Grade 4

Cluster 4: Rocks, Minerals, and Erosion

Overview

The study of rocks and minerals introduces students to geology. By examining various rocks and minerals found in the Earth's crust, students learn about their characteristics and properties. These characteristics and properties determine how these rocks and minerals are used by humans. Students discover the role rocks play in forming soil (see *Grade 3, Cluster 4: Soils in the Environment*) and in providing us with information about Earth's history. Students advance their understanding of the changing landscape by becoming aware of how wind, water, and ice continue to reshape it through erosion. This leads students to explore ways in which humans can adapt to and prevent or make changes in the landscape.

PRESCRIBED LEARNING OUTCOMES	SUGGESTIONS FOR INSTRUCTION
Students will...	
4-4-01 Use appropriate vocabulary related to their investigations of rocks, minerals, and erosion. Include: rock, mineral, characteristic, property, scratch test, streak test, igneous, sedimentary, metamorphic, fossil, organism, extinct, soil formation, erosion, natural phenomena. GLO: C6, D5	➢ Introduce, explain, use, and reinforce vocabulary throughout this cluster. ➢ **Word Splash** Begin the study of rocks and minerals with a Word Splash. Include the words rock, mineral, characteristic, property, scratch test, streak test, igneous, sedimentary, and metamorphic. (See *Success for All Learners*, 6.28 for a procedural outline.) ➢ **Word Wall** Begin to develop a Science Word Wall by recording the terms from the Word Splash on a large wall chart. (See *ELA, Strategies*, p. 19.)
4-4-02 Classify rocks and minerals according to student-generated criteria. GLO: C2, D3, D5 **4-0-5a**. Select and use tools to observe, measure, and construct. *Examples: tuning fork, prism, binoculars, measuring tape...* GLO: C2, C3, C5 **4-0-6a**. Construct bar graphs and pictographs using many to one correspondence, and interpret these as well as graphs from other sources. (Math SP-III.2.4) GLO: C2, C6 **4-0-6c**. Choose and identify relevant attributes for use in a classification system, and create a chart or diagram that shows the method of classifying. (Math PR-II.2.4) GLO: C2, C3, C5	➢ **Observing Rocks** Ask students to bring in a variety of rocks or provide students with kits. Have students work in pairs to describe, in as much detail as possible, the rocks in their collection. Use of tools such as magnifying glasses, scales, and measuring tapes, etc., should be encouraged to enhance observations. Once the observations are completed, have students classify the rocks and re-classify them several times, recording the groupings and criteria used each time. Have each pair share their classification categories with the class. The following charts can be used to record observations and classifications: **Rock Observations** Rock #1 _____ Rock #2 _____ Rock #2 _____ **Classifying Rocks** (sample chart) **Classification #1:** classified according to: shape **Rounded** **Sharp Edges** **Mixture of Round and Sharp** rock #1 rock #2 rock #4 rock #3 rock #5 **Classification #2:** classified according to: texture **Rough** **Smooth** rock #1 rock #2 rock #3 rock #4 rock #5

TEACHER NOTES

Overall Cluster Note: Teachers should be aware that the Earth (including rocks) is considered to be a living, spiritual force in traditional Aboriginal cultures. Additionally, rock plays an important role in many spiritual processes.

Caution: Encourage students to be cautious if collecting their own rocks. Trying to break apart a rock can send fragments flying into the air. Eye protection should be worn.

The label **rock** is often used to refer to rock or mineral substances. At this stage in the cluster, no attempt should be made to differentiate between the two.

Throughout Grades 1 to 3, students have developed their ability to observe using all of their senses and to identify and describe characteristics and properties of objects and materials. Students should be encouraged to use all of these skills in describing the rocks in many ways. Terms like **colour, texture, shape, size, smell, and lustre** (shiny or dullness) should appear in their discussions. Other characteristics such as mass/weight and magnetic attraction may also emerge.

Creative classification allows students to examine several rocks and minerals (without worrying about distinctions among them). Students can describe them, identify likenesses and differences, and develop classifications. Formal identification should not take place at this time.

SUGGESTIONS FOR ASSESSMENT

Self-Assessment: Observing Rocks

1. I used the following senses to observe the rocks:
   - ❑ sight
   - ❑ hearing
   - ❑ touch
   - ❑ smell
2. I used the following tools to observe the rocks:
   - ❑ ruler
   - ❑ magnifying glass
   - ❑ other _____
3. I identified the following properties:
   - ❑ colour
   - ❑ texture
   - ❑ shape
   - ❑ size
   - ❑ other _____
4. My observations skills are _____ _____.

PRESCRIBED LEARNING OUTCOMES

Students will...

4-4-03 Test to determine characteristics of rocks and properties of minerals, and classify accordingly.

Include: scratch test for hardness, streak test for colour.

GLO: A1, C2, D3, D5

4-4-04 Differentiate between minerals and rocks.

Include: minerals are composed of the same substance throughout, rocks are composed of two or more minerals...

GLO: D5

4-0-4a. Carry out a plan, and describe the purpose of the steps followed. (Math SP-V.2.4) GLO: C2

4-0-5c. Record observations in a variety of ways. *Examples: point-form notes, sentences, labelled diagrams, charts...* (ELA 2.1.1, 3.3.1, 4.1.1, 4.1.2; Math SP-1.2.4, SP-II.2.4) GLO: C2, C6

4-0-7b. Identify new questions that arise from what was learned. (ELA 3.3.4) GLO: A1, C2, C3

4-0-9b. Demonstrate confidence in their ability to do science. GLO: C5

SUGGESTIONS FOR INSTRUCTION

➢ **Rock or Mineral?**

Tell students that the "rocks" they have been classifying are actually mixtures of rocks and minerals. Provide each pair of students with a few samples of both rocks and minerals. Have students use a chart to describe and compare the characteristics of each. Have each pair share their findings. As a class, discuss the one characteristic that seemed to distinguish rocks from minerals. (The samples should be carefully chosen to clearly show rocks as mixtures of things and minerals as one substance throughout.) Have students write class definitions for rocks and minerals in their science journals. Students should also draw what each sample would look like if it was cut in half. (Have students visualize a plain muffin versus a blueberry and walnut muffin.)

➢ **Testing Minerals**

Provide students with informational text in which the properties of minerals are discussed (e.g., made from crystals, crystals can be identified by colour, hardness, crystal formation, etc.). Have students complete hardness tests on their sample minerals, as well as on minerals from their own collections. (They will first have to determine which samples from their own collections are minerals.) For the tests, students will attempt to scratch the mineral with their fingernail, a penny, and a steel nail, and record their results in a chart such as the following:

Mineral Hardness Test

Mineral	#1	#2	#3
fingernail scratches:	_____	_____	_____
penny scratches:	_____	_____	_____
steel nail scratches:	_____	_____	_____

Have students use Moh's Hardness Scale to determine each mineral's approximate hardness based on the results. Fingernails have a hardness of about 2.5, a penny has a hardness of 3, and steel has a hardness of about 5.5. Have students place their minerals in order from softest to hardest. After the mineral tests, have students reflect on the following questions in their science journals:

- How would you go about identifying an unknown material using the hardness test?
- Why wouldn't it be useful to carry out a hardness test on rocks?

TEACHER NOTES

Minerals are inorganic solids that occur naturally on the Earth. **Inorganic** means that the minerals were formed from substances that were never alive. Minerals don't include the remains of plants or animals. A mineral is usually made up of crystals. These can be identified by properties such as colour, hardness, and crystal form. Minerals look the same inside and out.

Minerals are the building blocks of **rocks**. Rocks are mixtures of minerals and vary in the number and amount of minerals present.

Moh's Scale of Mineral Hardness is a scale in common usage that measures the resistance of minerals to scratching.

1 - talc

2 - gypsum

3 - calcite

4 - fluorite

5 - apatite

6 - feldspar

7 - quartz

8 - topaz

9 - corundum

10 - diamond

A mineral can be scratched by any other mineral that has a higher number on the Moh's Scale. For example, gypsum can only scratch talc, but gypsum can be scratched by calcite, fluorite, apatite, etc.

SUGGESTIONS FOR ASSESSMENT

Science Journal Entry: Rock or Mineral

Have students answer the following questions in their science journals:

1. What is the definition of a rock?
2. What is the definition of a mineral?

Look for

- ❑ rocks are made up of minerals
- ❑ minerals are the same throughout and make up rocks

PRESCRIBED LEARNING OUTCOMES	SUGGESTIONS FOR INSTRUCTION
Students will...	
4-4-05 Compare rocks and minerals from the local environment with each other and with those from other geological areas. GLO: C2, D5, E1 **4-0-1a**. Ask questions that lead to investigations of living things, objects, and events in the local environment. (ELA 1.2.4, 3.1.2) GLO: A1, C2, C5 **4-0-2a**. Access information using a variety of sources. *Examples: school libraries, videos, traditional knowledge, CD-ROMs, Internet...* (ELA 3.2.2, 3.2.4, TFS 2.1.1) GLO: C6 **4-0-6e**. Evaluate, with guidance, the methods used to answer a question or solve a problem. GLO: C2, C3 **4-0-7a**. Draw a conclusion based on evidence gathered through research and observation. GLO: A1, A2, C2	➢ **Local Rock Collections** Have students examine the locally gathered rocks and minerals they brought in to class. Students should label their rocks according to where they were found and use simple identification guides to identify the samples. ➢ **Inquiry about Rocks and Minerals** With students, pose questions about the differences and similarities among the rocks and minerals found locally compared with those found in other locations. Inquiry questions may include the following: • What types of rocks and minerals are found locally? • Are the same rocks and minerals found throughout Manitoba? Throughout Canada? Why or why not? Use an I-Chart (Hoffman, 1992) to facilitate a whole class inquiry. Have students analyze pictures, charts, maps, graphs, or diagrams to find information or to answer inquiry questions about minerals and rocks from Manitoba and the various geographical areas. (Link to outcome 4-4-08.) (Note: The I-Chart is discussed in *ELA, Strategies,* pp. 83-87.) ➢ **Guest Presenter** Invite a geologist to share information and examples about his/her work. Help students to prepare for the visit by brainstorming and developing questions to ask. ➢ **Field Trip** Visit a local site such as a quarry or mine, or arrange for a trip to a museum to learn about rocks or minerals found locally.
4-4-06 Give examples of products derived from rocks and minerals. *Examples: china, chalk, jewellery, pumice stone, drywall, talcum powder...* GLO: B1 **4-4-07** Describe how characteristics of rocks and properties of minerals determine their uses. *Examples: soft soapstone is used for carving...* GLO: B1, D3, D5	➢ **What's It Made From?** Have students listen to, read, or view texts that will provide them with information about products or objects that are derived from rocks and minerals. Include resources that cover a range of multi-cultural examples. For example, Inukshuks are used in the Canadian North as landmarks. "Grandfather" rocks are used by Plains and other cultures in sweat ceremonies. Afterwards, have students brainstorm the properties that allow that rock or mineral to be used in that way. Have students work with a partner to complete a chart such as the one shown below.

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TEACHER NOTES	SUGGESTIONS FOR ASSESSMENT
Refer to Blackline Masters: 12-15 for Geologic Maps of Canada and Manitoba.	**Observation Checklist: Rocks and Minerals Inquiry** The student ❑ asks questions that lead to investigations of rocks ❑ makes predictions based on observed patterns, collected data, or data provided from other sources ❑ accesses information from a variety of sources ❑ identifies problem as they arise and works with others to find solutions ❑ works cooperatively ❑ shares group roles and responsibilities ❑ communicates questions, ideas, and intentions ❑ uses tools and apparatus safely ❑ records observations in a variety of ways ❑ draws a conclusion based on evidence gathered through research and observation

PRESCRIBED LEARNING OUTCOMES	SUGGESTIONS FOR INSTRUCTION
Students will...	

Object	Type of Rock	Properties
Inuit carving	soapstone	soft, opaque, can be carved
building	limestone	readily available, strong, yet can be cut
chalk	gypsum	soft, good writing instrument
coal	sedimentary	fuel, organic remains
diamond	diamond	hard, lustre

➢ **Product Collage**

Have students make a collage of products that are derived from rocks and minerals. Students may choose a theme for their collages, such as "In the Art Studio," "In the Home," etc.

➢ **Science Journals**

Have students finish the following prompts in their science journals:

1. Objects in the school that come from rocks include _____. (List five things.)
2. Objects at home that come from rocks are _____. (List five things.)
3. The most interesting thing I learned about rocks and minerals was _____.

4-4-08 Recognize that there are three types of rock, and describe how each is formed.

Include: igneous, sedimentary, metamorphic.

GLO: D5

4-0-2a. Access information using a variety of sources. *Examples: school libraries, videos, traditional knowledge, CD-ROMs, Internet...* (ELA 3.2.2, 3.2.4, TFS 2.1.1) GLO: C6

4-0-2b. Review information to determine its usefulness to inquiry or research needs. (ELA 3.2.3, 3.3.3) GLO: C6, C8

4-0-7e. Communicate results and conclusions in a variety of ways. Examples: point-form lists, sentences, graphs, labelled diagrams, charts... (ELA 2.3.5, 4.2.5; Math SP-III.1.4, SP-III.2.4; TFS 2.1.4) GLO: C6

➢ **How Did You Make that Rock?**

As a class, read and view informational texts including books, illustrations, CD-ROMs, videos, etc., to gather information on how rocks are formed. Divide students into small groups and assign each group the topics: igneous, metamorphic, or sedimentary rocks. Have students create a short presentation illustrating how their type of rock is formed. This could take the form of a rap song, a skit, a poster, etc.

TEACHER NOTES

SUGGESTIONS FOR ASSESSMENT

Igneous rocks derive from the cooling of magma (melted rocks and minerals) formed by volcanoes. Examples include pumice, basalt, and granite.

Sedimentary rocks are rocks made of sediment (sand, mud, pebbles, silt) that settles in layers on the ground and at the bottom of lakes and oceans. The weight of the layers eventually compresses them into rock. Often, plant or animal remains are trapped in the layers and can result in fossil formation. Examples include sandstone, limestone, and shale.

Metamorphic rocks are rocks changed from their original form by heat and pressure below the Earth's surface. Examples include marble, slate, and gneiss.

Learning Log Entry: How Did You Make that Rock?

Have students list the three types of rocks and explain how each type is formed.

Look for

- ❑ igneous - from cooling magma formed by volcanoes
- ❑ sedimentary - made of sediment that settles in layers; pressure eventually compresses the layers into rocks
- ❑ metamorphic - rocks changed from their original form by heat and pressure below the Earth's surface

PRESCRIBED LEARNING OUTCOMES	SUGGESTIONS FOR INSTRUCTION
Students will...	
4-4-09 Explain how fossils are formed. GLO: D1, D5, E3 **4-4-10** Describe how fossils help humans gain a better understanding of Earth's history, including identifying organisms that are now extinct. GLO: A1, A2, D1, D5 **4-0-2a**. Access information using a variety of sources. *Examples: school libraries, videos, traditional knowledge, CD-ROMs, Internet...* (ELA 3.2.2, 3.2.4, TFS 2.1.1) GLO: C6 **4-0-2b**. Review information to determine its usefulness to inquiry or research needs. (ELA 3.2.3, 3.3.3) GLO: C6, C8 **4-0-8b**. Recognize that scientists must support their explanations using evidence and scientific knowledge. GLO: A1, A2, C2	➢ **Observing the Environment — A Fossil Walk** If possible, have students visit local buildings that contain limestone. Have students go on a fossil hunt and complete rubbings or drawings of the fossils they find. ➢ **What Are Fossils?** Use KWL (Ogle, 1986) to organize a study of fossils. Together, brainstorm and list everything students know and think they know about fossils. Have students then pose questions that tell what they want to find out. Guide students' questions to focus on the following questions: • How are fossils formed? • Where are most fossils found in Manitoba? In Canada? • Why are they found there? Students then research by viewing videos and filmstrips and reading books and articles to find answers to their questions. They discuss findings and synthesize information. New ideas are grouped together and listed under the L column. (Note: KWL is discussed in *ELA, Strategies*, pp. 89-91.) ➢ **What Can Fossils Tell Us?** Have students prepare a short biography of a famous paleontologist, including what discovery he/she made and how this has helped us to gain an understanding of Earth's history. Students should present their information to the class.
4-4-11 Investigate and describe ways in which rock contributes to soil formation. GLO: D5, E2, E3 **4-4-12** Investigate and describe ways in which soil erosion is controlled or minimized in their community and in communities around the world. *Examples: windbreaks, retaining walls, terracing, cover crops, reforestation...* GLO: A5, B1, B5	➢ **Breaking Down Rocks** Have students place two to three clean rocks in a plastic container with a small amount of water and shake the container for one minute. (For this learning experience, choose at least one rock specimen that is soft.) Have students open the container and observe what happened. Have students reflect on the activity by asking the following reflection questions: • What would you call the particles collected in the container? • In nature, what would cause the rocks to rub together and wear away?

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Teacher Notes

Manitoba limestone from the Garson-Tyndall area of Manitoba is a common building material throughout Manitoba, Canada, and the world. It can be found in the Manitoba Legislative building and in numerous local town halls, post offices, libraries, and schools. Fossils in this type of limestone are from the Ordovician Period and contain earlier marine fossils such as trilobites, jellyfish, and coral, as opposed to the later-period dinosaurs.

See Blackline Master 12: Geologic Map of Canada, and Blackline Master 14: Geologic Map of Maniotba to locate fossil regions.

Suggestions for Assessment

Paper and Pencil Task: Fossils

Name: _____ Date:_____

1. Explain how fossils are formed. _____
   _____
   _____.
2. If you were going to search for fossils in Manitoba, where would the best place be to look? Explain your thinking.
   _____
   _____.
3. Fossils help humans understand Earth's history. Do you agree or disagree with this statement? Explain your answer. _____
   _____
   _____.

PRESCRIBED LEARNING OUTCOMES	SUGGESTIONS FOR INSTRUCTION
Students will...	
4-0-4f. Assume roles, and share responsibilities as group members. (ELA 5.2.2) GLO: C7 **4-0-4h**. Use tools and apparatus in a manner that ensures personal safety and the safety of others. GLO: C1	➢ **Centres: Exploring Erosion** Have students explore the effects of water and wind on sand through centres. At each centre have students record their observations using the following questions: • What effect did the wind/water have on the sand (include labelled diagrams)? • How could the erosion observed be prevented? Centres might include the following ideas and materials: Centre 1 - The effects of wind. Materials: small electric fan or hair dryer, container of sand. Centre 2 - The effects of water. Materials: container of sand, supply of water, small watering can or cup with holes. ➢ **Observing the Environment — Controlling Erosion** Have students take a neighbourhood walk to observe ways people control erosion. Methods can include edging around gardens, retaining walls, windbreaks, stone jetties, mulch, plantings, etc. Invite a local farmer to the class to talk about methods used to control erosion in agriculture. ➢ **Inquiry: Controlling Erosion Around the World** Have students use the I-Chart to develop a class inquiry on methods for controlling erosion around the world. As a class, develop questions to guide the inquiry. Have each group research a different country or different type of erosion control. Have students use the Jigsaw method (Aronson, Blaney, Silkes, and Snapp, 1978) to teach each other about their findings. (See *Success for All Learners*, 5.9.)

TEACHER NOTES

SUGGESTIONS FOR ASSESSMENT

PRESCRIBED LEARNING OUTCOMES

Students will...

4-4-13 Use the design process to determine an appropriate system for controlling soil erosion in a given situation.

GLO: B1, B5, C3, E3

4-0-1c. Identify practical problems to solve in the local environment. GLO: C3

4-0-3d. Brainstorm possible solutions to a practical problem, and identify and justify which solution to implement. (ELA 1.2.3) GLO: C3

4-0-3e. Create a written plan to solve a problem or meet a need. Include: identify steps to follow, prepare a labelled diagram. GLO: C3

4-0-3f. Develop criteria to evaluate an object, device, or system based on its function, aesthetics, and other considerations such as materials, and cost. GLO: C3

4-0-4b. Construct an object, device, or system to solve a problem or meet a need. GLO: C3

4-0-4c. Test an object, device, or system with respect to pre-determined criteria. GLO: C3, C5

4-0-4d. Identify and make improvements to an object, device, or system, and explain the rationale for the changes. GLO: C3

4-0-7c. Identify new problems that arise. GLO: C3

4-0-8c. Recognize that designing a solution to a simple problem may have considerations, such as cost, materials, time, and space. GLO: B2, C3

SUGGESTIONS FOR INSTRUCTION

➢ **Design Process: Controlling Soil Erosion**

Present a scenario to students such as: A farm couple whose land is on a hill keep losing their soil when it rains. They have a small amount of land with very fertile soil. What can they do to control erosion?

Have students work in small groups to brainstorm and create a written plan (labelled diagram) for the system they would recommend. Materials for a working model should be identified. When the plans are completed and materials gathered, have students visit a local sandbox to create a model of their farm, install their erosion control system, and test its effectiveness using a watering can. Evaluation criteria can include the following elements:

- shows a reduction in the amount of earth (sand) that is washed away
- includes detailed drawing
- utilizes method(s) of erosion control learned about during the cluster
- includes justification for choice of system

TEACHER NOTES

Have students use Blackline Master 4: Design Process Recording Sheet: Grades 3 and 4.

SUGGESTIONS FOR ASSESSMENT

Design Process Checklist

The student

- ❑ understands the problem
- ❑ brainstorms possible solutions
- ❑ creates a written plan
- ❑ develops criteria for success
- ❑ includes labelled diagram
- ❑ designs an appropriate system
- ❑ tests the system
- ❑ identifies and makes improvements
- ❑ identifies new problems that arise
- ❑ recognizes that designing a solution may involve cost and materials

PRESCRIBED LEARNING OUTCOMES	SUGGESTIONS FOR INSTRUCTION
Students will...	
4-4-14 Describe effects of wind, water, and ice on the landscape. *Examples: ice breaking rocks into soil, wind shaping sand dunes, waves polishing rocks on the shoreline...* GLO: D5, E3	➢ **Landscape Images** Have students create an image (using paint, felt-tip markers, coloured pencils, etc.) that portrays the effects of wind, water, or ice on a particular landscape. Students should use this activity to apply their learning about these effects. Have students combine pictures from magazines with their own drawings. Have students make notes based on the landscape images, summarizing the different effects.
4-0-4g. Communicate questions, ideas and intentions, and listen effectively to others during classroom-learning experiences. GLO: C6 **4-0-5c**. Record observations in a variety of ways. Examples: point-form notes, sentences, labelled diagrams, charts... (ELA 2.1.1, 3.3.1, 4.1.1, 4.1.2; Math SP-1.2.4, SP-II.2.4) GLO: C2, C6	
4-4-15 Identify natural phenomena and human activities that cause significant changes in the landscape. *Examples: floods, avalanches, mud slides, hydroelectric dams, clearing land for agriculture, clear-cut forestry, forest fires...* GLO: B5, D5, E3	➢ **Changing the Landscape** With students, develop a list of natural and human-caused phenomena that cause significant changes in landscapes. Example: **Landscape Changes** **Natural**: avalanches, mudslides, floods, forest fires **Human-Caused**: dams, agriculture/farming, forestry, urban housing ➢ **Telling a Story** Have students write a story from the viewpoint of a large boulder or rock outcrop, observing what happens to the surrounding area over a period of a hundred years. Stories should include both human and natural changes.

TEACHER NOTES

SUGGESTIONS FOR ASSESSMENT

At this point the emphasis is on recognizing that the landscape is ever-changing and that there are certain natural and human-caused events that can cause the landscape to change even more rapidly. Emphasis should not be placed on making judgements about good or bad, right or wrong.

Scoring Rubric: Telling a Story

Scale	Natural Phenomena	Human Activities	Communication
4	at least four examples included	at least four examples given	detailed, clear and well written
3	at least three examples included	at least three examples given	complete and well written
2	at least two examples included	at least two examples given	complete but may be unclear or lacks detail
1	at least one example included	at least one example given	incomplete

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