granite Basalt obsidian pumice

Source: Nowlan, Godfrey, & Ross, Beverly. (1999). *Rocks and Minerals*, developed for Making Connections Workshops, Calgary Science Network. Used with permission.

Common types of igneous rocks are:

- **Granite** – A coarse-looking rock made up of large crystals that are the same size. Usually white, grey or pink. Granite is an intrusive rock.
- **Basalt** – A coarse-looking black rock. It often has holes in it where gas bubbles or softer minerals used to be.

- **Obsidean** – A very smooth rock. Looks like black glass. Obsidian forms when molten rock (magma) cools very rapidly and the molecules can't join together to create crystals. Instead, they form a glassy material.

- **Pumice** – Pumice is a light rock that is full of bubbles and air holes. It is formed when air gets into magma and creates a foamy substance which then hardens.

Experiment

This experiment shows how **igneous rocks** are formed.

- Put some chocolate chips in a bowl.

- Heat them at low heat in a microwave until they are melted.

- Pretend that the melted chocolate chips are molten rock.

- Put a big spoonful of melted chocolate on a piece of paper. Gently lay another piece of paper on top. Let the chocolate cool.

  What does the chocolate look like? _____

  _____

  This is similar to what happens when igneous rocks are formed deep within the earth (intrusive rocks).

- Let the chocolate cool a bit so it isn't runny. Put a big spoonful on a piece of paper. Cut holes of various sizes in another piece of paper. Put the second piece of paper on top and press gently. Let it cool.

  What does the chocolate look like? _____

  _____

  This is what happens when molten rock gets pushed up through the earth's surface and igneous rocks form on top of the earth (extrusive rocks).

- Mix some coloured sprinkles into a spoonful of chocolate. Put the chocolate on a plate and let it cool.

  What does the chocolate look like? _____

  _____

  This is what happens when minerals, plants or other rocks get mixed in with molten rock.

Observation

Look at samples of real **igneous rocks**.

Do you see any rocks that are smooth and glassy looking? Describe and draw what you see.

_____

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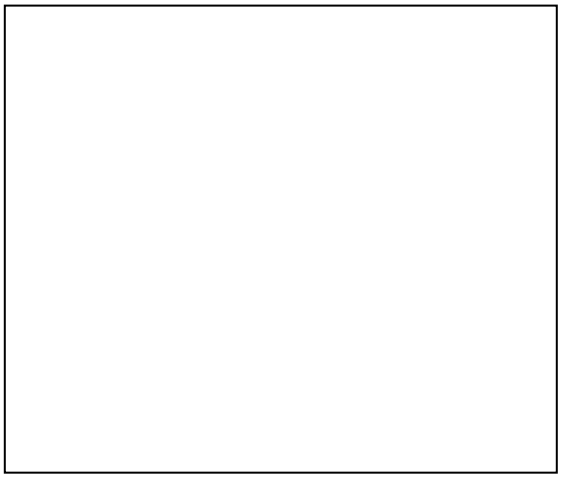

Do you see any rocks with large crystals that are all the same size? Describe and draw what you see.

_____

_____

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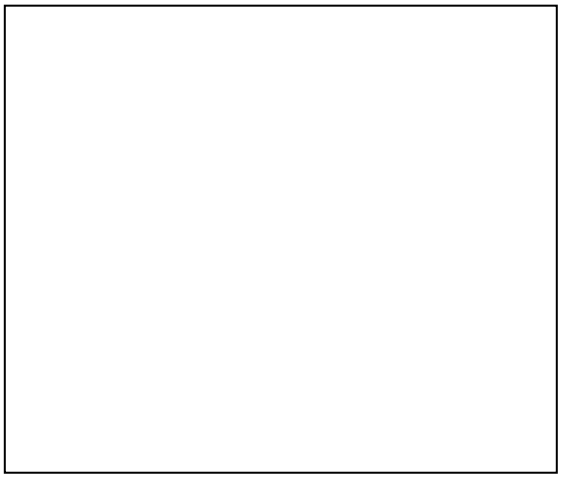
_____

_____



Do you see any rocks with little holes in them? Describe and draw what you see.

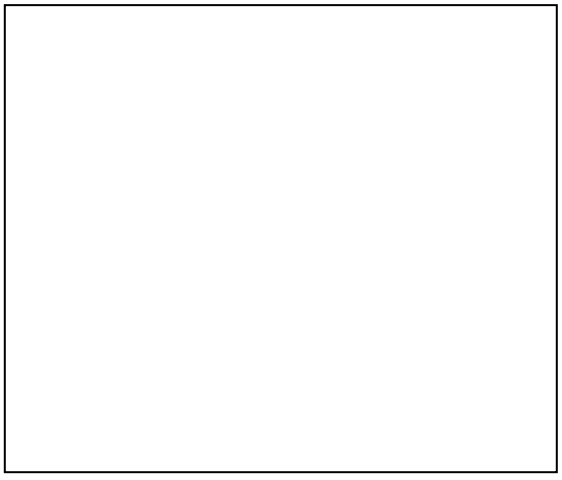
_____

_____

_____

_____

_____



Metamorphic Rocks

Metamorphic rocks used to be another kind of rock (sedimentary, igneous or some other kind of metamorphic). The rock was subject to great heat and/or pressure that caused it to change its character. This heat and/or pressure usually occurred because a mountain was created on top of the rock or it was buried deep in the earth.

Metamorphic Rocks

quartzite marble slate schist

Source: Nowlan, Godfrey, & Ross, Beverly. (1999). *Rocks and Minerals*, developed for Making Connections Workshops, Calgary Science Network. Used with permission.

Common types of metamorphic rocks are:

- **Quartzite** – Quartzite is made mostly out of the mineral quartz. It is formed when buried sandstone is heated and the quartz grains are forced tightly together. Quartzite may look like sandstone with many layers, but it is much harder than sandstone. Usually pink, pinkish grey or pinkish white.
- **Marble** – A soft smooth rock that used to be limestone. It can be any colour (red, pink, white, cream, grey, black). It can have bands of darker or lighter colours.
- **Slate** – A very fine-grained rock that used to be shale. Usually black or dark brown. Splits easily into thin layers. Can contain small shiny flecks of mica.
- **Schist** – Schist used to be slate. It was changed by great heat and pressure under the earth. It has medium to coarse grains that are arranged in parallel sheets. Most schist is grey or black. Some has sparkly flecks of mica.
- **Gneiss** (pronounced "nice") – Gneiss used to be granite, shale or sandstone. It can be any colour (red, pink, grey, black, light brown, dark brown). Most gneiss has very distinct light and dark layers.

Experiment

This experiment shows how **metamorphic rocks** are formed.

When rocks are subject to great heat and pressure, they become soft.

- Get two colours of modeling clay.
- Shape colour #1 into two flat sheets.
- Shape colour #2 into balls, lumps or logs.
- Place the clay balls, lumps or logs on one layer of the flat sheets of clay. Cover with the second flat sheet to make a sandwich.
- Fold or roll your clay sandwich so that it is more than one layer thick.
- Press on the clay with your hand or with a book.
- Cut the clay into chunks.

  How did the pressure change your pretend rock?

  _____

  _____

- Put two or three of the chunks into the microwave.
- Heat them at low heat.

  How did the heat change your pretend rock?

  _____

  _____

Observation

Look at samples of real **metamorphic rocks**.

Describe and draw any layers, bands or folds that you see.

_____

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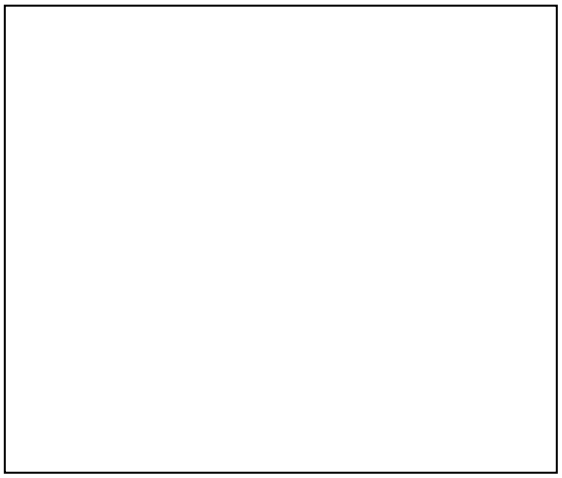

Do you see big or small flecks of several colours in the rock? Do you see shiny flecks of mica? Describe and draw what you see.

_____

_____

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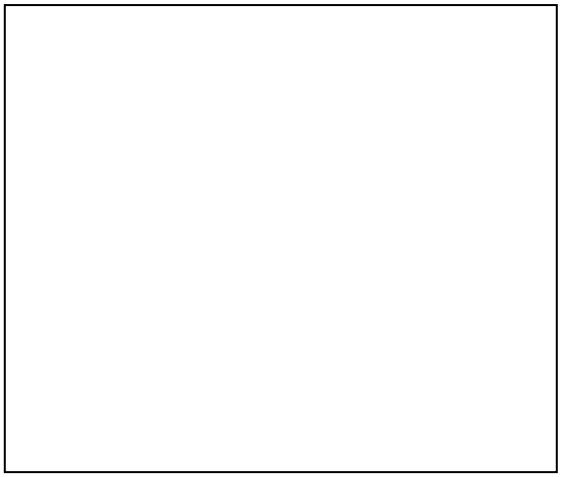


How Do Rocks Change? – Teacher Sheet

Purpose

- To illustrate the rock cycle
- To demonstrate some of the forces that cause rocks to change

Grade Levels – Grades 4 to 8.

Materials Needed

Freezing Changes Rocks

- modeling clay
- plastic wrap
- access to a deep-freeze (a fridge freezer isn't cold enough)

Erosion Changes Rocks

- several cookie sheets or trays with sides
- brown sugar
- several cups or pitchers

Movements of the Earth's Crust Changes Rocks

- several different colours of modeling clay
- jars or rolling pins to roll out clay
- dull knives

Instructions

- Have students work in groups of two or three.
- At the end of each experiment, ask questions or give explanations to ensure that students understand how the experiment relates to the rock cycle.

How Do Rocks Change? – Student Sheet

Name _____ Date _____

Background

Rocks are in a constant cycle of changing. They are created, deformed, eroded, lifted up and moved.

- All rocks begin as molten rock (called lava or magma) deep within the earth's crust.

- Molten rock becomes igneous rock when it cools. If it cools slowly inside the earth it forms plutonic rock like granite. If it reaches the surface and erupts from a volcano, it hardens quickly into volcanic rock like basalt.

- Igneous rocks can be changed into:

  (1) metamorphic rocks, if they are buried deep in the earth and subjected to great heat and/or pressure

  (2) sedimentary rocks, if they are on the top of the earth and are subjected to weathering and erosion. Weathering and erosion break the sedimentary rocks into smaller pieces and move them around

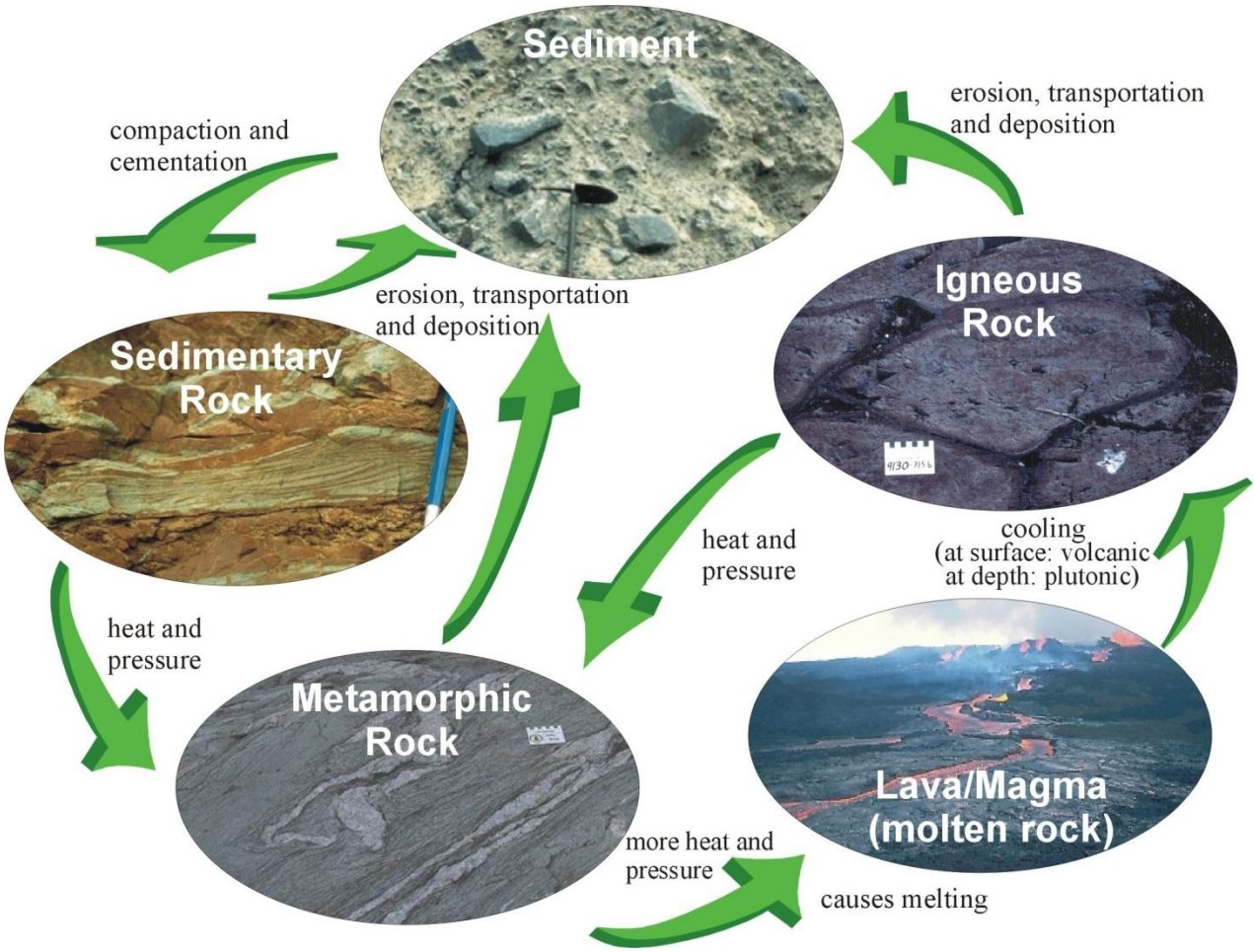
- Metamorphic rocks and older sedimentary rocks can be eroded to form new sedimentary rocks.

- Sedimentary rocks can be changed into metamorphic rocks if they are buried to great depths.

- Metamorphic rocks that are buried deep in the earth and subjected to great heat and/or pressure can melt into magma and become igneous rocks.

The rock cycle is illustrated on the next page.

The Rock Cycle



Source: Saskatchewan Geological Society.

The forces that cause rocks to change include:

- heat and pressure deep in the earth which cause rocks to change form
- volcanoes which bring molten rock to the surface
- wind and water which wear away rocks (erosion) and move rocks from one place to another
- glaciers which move rocks around and break them up into smaller pieces
- movements of the earth's crust which cause huge blocks of rock to buckle and shift, forming mountains and valleys
- earthquakes which cause rocks to break and move
- freezing which often causes rocks to crack and break

Freezing Changes Rocks

Experiment

This experiment shows how freezing changes rocks.

- Get two lumps of modeling clay. Moisten the lumps of clay and wrap them in plastic wrap.
- Put one lump of clay in the freezer, leave it until next class. Leave the other lump of clay in your classroom.
- Next class, take the lump of clay out of the freezer.
- Compare the two lumps of clay. How are they different?

Observation

Compare the two lumps of clay. How are they different?

_____

_____

_____

Draw the two lumps of clay in the space on the right.

If the frozen lump was frozen and thawed many times over several years what do you think would happen to it?

_____

_____

_____

_____

_____

Erosion Changes Rocks

Experiment

This experiment shows how moving water erodes rocks and changes them.

- Get the following items:
  - cookie sheet or tray with sides
  - brown sugar
  - cup or pitcher

- Put the brown sugar in a big pile at one end of the cookie sheet. Pretend this pile of sugar is a mountain. Draw your brown sugar mountain in the space on the right.

- Slowly drip water on your brown sugar mountain. Pretend this dripping water is rain.

Observation

What happens when you drip water on your mountain?

_____

_____

_____

What colour is the water that runs off the mountain? Why is it this colour?

_____

_____

_____

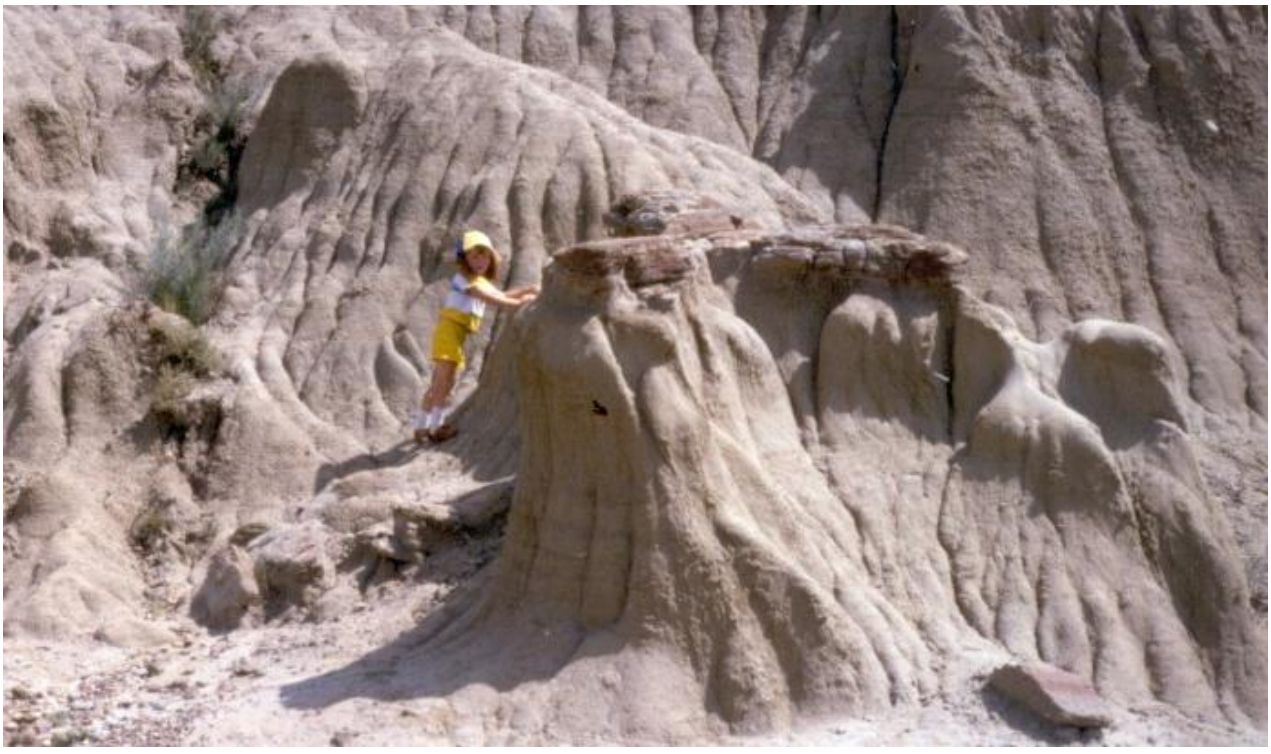
- Let your experiment sit for a few days until all the water has evaporated. How has the dripping water changed it?

_____

_____

_____

- Draw what you see in the space on the right.



Hoodoos in the Avonlea Badlands are formed by wind and rainwater erosion of soft rocks (shale and siltstone) beneath a more resistant layer of rock (cemented sandstone).
Photo provided by D.M. Kent.

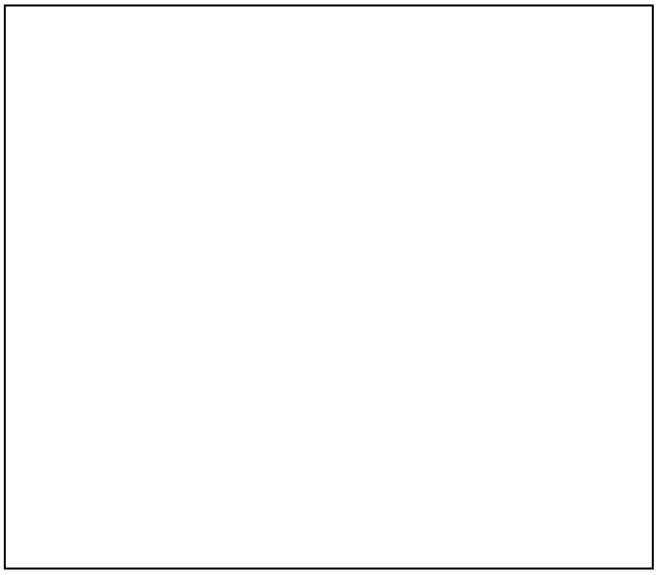
Movements of the Earth's Crust Changes Rocks

Experiment

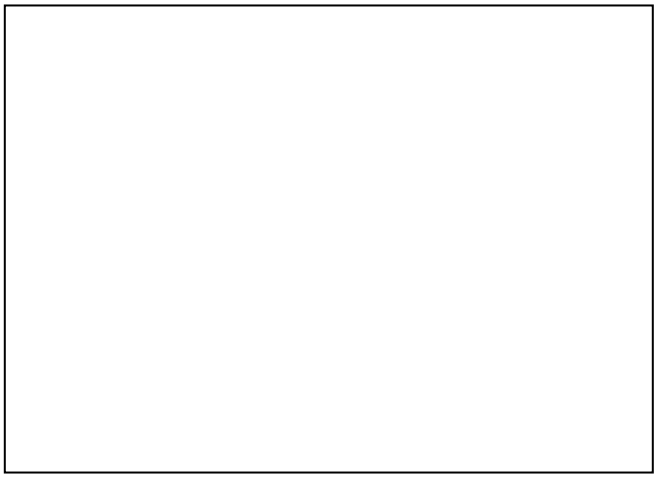
This experiment shows how movements of the earth's crust change rocks.

- Roll out several flat sheets of modeling clay, each one a different colour.

- Put the flat sheets one on top of each other. Pretend this flat pile of modeling clay is flatlands.
- Cut through your pretend flatlands with a dull knife so you can see the layers.
- Draw the layers in your pretend flatlands in the box on the right.



- Put your hands on each side of the flat clay pile and push your hands together.
- The clay will buckle upwards. This is how mountains and valleys are formed when the earth's crust moves.
- Draw your pretend mountain in the space on the right.



Glaciers – Teacher Sheet

Purpose

- To illustrate that glaciers move rocks and create valleys and plains on the surface of the earth.

Grade Levels – Grades 4 to 8.

Materials Needed

- large baking pans or cookie sheets with sides (one pan for each group of two or three students)
- flat pieces of ice – use cupcake pans or medium-sized foil tart pans full of water to make the flat pieces of ice.
- soil, sand, small gravel, bits of wood, bits of dead leaves.

Instructions

- Have students work in groups of two or three
- At the conclusion of each phase of the activity, ask "What does this tell us about the way glaciers affect rocks? About the way glaciers affect the surface of the earth?"

Glaciers – Student Sheet

Name _____ Date _____

Background

Glaciers are like huge frozen rivers that move slowly. Today most glaciers are in cold places like high mountains and the North and South Poles. But long ago, there were Ice Ages when most of Canada and all of Saskatchewan were covered by glaciers. The last Ice Age in Saskatchewan was about 18,000 years ago. Glaciers change the surface of the earth and individual rocks. Glaciers:

- create deep valleys and flat plains when they move over the earth's surface
- move rocks from place to place when rocks get frozen into the glacier
- scratch and gouge the rocks they scrape against. These scratch marks are often curved like this (((or like this)))
- leave big piles of gravel and rock behind when they melt

Materials

- a large flat baking pan with sides
- flat pieces of ice – fill medium-sized cupcake or foil tart pans with water and freeze
- soil, gravel, sand, small bits of wood, bits of dead leaves

Instructions

- Fill the baking pan with soil, sand, gravel, bits of wood, etc.
- Put the flat piece of ice on top of the soil at one end of the pan.
- Pretend that the pan full of soil is the earth's surface and the ice is a glacier.
- Leave the pan and the ice at room temperature until the ice is about one-third melted.
- Put the pan and the ice back in the freezer and freeze solid.
- Next day take the pan out of the freezer. Lift up your pretend glacier. Draw what you see in the box on the right.

- How much sand, soil, pebbles, etc. have become frozen into your pretend glacier?

_____

_____

_____

_____

- Drag the pretend glacier through the pan, from the top to the bottom.
- Then look at the soil in the pan.
- Draw what you see in the space on the right.

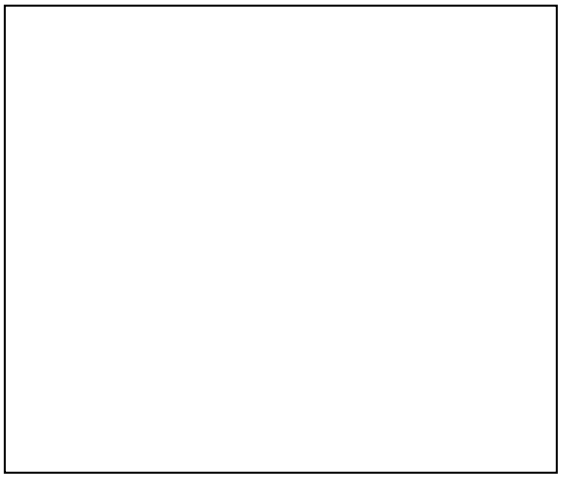
- What happened to the soil in the pan when you dragged the pretend glacier through it.

_____

_____

_____

- Leave the pretend glacier at the bottom of the pan.
- Let it melt completely.
- Draw what you see in the box on the right.



- How has the pretend glacier changed the soil and gravel in the baking pan?

  _____

  _____

  _____

On-Site Activities

Observing Rocks – Teacher Sheet

Purpose

- To familiarize students with the rocks in the GEOrock Garden
- To develop students' observation skills
- To enhance students' ability to describe objects
- To enhance students' ability to contrast and compare

Grade Levels – Grades K to 12.

This activity is appropriate for Grades 4 to 8, but can be adapted for other grade levels.

For K to Grade 3 students or students with limited writing skills, do the activity orally. Ask students to work in groups of three or four. Assign a volunteer parent or older student to each group. The volunteer asks each question, students observe the rock and respond orally.

For students in Grades 9-12, expect a more complex type of description.

Materials Needed

- One clipboard for each student (if students don't have clipboards, make them with a piece of firm cardboard and elastic bands at top and bottom to hold the paper on)

Classroom Preparation

- Tell students what they will be doing at the site.
- Review words that might be used to describe colour, texture and shape.
- Review the characteristics of igneous, sedimentary and metamorphic rocks.

On-Site Activity

- Have students work in pairs. Assign one rock to each pair. Give each student a worksheet (although students work in pairs, each fills out their own worksheet.)
- Ask students to complete the worksheet.
- When students have finished describing one rock, tell them to complete the process with a second rock.

Classroom Follow-up

- Ask students to work in pairs. Ask each pair to make a poster describing and illustrating one of the rocks they observed.
- In a whole class discussion, ask students:
  - What surprised you about the rock you were observing?
  - What are some unique features that rocks can have?
- Ask students to write a description of their rock using full sentences. Tell older students that their description must have several paragraphs, one paragraph about colour, one about size and shape, one about texture, etc.

Observing Rocks – Student Sheet

Name _____ Date _____

Instructions

Pick a rock at the GEOrock Garden that you like. Go to your rock and answer each of the following questions. Pay close attention to detail. Give as much description as possible for your rock. If you finish describing one rock, ask your teacher for another worksheet and describe a second rock that is different from the first.

Colour

- Describe the colours in the rock.

_____

_____

Shape and Size

- What **shape** does the rock have?

_____

_____

- Compare the **shape** of the rock to another rock. How are they different? How are they the same? Which is the most beautiful shape to you?

_____

_____

- Compare the **size** of the rock to another rock. Compare the size of the rock to you. Is it taller or shorter than you? Thinner or thicker?

_____

_____

Texture

- What does the rock feel like?

_____

_____

- Compare the feel of this rock to the feel of another rock. How are they the same? How are they different?

_____

_____

Interesting Features

- What is unique about this rock?

_____

_____

- What feature would you use to find this rock again?

_____

_____

Type of Rock

- Is this rock:

1 igneous
1 sedimentary
1 metamorphic

- Explain why you think so.

_____

_____

Identifying the Rocks – Teacher Sheet

Purpose

- To help students recognize the characteristics of various types of rocks

Grade Levels – Grades K to 12.

Background

Before this activity, spend some time in the classroom examining small rock samples and reviewing the characteristics of different kinds of rocks.

Instructions

- Divide students into groups of two or three. Assign each group of students to a separate section of the GEOrock Garden. If necessary, tell students the direction they should walk, so they don't bump into each other.
- Identify the first rock with the class as a whole and demonstrate how to work through the rock identification chart.
- At the end of the activity, identify each rock for students and ask them to check their work.

Identifying the Rocks – Student Sheet

Name _____ Date _____

Instructions

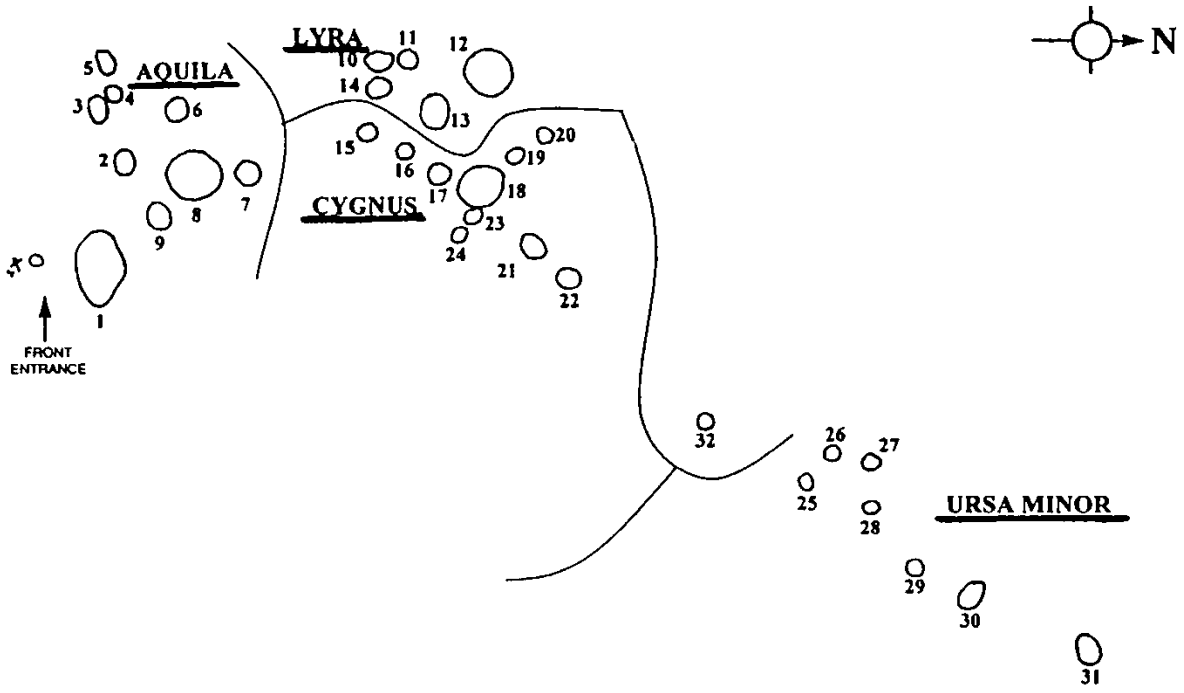
Work in groups of two or three. Walk from one rock to another in the rock garden. (Your teacher will lay out a path, so that you don't bump into other students.) Try to identify six or seven rocks. You probably won't have time to do them all.

Look carefully at each rock and feel it. The colour, texture, lustre and crystal shape and cleavage pattern will give you clues about what the rock is. Use the chart on the next page to help you identify the rocks.

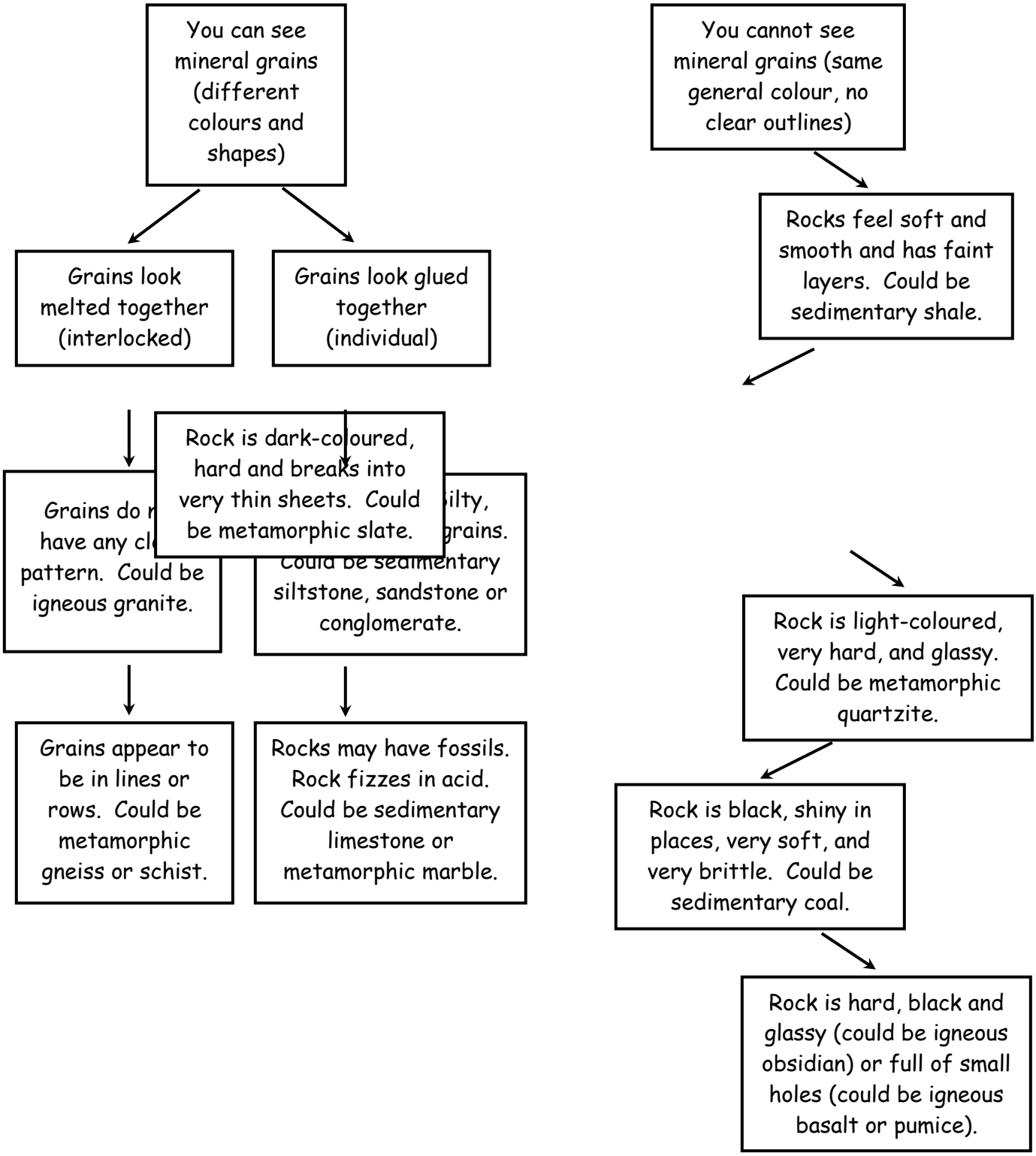
Below is a map of the GEOrock Garden.

Label the rocks you identified.

At the end of the class your teacher will tell you what type each rock is.



Rock Identification Chart



Source: Nowlan, Godfrey, & Ross, Beverly. (1999). *Rocks and Minerals*, developed for Making Connections Workshops, Calgary Science Network. Used with permission.

Drawing the Rocks – Teacher Sheet

Purpose

- To develop students' observation skills
- To develop students' illustration skills

Grade Levels – Grades K-12.

The worksheet is suitable for Grades 4-12. Expect more sophisticated and complex drawing and illustration from older students than from younger. Give instructions orally to beginning readers.

Classroom Preparation

- Explain the tasks to students.
- Ask each student to think about the best medium for drawing the entire rock (pencil, black felt pen, charcoal are possibilities).
- Ask each student to consider the best medium for a close-up, coloured illustration of a section of rock (pencil, crayons, felt pen, water colours are possibilities).
- Review artistic techniques that may be useful for this activity, for example, pointillism may be a useful technique to illustrate rocks such as sandstone or conglomerate.

On-Site Activity

Ask students questions that will encourage them to observe the rock they are illustrating. For example:

- How many colours do you see in this rock?
- Is the shape of the rock different when you stand on the other side of it?
- What different shapes do you see within the rock itself?
- Where do you see shadows on the rock?

Classroom Follow-up

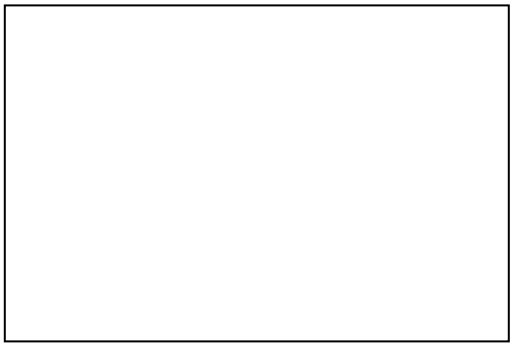
- Ask students to review the medium and techniques they used to illustrate the rocks. What worked well? What would they change next time?

Drawing the Rocks – Student Sheet

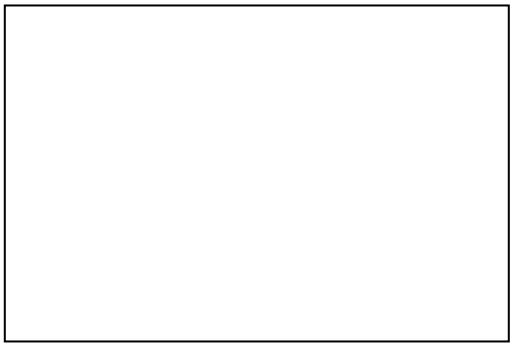
Name _____ Date _____

Instructions

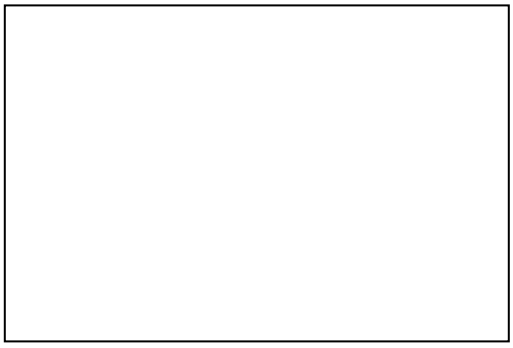
- Pick a rock you like.
- Stand back from the rock. Draw the rock as it appears from a distance. Pay particular attention to the shape of the rock.



- Move to the opposite side of the rock. Draw the rock again.



- Create a coloured close-up illustration of a section of the rock. What colour is the rock? Is it rough or smooth? Try to draw the colours and texture of the rock as realistically as possible.



- Pick another rock that is different in size, colour and shape from the first one. Repeat the process above. Use a new worksheet or a separate piece of paper.

Mapping the Rocks – Teacher Sheet

Purpose

- To enhance students' measurement skills
- To enhance students' map-making skills

Grade Levels – Grades 5 to 12.

Encourage older students to be more precise with their maps. For example, some rocks have sharp corners. Students can calculate the angle of these corners and transfer them to their maps. They can calculate the angles between the rocks and ensure that these angles are exact on their maps.

Materials Needed

- flexible cloth tape measures
- metal tape measures
- graph paper

Classroom Preparation

- Review the concept of scale with students.

Classroom Follow-up

- Have students compare their maps. How are they different? Why did these differences occur?

Mapping the Rocks – Student Sheet

Name _____ Date _____

Instructions

- You will need a flexible cloth tape measure and a metal tape measure.
- Work in groups of two or three.
- Your teacher will assign you to a group of four or five rocks.
- Draw a map of the rocks.
- Your teacher will give you some graph paper marked into squares. Draw your map on this graph paper.
- Imagine you are in a helicopter looking down. What would the shape of each rock be? This is the shape to draw on your map.
- Measure each rock. The way you measure will depend on the shape of the rock. If the rock has sides, measure each side. If the rock is round, measure around the rock. Draw a scale picture of each rock.
- Measure the distance between rocks. Be sure the distance is correct to scale on your map.
- Mark North, South, East and West on your map.

Finding Fossils – Teacher Sheet

Purpose

- To sharpen students' observation skills
- To enhance students' knowledge of fossils

Grade Levels – Grades K-12.

Classroom Preparation

- Review how fossils are formed.
- Provide students with some samples of rocks containing fossils.
- Review the most common types of fossils with students (ammonites, belemnites, brachiopods, coral, echinoids, gastropods, pelecypods, plants, trilobites).
- Remind students that the same fossil may look different depending on whether you are looking at it from the front or the side.

Classroom-Follow-up

- Encourage students to try to identify the fossils they saw at the GEOrock Garden by looking them up in textbooks or reference books.

- Fossils that are in the rocks at the GEOrock Garden include:

    (1) Gastropods: high spiral and planispiral coiling
    (2) Colonial corals
    (3) Solitary corals (horn corals)
    (4) Stromatoporoids
    (5) Stromatolites

Extensions

- Take students to the outside of the T.C. Douglas Building in Regina. This building is made of Tyndall Stone that has been cut and polished. You can see many fossils in the stone when you walk around the building. Other fossils that are common in Tyndall Stone include:

    (1) Cephalopod with straight shell (orthocone)
    (2) Cephalopod with curved shell
    (3) Chain coral
    (4) Receptaculitid

Finding Fossils – Student Sheet

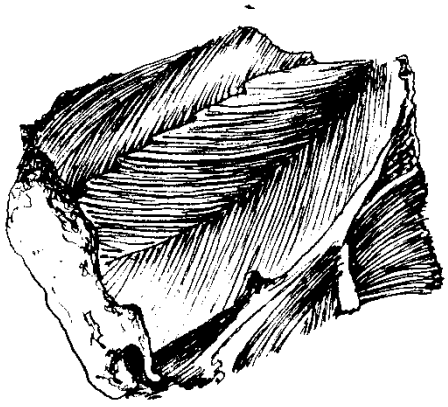
Name _____ Date _____

Background

Fossils are the remains, preserved in rocks, of plants and animals that lived long ago. Fossils tell us what life was like millions of years ago.

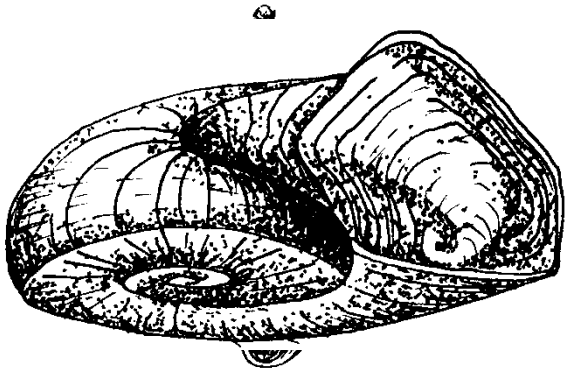
When plants and animals die, their remains are usually eaten or rot away. Fossilized plants and animals have been preserved because their remains were covered with sand or mud before they rotted or were eaten. This often happens in lakes, rivers or the ocean. Thus, fossils are often of animals or plants that lived in or near water.

Here are some illustrations of fossils:



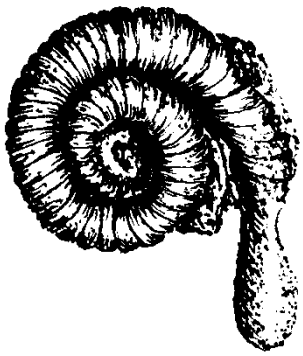
Fossil of a snail (gastropod)

Fossil of a leaf



Fossil of a snail (gastropod) (side view)

Fossil of a snail (gastropod)
(fossil has been cut in half)



This fossil is called a cephalopod.
It was probably like a squid or
cuttlefish when it was alive.

Instructions

- Walk from rock to rock in the GEOrock Garden. Search each rock carefully for fossils.
- For each fossil you find, draw a picture and answer these questions.
- Draw the fossil in the space below.

What rock did you find the fossil on?

_____

_____

Is the fossil a plant or an animal?

_____

_____

Do you think the fossil plant or animal lived in water or on land?

_____

_____

Is the fossil you saw in the rock the whole plant or animal or only part of it?

_____

_____

Watching for Weathering – Teacher Sheet

Purpose

- To sharpen students' observation skills
- To increase students' knowledge about the process of weathering

Classroom Preparation

- Review the different ways that rocks weather and the effect that weathering has on rocks.

Classroom-Follow-up

- Ask students to work in small groups of three or four.
- Ask them to share their answers to the questions on the worksheet.
- Ask them, "Why did some of you have different answers for some of the questions?"

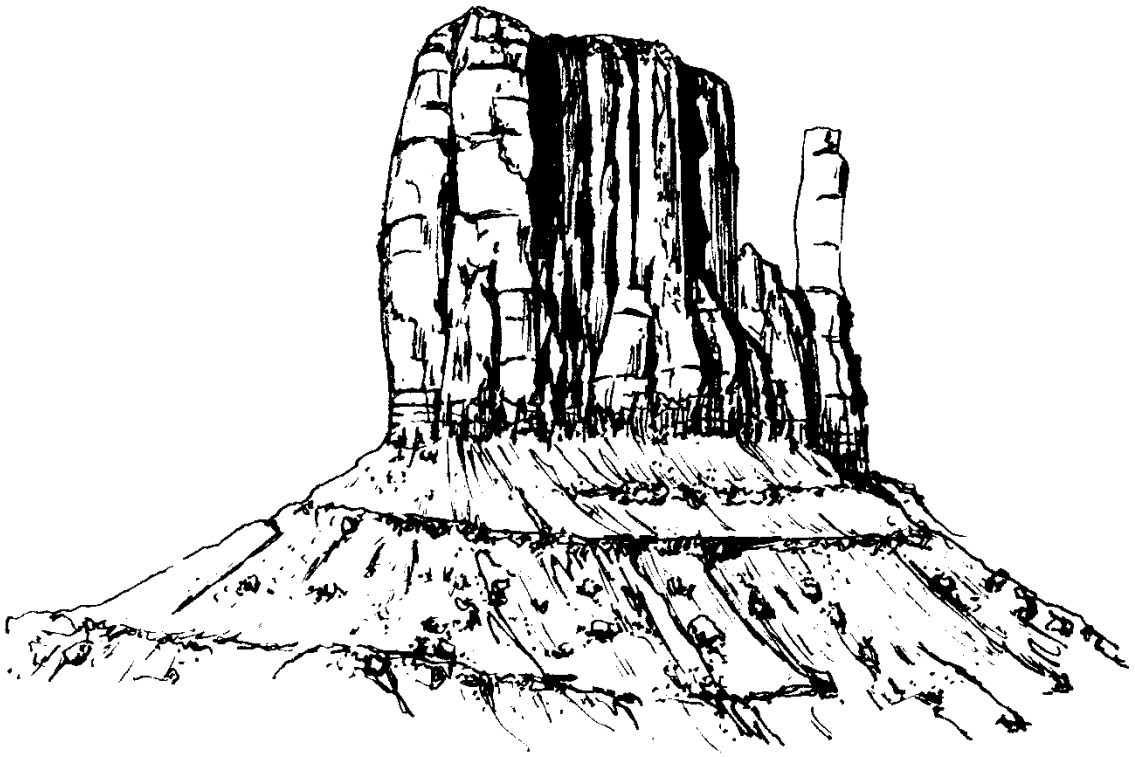
Watching for Weathering – Student Sheet

Name _____ Date _____

Background

Weathering causes rocks to change in shape, to break up into smaller rocks and to break into grains of sand. Weathering is caused by:

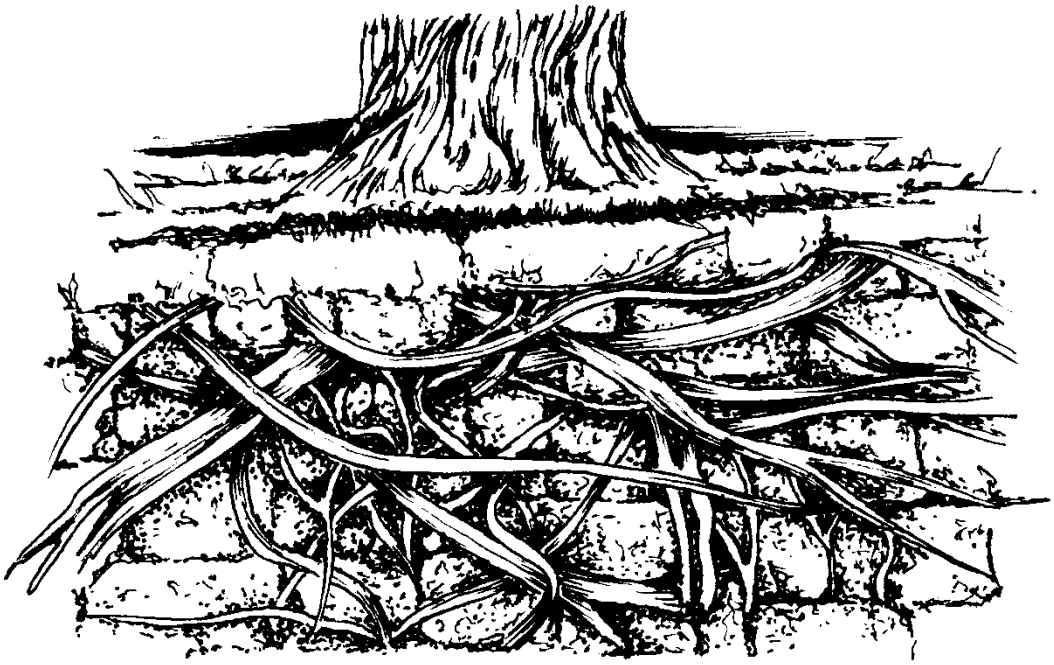
- Wind – When wind blows over the edges of a rock for many thousands of years, the edges are gradually worn smooth.



Wind erosion has worn away the soft parts of this big rock.

- Water – Water from rain or snow gets into tiny cracks in rocks. When the water freezes, it expands and causes the rock to break or crack more. When rocks are in a river or ocean, the water flowing over them wears away sharp edges and makes the rock smooth.

- Roots of trees and plants – Sometimes moss and lichens grow on rocks. Their tiny roots can cause the surface of the rock to crumble. Other times, roots of trees or plants will grow into tiny cracks in the rocks. Sometimes, these roots are strong enough to break the rock, make the crack bigger or cause the rock to crumble.



Tree roots have grown through these rocks and caused them to break.

- Chemicals in the air – Water in the air often combines with chemicals in the air. Sometimes these chemicals occur naturally. Other times they are caused by fires, smoke from factories or car exhaust. When water combines with chemicals in the air, an acid is formed. This acid eats away at rocks or causes them to crumble.

This statue was carved from rock. Its face has been eroded by chemicals in the air.

Instructions

Carefully observe three or four rocks. Try to find at least one sample of each of the following kinds of weathering.

- Find a big crack in a rock. Draw what you see in the space on the right. What do you think caused this crack?

_____

_____

_____

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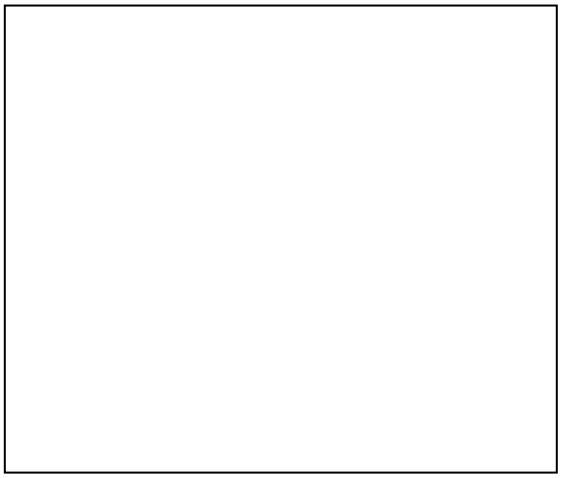

- Find a very tiny crack in a rock. Draw what you see in the space on the right. What do you think caused this crack?

_____

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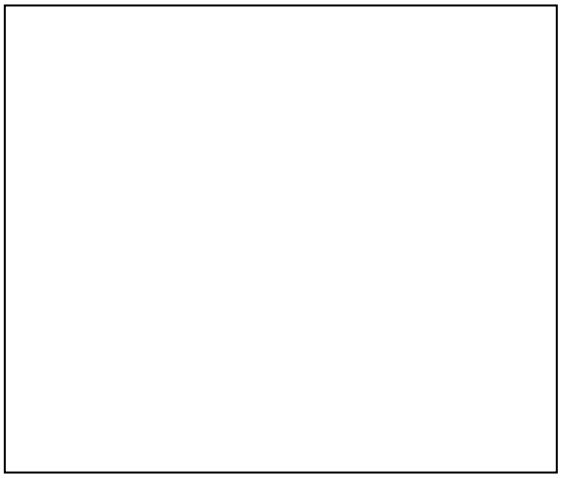
_____

_____

_____



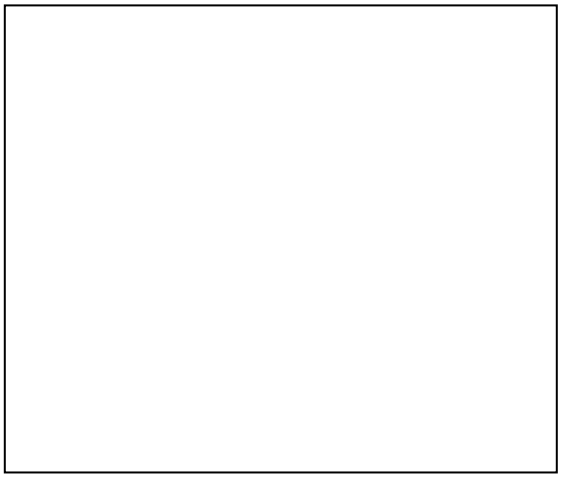
- Find a rock that has very smooth edges. Draw what you see in the space on the right. What do you think made these smooth edges?

_____

_____

_____

_____



- Find a rock that has a crumbly spot on its surface. Draw what you see in the space on the right. What do you think caused this crumbly spot?

_____

_____

_____

_____

- Find a rock that has moss or lichens growing on it. Draw what you see in the space on the right. What effect do you think the moss or lichens will have on the rock?

_____

_____

_____

_____

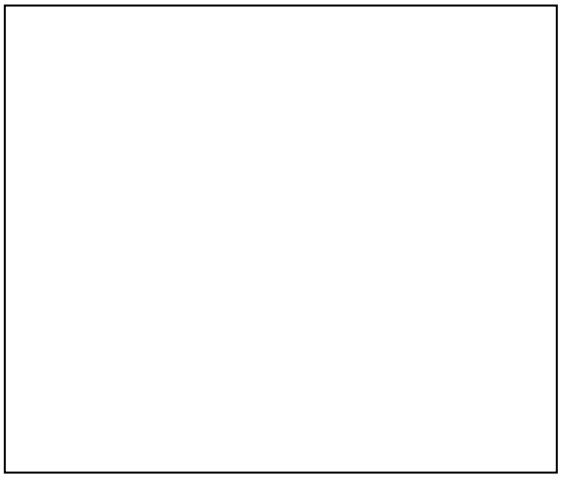
- Find a rock that has a plant growing on it. Draw what you see in the space on the right. What effect do you think the roots of this little plant will have on the rock?

_____

_____

_____

_____



A Rock's Journey – Teacher Sheet

Purpose

- To illustrate that rocks are constantly moving and changing

Classroom Preparation

- Use one rock as an example.
- Describe its possible journey to students.

Classroom-Follow-up

- Ask students why some of them suggested different journeys for the same rock.

A Rock's Journey – Student Sheet

Name _____ Date _____

Background

Rocks are constantly moving and changing.

- They are usually formed deep within the earth or at the bottom of seas or big lakes.
- They may be changed by heat and/or pressure deep within the earth or pressure at the bottom of the sea.
- Movements of the earth's crust cause huge layers of rock to break, shift and fold.
- Movements of the earth's crust move rocks from where they are formed to the earth's surface.
- Glaciers and rivers move rocks from one location to another.
- Weathering breaks rocks down into smaller pieces and turns them into sand or soil.
- Sedimentation occurs when small rocks, sand and soil pile up in layers. Sedimentation creates new rocks.
- People move rocks around, crush them into gravel or sand, put them into rock gardens, use them for building.

Instructions

- Pick a rock that you like.
- Is this rock:
  - 1 igneous
  - 1 sedimentary
  - 1 metamorphic

- Write a story about how your rock got to be at the GEOrock Garden. In your story answer these questions.

  How was your rock formed? Where was it formed? What minerals are in your rock?

  _____

  _____

  _____

  _____

  _____

  What effect did heat and/or pressure have on your rock?

  _____

  _____

  _____

  _____

  _____

  How did your rock get from where it was formed to the earth's surface?

  _____

  _____

  _____

  _____

  _____

  _____

Do you see any evidence that your rock was moved by glaciers? Rocks that have been moved by ice may have curved scratches or gouges like this: (((or like this))).

_____

_____

_____

_____

_____

How did your rock get from where it was first formed to the GEOrock Garden? List all the journeys it took.

_____

_____

_____

_____

_____

- Draw a diagram or map that shows how your rock got from the place where it was formed to the GEOrock Garden.

Writing Haiku – Teacher Sheet

Purpose

- To enhance students' observation skills
- To give students practice writing haiku

Grade Levels – Grades 6 to 12.

Classroom Preparation

- Review the haiku poetry form and read some haiku aloud.

Classroom-Follow-up

- Ask students to read their haiku aloud. (Ask for volunteers. Some students may not want to share their work.)

Writing Haiku – Student Sheet

Name _____ Date _____

Background

A haiku is a poem that has three lines and 17 syllables. The first line has five syllables. The second line has seven syllables. The third line has five syllables. Haiku are usually about some aspect of nature. They do not rhyme. Haiku originated in Japan, but now are well-known in many countries.

Instructions

Write a haiku about one rock you liked or about the GEOrock Garden as a whole. Here are some questions to get you thinking:

- How do the rocks look when the sun shines on them?
- How do the rocks look in the rain?
- Is there any moss or lichen growing on the rocks?
- What colour is a particular rock?
- What shape is a particular rock?
- Do grass or flowers grow at the base of the rocks?
- What kind of shadows do the rocks cast?

Write your haiku below:

Haiku #1

_____ 5 syllables
_____ 7 syllables
_____ 5 syllables

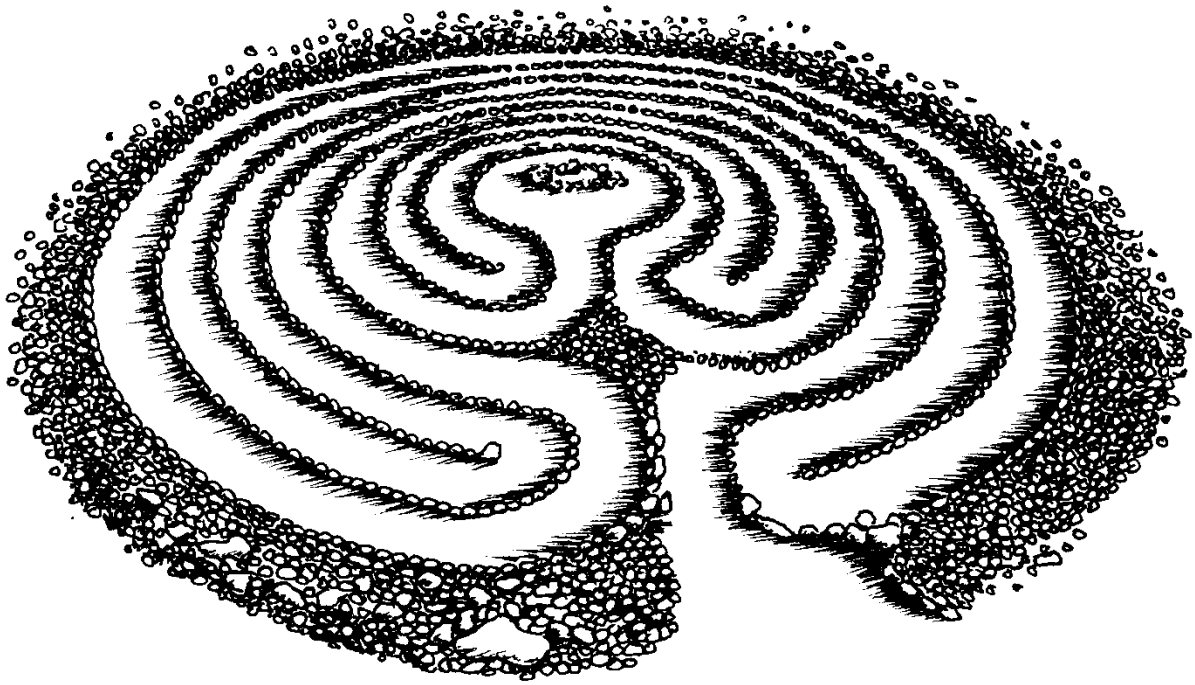
Haiku #2

_____ 5 syllables
_____ 7 syllables
_____ 5 syllables

Haiku #3

_____ 5 syllables
_____ 7 syllables
_____ 5 syllables

Follow-up Activities



Building with Rocks – Teacher Sheet

Purpose

- To make students aware of some of the practical uses of rocks
- To increase students' knowledge about their own community

Grade Levels – Grades 3 to 12.

Older students (Grades 6 to 12) can do this as an independent activity. For younger students, organize a walking tour that passes by three or four sites where rocks are used as a building material. At each site, ask students to draw what they see.

Classroom Preparation

- Bring illustrations to class that show buildings, walls, etc. made of rocks. Try to get a balance of the magnificent (the Great Wall of China, European cathedrals) and the everyday (paths, garden walls, houses, local buildings). Travel brochures, and gardening and building magazines will be good sources of photos. Discuss these illustrations with students.
- Students may need some suggestions about where to look for the various uses of rocks.

Classroom Follow-up

- Ask students who are interested in engineering and building to research and write a report on the technology used to create the Great Wall of China, one of the great cathedrals in Europe, or a local building made of stone such as the Legislative Building or the T.C. Douglas Building in Regina.
- Students can create a miniature construction using small rocks as a building material. For example, a wall, fountain or birdbath.

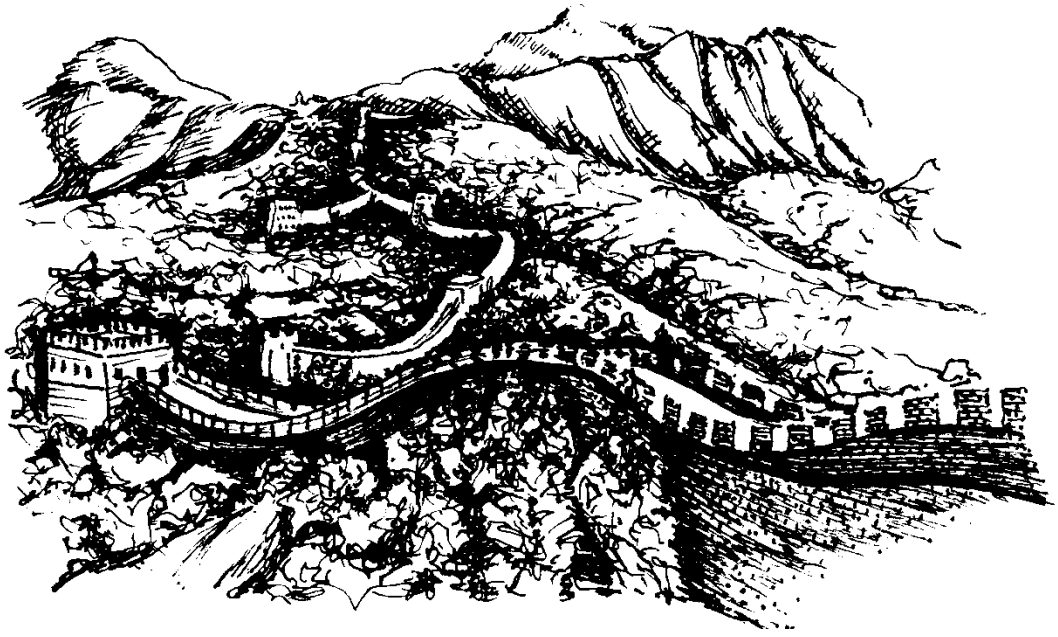
Building with Rocks – Student Sheet

Name _____ Date _____

Background

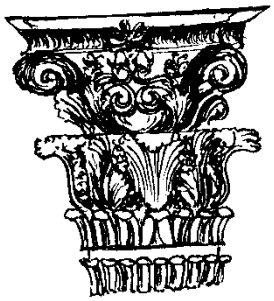
Rocks are sometimes used to construct buildings, walls, paths, fences and gardens.

An example of a rock garden.



The Great Wall of China is made out of rocks.

This building decoration is carved out of rock.



- What **advantages** do rocks have as a building material?

_____

_____

_____

_____

- What **disadvantages** do rocks have as a building material?

_____

_____

_____

_____

_____

Instructions

Walk around your community. Try to find at least one example of each of the following uses of rocks. Tell where you found each example (address or building name). Draw each example you find.

Find smooth flat rocks used to make a path.

_____

_____

Find round rocks used to make a chimney, fireplace or barbecue.

_____

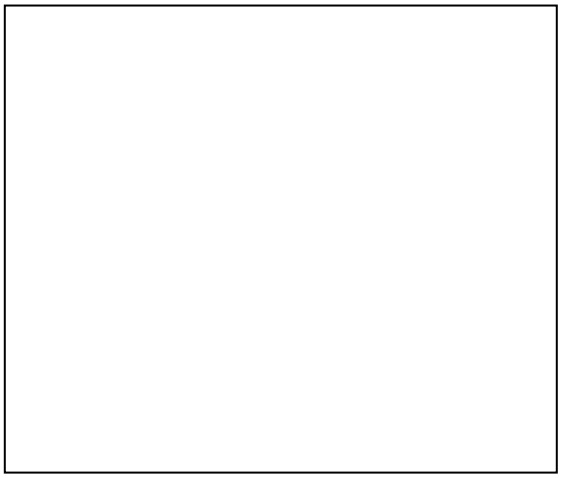
_____

_____

_____

_____

_____



Find round rocks used to make a wall around a garden or yard.

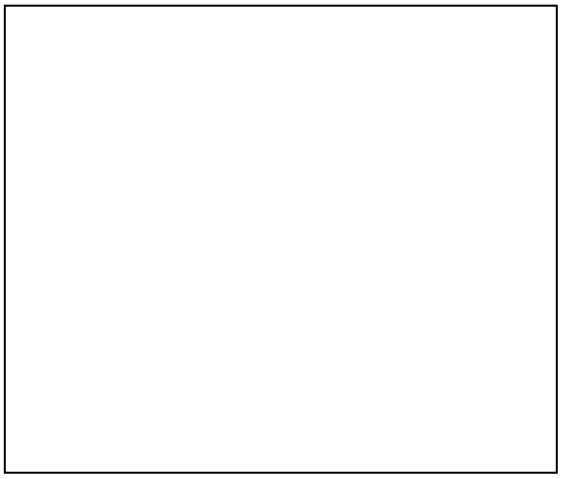
_____

_____

_____

_____

_____



Find big rocks that have been cut flat and polished and used to make a whole building.

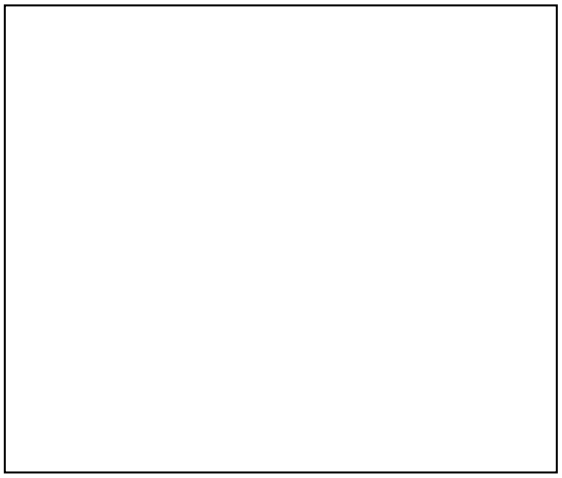
_____

_____

_____

_____

_____



Find smooth flat rocks (like slate or marble) used for a floor.

_____

_____

_____

_____

_____

Find rocks used to make a fountain or a bird bath.

_____

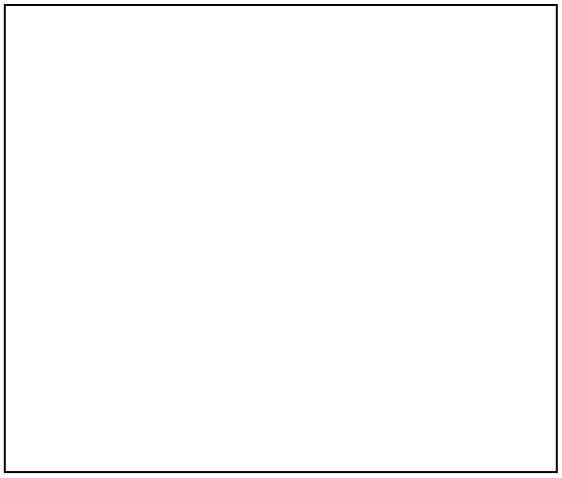
_____

_____

_____

_____

_____



Find big rocks used to create an edge around a pond.

_____

_____

_____

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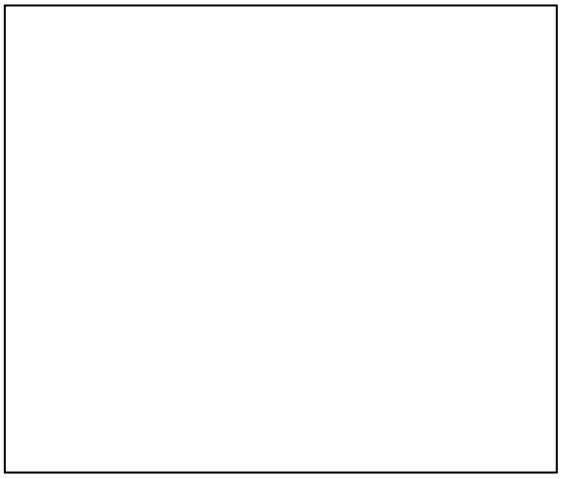
_____

_____



Arranging Rocks – Teacher Sheet

Purpose

- To demonstrate that many of the things we use in everyday life come from rocks and minerals.

Grade Levels – Grades 4 to 8. Can be adapted for older students.

With older students (Grades 9-12) ask students to select one item that came from rock and to research all of the mining and manufacturing processes that were necessary in order to turn rock into a finished item. They can present their findings using a written description and a diagram.

Classroom Preparation

- Model the activity by identifying three or four things in the classroom that are made of rocks or minerals.

Arranging Rocks – Student Sheet

Name _____ Date _____

Background

Rocks and minerals are used to make many of the things that we take for granted. For example:

- Glass is made from melted sand (sand is actually tiny grains of rock).

- Concrete is made of aggregate (sand and gravel) held together by cement (a mixture of clay and limestone). Concrete is used to make buildings, streets, roads and bridges.

- Metals are found in rocks called metal ores. The metal ore is heated to separate the metal from the unwanted rock. Some metals and their common uses are:
  - copper – used for water pipes and electrical wire
  - aluminum – used to make aluminum foil, cooking pots
  - gold – used in computers, by dentists, and to make jewelry
  - iron – used to make steel. Steel is used to make hundreds of items ranging from knives and forks, to cars, to big machinery.

Dozens of everyday items are made from rocks or minerals. For example, the legs of your school desk are probably made of steel. Your bicycle is probably made of steel and aluminum. The body of your school bus is probably made of steel and wires in the engine are made of copper. Houses, schools, cars, and buses all have windows made of glass.

Activity

- Closely examine one of the following:
  - your classroom
  - your toy box
  - the kitchen of your home
  - the school gym
  - the school-yard

  List all the things you can see that you think began as rocks. Use a separate sheet of paper.

- If you aren't sure what something is made of ask your teacher or look it up online in the school library.

- Compare your lists with those of your classmates.

Using Rocks and Minerals – Teacher Sheet

Purpose

- To emphasize that people use rocks for symbolic purposes as well as for practical purposes.

Grade Levels – Grades 4 to 8.

Classroom Preparation

- Bring photos of inukshuks and Stonehenge to class (such photos often appear in travel brochures). Discuss the photos with students.

Classroom Follow-up

- Encourage students to discuss the engineering aspects of these rock structures. How did the Inuit move rocks to the location of the inukshuk? How did the people of southern England transport the rocks for Stonehenge and set them up? How were the rocks for the GEOrock Garden moved from Moose Jaw to Regina?

Using Rocks and Minerals – Student Sheet

Name _____ Date _____

Background

The rocks in the GEOrock Garden are arranged to reflect the four summer-sky constellations: Aquila, Lyra, Cygnus and Ursa Minor. The garden was laid out in this way because our planet came from space and rocks are connected to the stars.

For thousands of years, people have arranged rocks to create symbols that have meaning to them. Some examples are:

- Inukshuks
- Medicine Wheels
- Stonehenge

All of these examples are made without mortar or any other material to hold the rocks together.

Inukshuks

Inukshuks are created by the Inuit people in northern Canada. They are human figures made of stones. They are markers to guide travellers.

Inukshuks help travellers find their way.

Medicine Wheel

Medicine Wheels are created by First Nations people of Saskatchewan and other prairie provinces and states. Medicine Wheels are made of stones and usually have two or more of the following characteristics:

- a central stone or group of stones
- one or more rings of stones
- stone lines or spokes that extend out from the centre

Medicine Wheels vary in size. Most Medicine Wheels are associated with ceremonies such as the Sun Dance that involved large groups of people.

Medicine Wheels are created by First Nations people.

Stonehenge

Stonehenge is about 2,000 years old.

Stonehenge was built about 2,000 years ago in southern England. Some of the stones used to make Stonehenge are arranged so they line up with the sun and the moon on the solstices (the longest and shortest day of the year). Stonehenge was probably used to help keep a calendar.

There are many other structures like Stonehenge in southern England, but it is the best known.

Instructions

Choose one of the activities below.

- Look up the summer sky in an encyclopedia or astronomy book. Draw a sketch of the night sky and name all the important stars. Compare your sketch to the layout of the GEOrock garden.

- Use small stones to make a model of an inukshuk. Don't use any glue or cement. What challenges did you face when you built your model. What challenges do you think the Inuit people face when they build inukshuks?

- Use small stones to make a model of Stonehenge. Don't use glue or cement. What challenges did you face? What challenges do you think the people who built Stonehenge faced?

- Interview a First Nations Elder about Medicine Wheels. Ask about how these symbols were created and their role in spiritual life and ceremonies.

Geology Find-A-Word – Teacher Sheet

Purpose

- To reinforce vocabulary related to the GEOrock Garden and to geology generally.

Grade Levels – Grades 4 to 8.

Classroom Preparation

- Review the meaning of geology words with students.
- Remind students that they can look in their textbooks, a dictionary or an encyclopedia if they don't know the definitions of some of the words in the puzzle.

Extensions

- Give students a blank grid and ask them to make their own geology find-a-word.

Geology Find-A-Word – Student Sheet

Name _____ Date _____

The words listed are hidden in the puzzle below. Find each word and circle it. Write a definition of each word in the space after it.

Basalt _____
Conglomerate _____
Feldspar _____
Fossils _____
Gneiss _____
Granite _____
Igneous _____
Marble _____
Metamorphic _____
Mica _____
Minerals _____
Obsidean _____
Pebbles _____
Quartz _____
Rocks _____
Sand _____
Sandstone _____
Sedimentary _____
Slate _____
Weathering _____

F	R	U	X	B	N	P	R	D	E	U	S	S	V	M	P	Q	X	B	B
J	L	M	C	U	P	W	M	A	I	Y	S	H	D	R	M	N	Z	A	B
Q	U	V	B	N	I	T	S	U	O	G	R	A	N	I	T	E	R	S	F
S	E	D	I	M	E	N	T	A	R	Y	B	L	A	T	R	V	I	A	D
V	I	V	G	E	M	O	T	X	O	H	R	E	R	L	T	S	U	L	K
M	N	T	N	T	E	E	L	M	C	A	P	I	L	A	M	E	S	T	E
O	R	G	E	A	R	R	O	S	K	R	F	E	L	D	S	P	A	R	T
P	M	M	O	M	H	F	O	S	S	I	L	S	A	D	L	Q	T	G	U
K	A	O	U	O	B	S	I	D	E	A	N	T	B	E	A	V	R	N	K
C	D	D	S	R	S	A	N	E	T	S	U	J	O	F	T	M	H	E	O
X	J	S	A	P	H	R	S	A	N	D	S	T	O	N	E	M	K	I	R
M	N	R	D	H	P	C	D	M	F	K	L	X	R	S	T	A	L	S	S
I	O	N	L	I	M	W	E	A	T	H	E	R	I	N	G	R	A	S	Y
T	P	H	P	C	O	N	G	L	O	M	E	R	A	T	E	N	Y	P	N
S	C	C	R	L	E	A	M	R	N	I	A	S	B	A	D	R	L	J	B
M	A	R	B	L	E	B	E	I	M	C	M	G	A	R	S	Y	N	O	A
B	L	V	E	D	M	I	N	E	R	A	L	S	Z	M	S	A	N	D	I
O	Q	U	A	R	T	Z	R	S	U	L	E	D	T	B	N	E	O	X	O
T	R	M	S	K	A	B	N	O	I	P	E	B	B	L	E	S	A	F	J
A	S	P	T	G	Q	C	Z	Y	M	V	L	S	A	I	K	E	N	S	O

Geology Find-A-Word Answer Key

F	R	U	X	B	N	P	R	D	E	U	S	S	V	M	P	Q	X	B	B
J	L	M	C	U	P	W	M	A	I	Y	S	H	D	R	M	N	Z	A	B
Q	U	V	B	N	I	T	S	U	O	G	R	A	N	I	T	E	R	S	F
S	E	D	I	M	E	N	T	A	R	Y	B	L	A	T	R	V	I	A	D
V	I	V	G	E	M	O	T	X	O	H	R	E	R	L	T	S	U	L	K
M	N	T	N	T	E	E	L	M	C	A	P	I	L	A	M	E	S	T	E
O	R	G	E	A	R	R	O	S	K	R	F	E	L	D	S	P	A	R	T
P	M	M	O	M	H	F	O	S	S	I	L	S	A	D	L	Q	T	G	U
K	A	O	U	O	B	S	I	D	E	A	N	T	B	E	A	V	R	N	K
C	D	D	S	R	S	A	N	E	T	S	U	J	O	F	T	M	H	E	O
X	J	S	A	P	H	R	S	A	N	D	S	T	O	N	E	M	K	I	R
M	N	R	D	H	P	C	D	M	F	K	L	X	R	S	T	A	L	S	S
I	O	N	L	I	M	W	E	A	T	H	E	R	I	N	G	R	A	S	Y
T	P	H	P	C	O	N	G	L	O	M	E	R	A	T	E	N	Y	P	N
S	C	C	R	L	E	A	M	R	N	I	A	S	B	A	D	R	L	J	B
M	A	R	B	L	E	B	E	I	M	C	M	G	A	R	S	Y	N	O	A
B	L	V	E	D	M	I	N	E	R	A	L	S	Z	M	S	A	N	D	I
O	Q	U	A	R	T	Z	R	S	U	L	E	D	T	B	N	E	O	X	O
T	R	M	S	K	A	B	N	O	I	P	E	B	B	L	E	S	A	F	J
A	S	P	T	G	Q	C	Z	Y	M	V	L	S	A	I	K	E	N	S	O