Rocky the Racoon explores the Niagara Escarpment Teacher's Guide

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Illustrated by Alexander Young

Special thanks to the people who provided helpful feedback on the book and teacher's guide!

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Dear Educators,

Thank you for everything you do to teach students about the natural world around them!

We hope you enjoy this book and have an opportunity to use it in your classrooms. The following teacher's guide is full of ideas and resources assembled from multiple sources that can supplement "Rocky the Raccoon Explores the Niagara Escarpment". The guide is organized into printable information sheets, virtual activities, activities and worksheets, reviews and quizzes, posters, and resources.

The Niagara Escarpment is a spectacular geological feature that extends from New York State across Ontario and into Michigan and Wisconsin. The rocks exposed along the escarpment influence our economy, transportation, building materials, drinking water, climate and agriculture. For more information about the environmental influence of the Niagara Escarpment and possible field trip locations visit geoscienceinfo.com.

The current Ontario Curriculum standards for Grade 4 Earth and Space Science (2022) are included below. This book was written to align with the overall expectations and some of the specific expectations of this curriculum. If you are interested in full lesson plan packages and additional resources see the Mining Matters Classroom Resource Kits, which are available for junior, intermediate and senior classrooms at subsidized costs (https://miningmatters.ca/classroom-resource-kits).

We look forward to you sharing these resources with your students and inspiring the next generation to learn about the amazing geology that lies in their backyards.

Sincerely,
Rocky Teacher's Guide Team

The Ontario Curriculum: Science and Technology © King's Printer for Ontario, 2022
8 March 2022 Available at: https://www.dcp.edu.gov.on.ca/en/curriculum/science-technology/grades/grade-4/strands#e

E. Earth and Space Systems
Rocks, Minerals, and Geological Processes

In this strand, students integrate learning from Strand A as they investigate concepts, develop and apply skills, and make meaningful connections to their lives and communities.

Overall expectations
By the end of Grade 4, students will:
E1. Relating Science and Technology to Our Changing World
assess the social and environmental impacts of geological processes and of human uses of rocks and minerals

Specific expectations
By the end of Grade 4, students will:
Rocks, Minerals, and Geological Processes

E1.1 analyse ways in which geological processes impact society and the environment
E1.2 assess social and environmental impacts of extracting and refining rocks and minerals and of manufacturing, recycling, and disposing of products derived from rocks and minerals, while taking various perspectives into account
E2. Exploring and Understanding Concepts
demonstrate an understanding of rocks, minerals, and Earth's geological processes

Specific expectations
By the end of Grade 4, students will:
Rocks, Minerals, and Geological Processes

E2.1 explain geological processes that result in the formation of igneous, sedimentary, and metamorphic rocks, using the rock cycle
E2.2 describe the physical properties of igneous, sedimentary, and metamorphic rocks
E2.3 classify different rocks and minerals according to their composition and physical properties, using various tests and criteria
E2.4 describe everyday uses of rocks and minerals
E2.5 describe how fossils are formed and what information they can provide about Earth's history
E2.6 demonstrate an understanding of First Nations, Métis, and Inuit geological knowledges that are used in the selection of different rocks and minerals for specific purposes.

Table of Contents

Information sheets

ROCKS, MINERALS, AND FOSSILS

What is a Geologist?
A geologist is a scientist who studies rocks and minerals and the physical characteristics of the Earth and other planets of the solar system.

What is a Paleontologist?
A paleontologist is a scientist who studies fossils to learn about the history of life on the Earth.

Our Earth
Our planet is a gigantic ball of liquid and solid rock. Rocks are made up of different kinds of minerals. Many kinds of minerals and rocks are found all over the world.

Rocks
All rocks and stones, regardless of size, are made up of two or more minerals. No two rocks are exactly alike. They have different sizes, colours, and shapes and some are harder than other. Rocks are formed in different ways. There are three types of rocks: Igneous, Sedimentary, Metamorphic.

Minerals
Minerals are non-living solid substances. They are made up of the same substance throughout. There are about 4000 different types of minerals found on Earth, but only a handful are common. When you look at minerals under a magnifying glass or microscope, you will see that they are formed of distinct shapes called crystals.

Fossils
Fossils are the remains or traces of ancient organisms. Most fossils are hard body parts like bones, shells, and teeth. Animals, plants, and microscopic life can be preserved as body fossils. Trace fossils are the evidence left behind by the movement of ancient creatures such as footprints and burrows.

ROCKS VS MINERALS

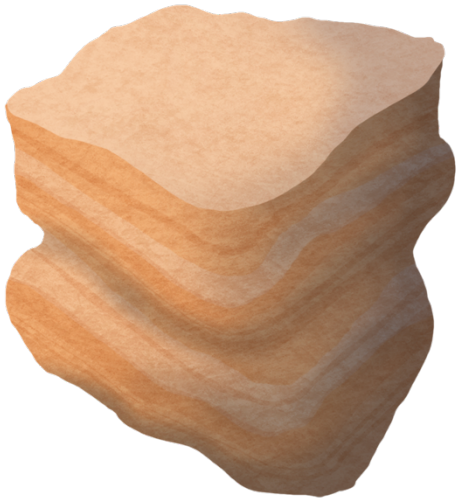
What is the difference between a rock and mineral?
One way to think about the difference is to think of chocolate bars! Imagine two chocolate bars. One is pure chocolate. Each bite that you take will be exactly the same. The other is filled with nuts, marshmallows, and even caramel. You may get a different mixture of these ingredients with each bite.

How does this help you understand the difference between rocks and minerals?
The pure chocolate bar is like a mineral with the same substance throughout. The chocolate bar with all the other good stuff is a like a rock made of two or more minerals.

Why do you think rocks are different colours?
Rocks are different colours because they are made up of two or more minerals and the colour of a rock will vary depending on the combinations of minerals.

How do we classify rocks and minerals?
Rocks and minerals are classified according to colour, shape, size, hardness, texture, and weight.

Mineral: Quartz



Rock: Sandstone

HOW TO CLASSIFY MINERALS

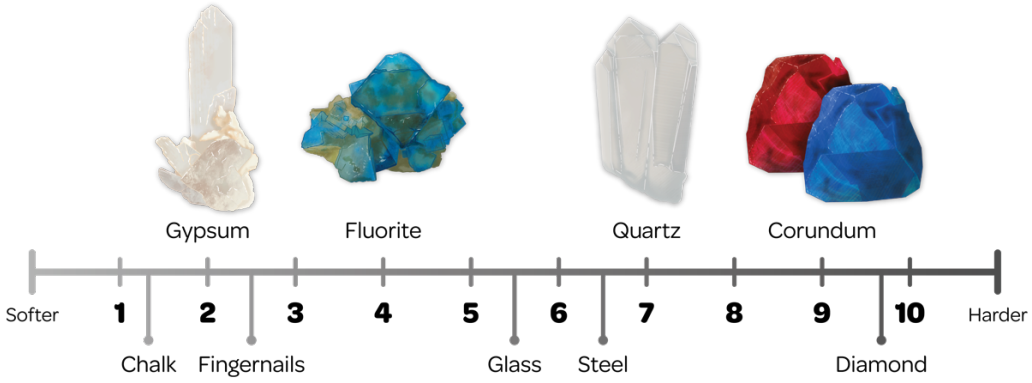
What are some of the standard tests used by geologists to classify rocks?

Streak test
Streak test is a common test used to classify rocks. A rock is rubbed on a streak plate (ceramic tile) to see what colour of dust will be left behind.

Acid test
Acid test is a common test used to find rocks that contain calcium carbonate. A rock that contains calcium carbonate (such as limestone) will fizz if placed in vinegar.

Colour test
You can use colour to help identify a mineral. However, remember to be careful because some minerals have the same colour.

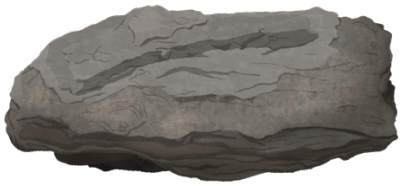
Hardness test
Scientists use the **Mohs Scale of Hardness** (numbered from 1-10) to compare the hardness of different minerals. Talc is the softest mineral while diamond is the hardest. Each mineral on the scale is able to scratch a mineral with a lower number rating. For example, quartz can scratch gypsum, but gypsum cannot scratch quartz. You can test your mineral by trying to scratch it with your fingernail (Hardness 2.5), a penny (Hardness 3.5), and a steel nail (Hardness 6.5). If you can scratch the mineral with your penny, but not the steel nail then the hardness would be between 3.5 and 6.5.



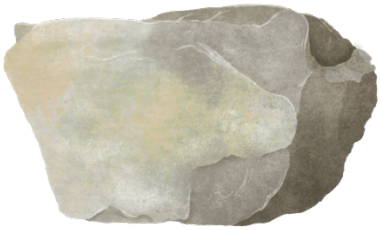
SEDIMENTARY ROCKS

What are sedimentary rocks?
Sedimentary rocks contain small pieces of other rocks called sediments. **Sediments** are created when rocks are broken up through natural processes called **weathering**. These small pieces of broken up rock are called sediments and are carried by water and wind to new places through erosion. Over time, chemicals in water help the piles of sediment stick together, often in layers, and harden to become sedimentary rock.

Sandstone



Shale



Limestone

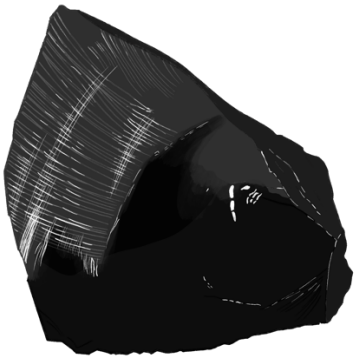
What is the difference between sandstone and limestone?
Sandstones are made of sand grains which have stuck together, and shale is made of hardened mud. Limestones are special because they are made of the shells and skeletons of ancient sea creatures.

Where can you find sedimentary rocks?
Sedimentary rocks can be found in many environments where wind and water move sediments. Sandstones can form in rivers or at the beach. Limestones form in shallow ocean habitats similar to where coral reefs live. Shales form in deeper lakes and oceans.

IGNEOUS ROCKS

What are igneous rocks?
Igneous rocks form when hot lava or magma cools. The word igneous means from fire or heat. **Lava** is hot, molten rock **above** the Earth's surface that cools to form **extrusive, igneous rocks. Magma** is hot, molten rock **below** the Earth's surface that cools to form **intrusive, igneous rocks.**

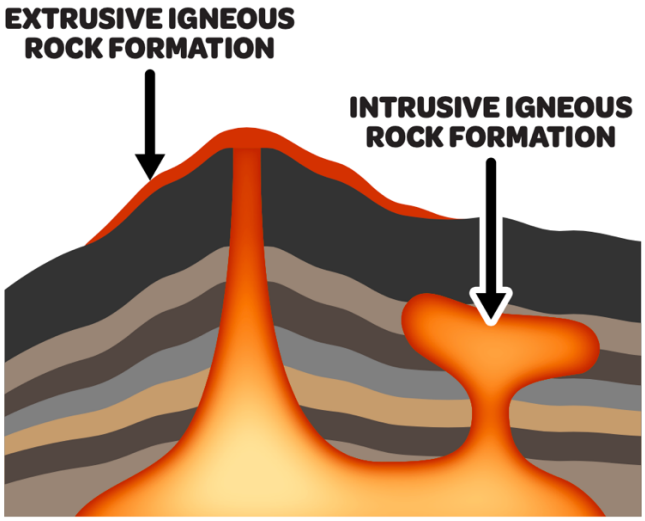
Granite



Obsidian

Pumice

What is the difference between Intrusive and Extrusive Igneous rocks?



Extrusive igneous rocks form on the Earth's surface when **lava** from volcanic eruptions cools. These rocks cool very quickly. Intrusive igneous rocks form inside the Earth when **magma**, or molten rock, cools slowly.

METAMORPHIC ROCKS

What are metamorphic rocks?

Metamorphic rocks are formed by extreme heat and pressure. The word metamorphism comes from Greek for “change of form”. Metamorphic rocks can be found deep in the Earth and at plate tectonic boundaries. When two plates collide, they can build mountains, and the rocks end up under extreme heat and pressure. Metamorphic rocks include gneiss, marble and schist. **Limestone** is changed into **marble** when it recrystallizes due to high heat and pressure. Shales can change into slate which is often used for roofing tiles.

Gneiss

Marble

Quartzite

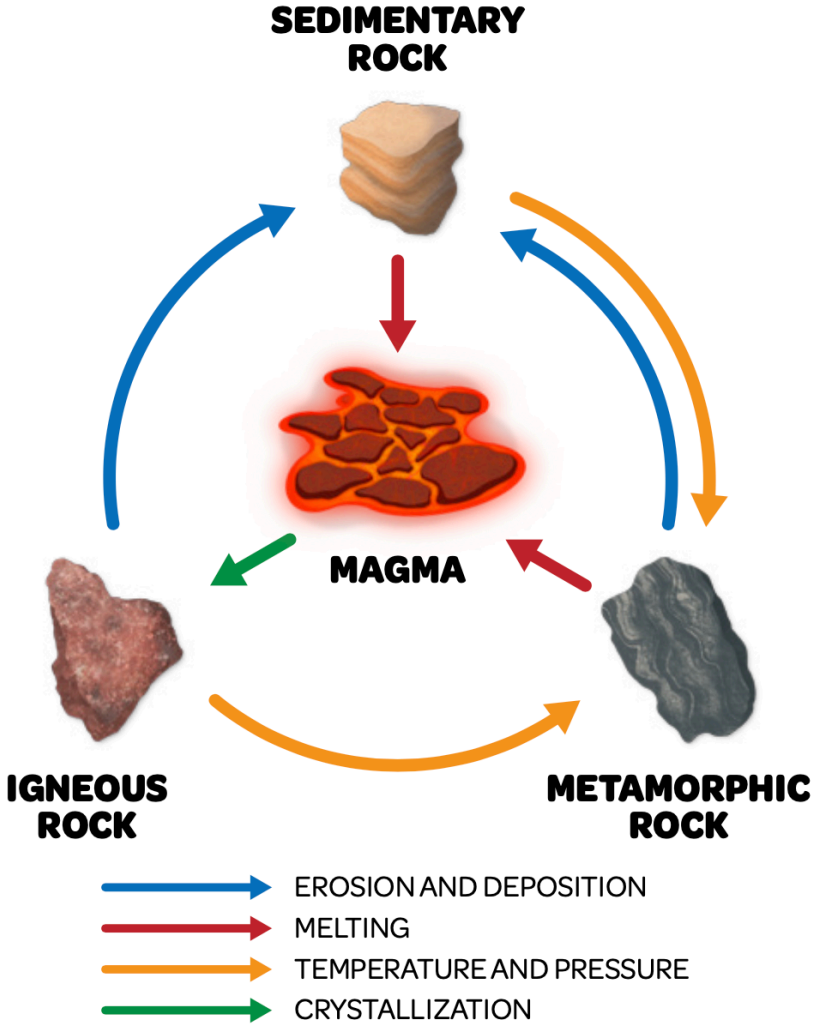
What is plate tectonics?

The continents have not always been in the same locations they are today. They move around on giant tectonic plates on the Earth’s outer shell called the lithosphere. These tectonic plates can collide to build mountains or deep ocean trenches. Supercontinents (such as Pangea) can form when all or most of the continents join together.

ROCK CYCLE

What are the three rock types?
The three rock types are sedimentary, igneous, and metamorphic.

What is the rock cycle?
The rock cycle is a continuous process by which rocks are formed, broken down, and reformed. Metamorphic and igneous rocks **erode** (blue lines) to form sedimentary rocks. Sedimentary and igneous rocks can be **heated under extreme pressure** (yellow lines) to make metamorphic rocks. Metamorphic and sedimentary rocks **melt** (red lines) to become igneous rocks.



FOSSILS

What are fossils?
Fossils are the preserved remains of living organisms. Fossils can be found in sedimentary rocks. Bones, teeth, and footprints can all be fossilized. Even soft and squishy creatures like jellyfish and seaweed can be fossilized in special places.

How are fossils formed?
Fossils can in many different ways. To make a fossil, the organism needs to be covered by sediment shortly after its death. Fossils can be buried by mud, sand, ash, sticky resin (similar to tree sap) or sticky tar. Minerals help preserve the fossils by replacing the parts that decompose.

Why are fossils hard to find?
Most organisms that have lived on Earth did not get preserved as fossils. Fossils are a rare treasure that provide a clue to what life looked like in the past. We are lucky when we find a fossil since it was not only preserved but also brought to the Earth's surface for us to find it. Sometimes fossils are buried deep in sedimentary rocks, and we cannot find them until erosion brings the fossils to the Earth's surface.

What are crinoids?
Crinoids are creatures that live on the sea floor and collect food using their many arms. They are related to starfish and still live in the ocean today. They have three main parts: the **crown**, the **stalk**, and the **roots**. The stalk is fragile and breaks apart easily. It is made of many hard, small parts called **ossicles** that are stacked up on top of each other. When the stalk breaks, the ossicles fall to the seafloor. Crinoids are called sea lilies, but they are animals not plants.

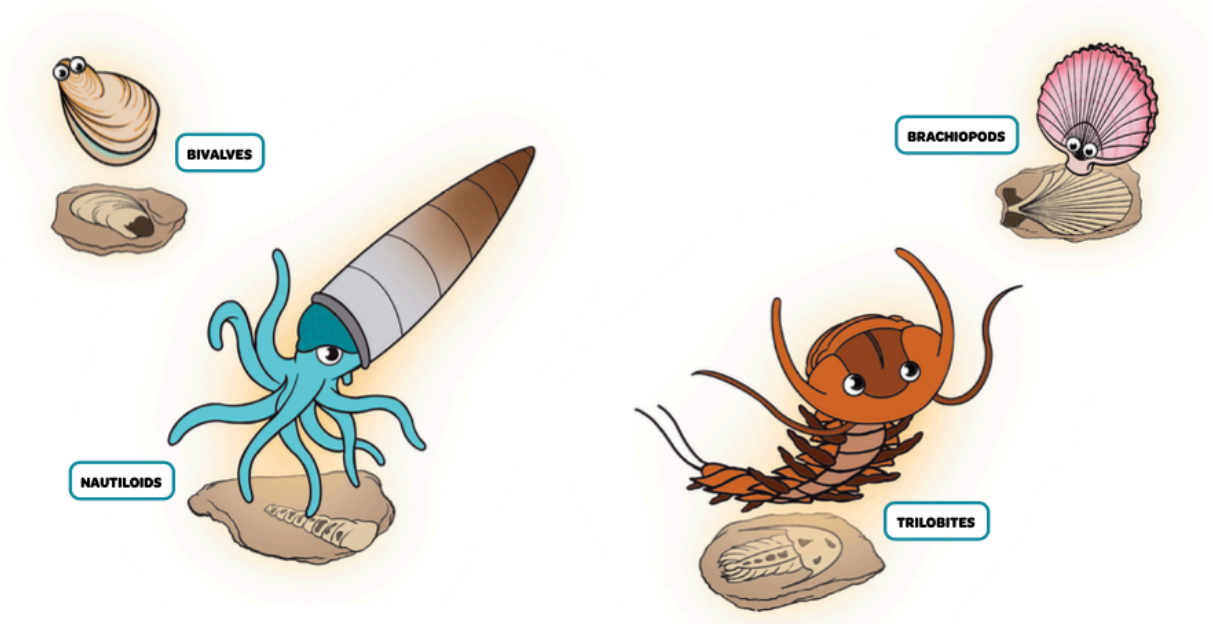
PALEOZOIC FOSSILS

What are brachiopods?
Brachiopods (Brak-ee-o-pods) are shelled creatures that live in the oceans. There used to be lots of brachiopods in the ocean, but many brachiopods went extinct (died) almost 252 million years ago. Each half of their shell is symmetrical, but the top and bottom half are not identical.

What are bivalves?
Bivalves are still abundant in the ocean today. Bivalves are molluscs like mussels, scallops and clams. They have a matching top and bottom shell, but each shell would not match if you could fold it in half (e.g., not symmetrical).

What are nautiloids?
Nautiloids are related to squids and lived in the ancient oceans. They have a hard shell that can be long and straight or coiled. Straight shelled nautiloids are extinct, but collided shelled nautiloids live in the ocean today.

What are trilobites?
Trilobites are ancient bugs that are now extinct. They have three main parts: head, middle, and bottom. Trilobites are the first creatures to have complex eyes.



CRYSTALS AND GEMSTONES

What are crystals?

Crystals are solid objects with a microscopic (e.g., very small), repeating pattern. Minerals have a distinctive crystal shape when they form slowly.

What are gemstones?

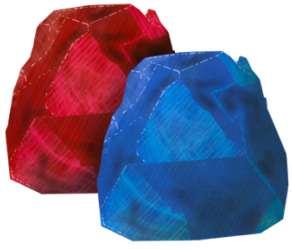
Gemstones are precious minerals that are cut and polished in a special way to make them shine and sparkle. Sometimes different gemstones are formed of the same mineral. For example, rubies (red) and sapphires (blue) are different coloured gemstones of the same mineral, corundum. Diamonds are now very precious gemstones but used to be unpopular because coloured stones were considered more valuable.

What are birthstones?

A birthstone is a gemstone that represents a month of the year.

Month	**Gemstone**
January	Garnet
February	Amethyst
March	Aquamarine
April	Diamond
May	Emerald
June	Pearl
July	Ruby
August	Peridot
September	Sapphire
October	Opal
November	Topaz
December	Turquoise

Flourite



Rubies & Sapphires

MINING

What is mining?
Mining is the process of extracting valuable minerals from the Earth. These minerals can be useful as gemstones, building materials, and even to create batteries. Diamonds were discovered in the Northwest Territories of Canada in 1991. Canada is now the third largest producer of diamonds in the world, and some are marked with a tiny polar bear. Mining is an important industry in Canada that provides a lot of jobs, but it can be dangerous for people and the environment.

What are two common methods of mining?
Open pit mining involves removing minerals found close to the Earth's surface by digging large, open pits. Underground mining involves digging underground tunnels to reach deeper minerals and miners use elevators to reach these tunnels.

What is ore?
An ore is a rock that contains useful minerals.

What are a few of the pros and cons of mining?

Pros (the good side)	Cons (the bad side)
• We need minerals for our daily lives • Provides jobs • New technology is making mining safer • New rules and regulations mean that mines must protect the environment	• Mines can destroy plants and animal habitats and food sources • Working in mines can be dangerous • Poisonous liquids from the mines can get into rivers and lakes

Virtual activities

SKYPE A SCIENTIST

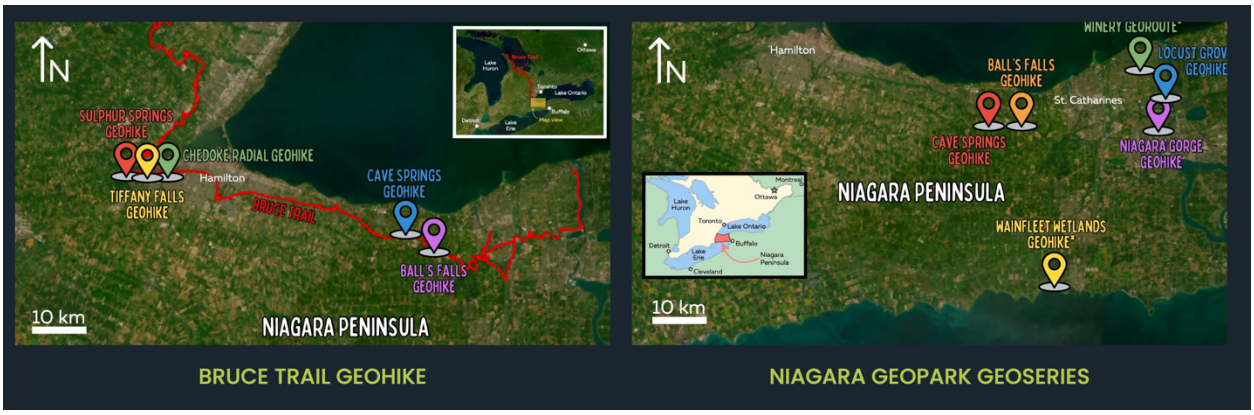
Invite a scientist to virtually talk to your class to introduce the unit or answer questions along the way. Use the Educator Sign up form (https://www.skypeascientist.com/sign-up.html) to connect with a scientist in your time zone who can talk to your class and answer questions. You can request a specific scientist by browsing the list or select from general categories. Scientists change based on their availability and sign up every Summer/Fall and Winter/Spring. You will receive an email when you have a match and then you can coordinate with the scientist through email to plan your chat.

It is helpful to brainstorm a list of questions with your class once you learn who you are matched with. You can also share the questions with your scientist in advance.

Here are a few example questions for a Grade 4 classroom:

1. How did you become a geologist/paleontologist?
2. What is a day in the life of a geologist/paleontologist like?
3. How long did you go to school for?
4. What is your favourite part of your job?
5. What is your least favourite part of your job?
6. Have you ever discovered a new type of rock or fossil?
7. What is your favourite rock or fossil?
8. Did you always know you wanted to be a geologist/paleontologist?
9. What advice would you give 10-year-old you?

VIRTUAL FIELD TRIPS



The APGO Education Foundation (APGOEF) offer free accessible, accurate information about geoscience to the public. Using the GeoscienceINFO.com website you and your class can explore a series of educational resources including GeoRoutes, the Niagara GeoPark, GeoHikes, Urban GeoWalks, GeoVideos and GeoBlog with a particular focus right here in Ontario.

GeoHikes

- Explore local minerals, rocks, and fossils along nature trails similar to where Rocky's adventure takes place
- Learn about the geological history and environmental influence of the Niagara Escarpment
- Examples: Chedoke Radial Trail, Niagara Gorge

Urban GeoWalks

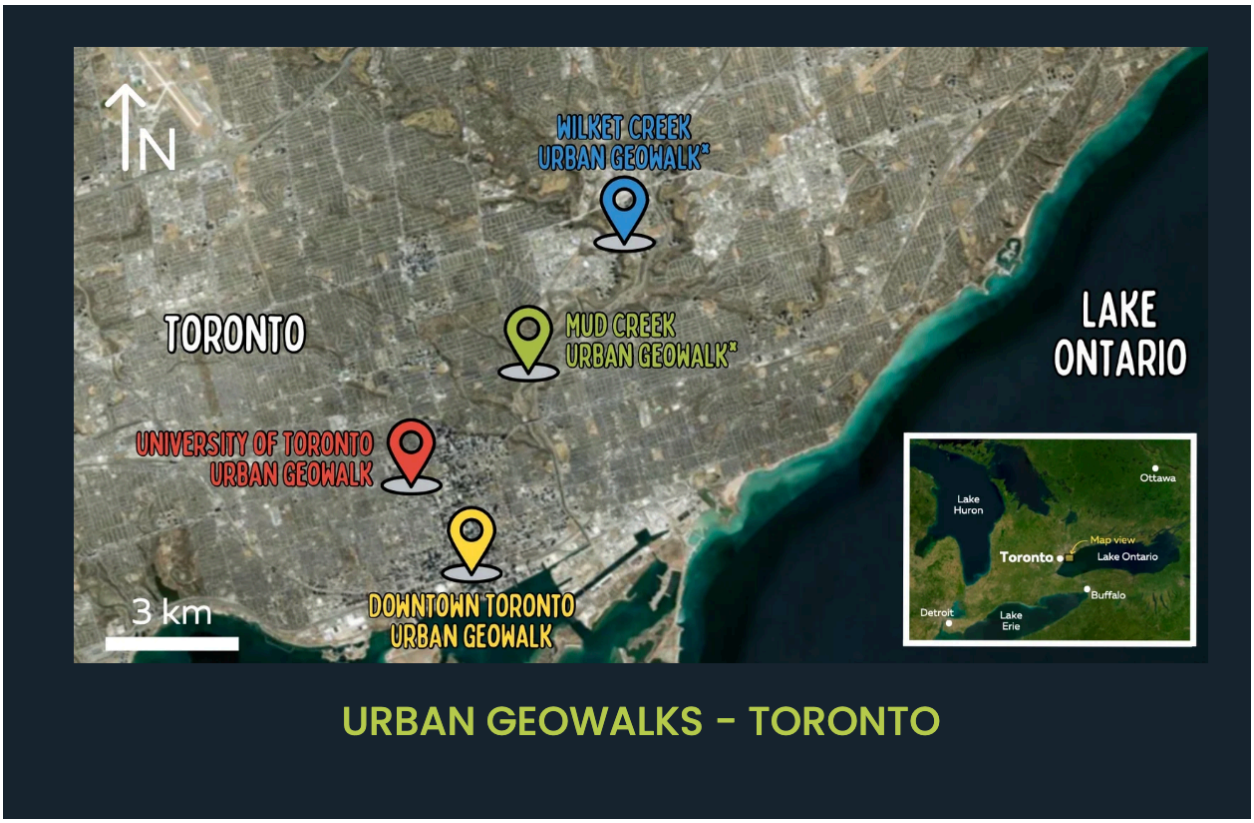
- Explore the geological history of the building blocks that shape our cities and university campuses
- Discover the history preserved in building stones that have been collected from local quarries and transported internationally

GeoRoutes

- Explore Ontario's geological history by car stopping at local highlights including fossil sites and the famous Sudbury Nickel

Classroom Ideas to use virtual field trips:

1. **GeoHikes Project**: Have students work in groups on chromebooks to research one of the GeoHikes. Students can put together a brochure or poster to summarize their chosen location to the rest of the class highlighting the local minerals, rocks and fossils.
2. **Persuasive Writing:** Students can explore the virtual field locations and write a letter to the teacher about why their chosen location would be the ideal place to visit on a field trip to learn about rocks and minerals.
3. **Community Stewardship:** Students work in groups to prepare a poster for the public explaining why the Niagara Escarpment is important and how it influences our daily lives (e.g., transportation, climate, agriculture, tourism, economy)



VIRTUAL MUSEUM VISITS

Royal Ontario Museum

1. Burgess Shale Virtual Museum: https://burgess-shale.rom.on.ca/en/index.php
2. Education Resources: https://www.rom.on.ca/learn/for-educators
3. Visit in person (2nd floor: Willner Madge Gallery Dawn of Life; Teck Suite of Galleries Earth's Treasures)

Smithsonian Virtual Museum

1. Virtual Tours: https://naturalhistory.si.edu/visit/virtual-tour (2nd floor David H. Koch Hall of Fossils-Deep Time; 3rd Floor: Janet Annenberg Hooker Hall of Geology, Gems, and Minerals)
2. Educational Resources: https://naturalhistory.si.edu/education/teaching-resources?f%5B0%5D=resource_topics%3A88&f%5B1%5D=resource_topics%3A199

Natural History Museum: https://www.nhm.ac.uk/discover/dinosaurs.html

Natural History Museums of LA County

1. Dinosaur Collection: https://nhm.org/stories/virtual-tour-dino-hall-english
2. La Brea Tar Pits Collection: https://tarpits.org/

ROCK TYPES WORKSHEET

Fill in the blanks below with “igneous”, “sedimentary” or “metamorphic”

1. Granite and basalt are_____ rocks.
2. Rocks that form in layers are_____.
3. _____ rocks form during mountain building.
4. _____ rocks form when hot magma cools.
5. You can find fossils in _____ rocks.
6. _____rocks can be intrusive or extrusive.
7. When magma cools below the Earth’s surface intrusive _____ rocks are formed.
8. _____rocks include quartzite, slate, and marble.
9. _____ rocks include sandstone, limestone and shale.
10. When sediment settles on the bottom of oceans and lakes _____ rocks are formed.
11. _____rocks are formed by intense heat and pressure.
12. _____rocks can be made of pieces of shells or corals.
13. Rocks formed when magma cools above the Earth’s surface are called extrusive _____ rocks.

ROCK TYPES FILL IN THE BLANKS KEY

Fill in the blanks below with “igneous”, “sedimentary”, or “metamorphic”

1. Granite and basalt are __**Igneous**__ rocks.
2. Rocks that form in layers are___ **Sedimentary**__.
3. ___ **Metamorphic**_____ rocks form during mountain building.
4. _____ **Igneous** _____ rocks form when hot magma cools.
5. You can find fossils in ___ **Sedimentary** ___ rocks.
6. _____ **Igneous** _____rocks can be intrusive or extrusive.
7. When magma cools below the Earth’s surface intrusive _____ **Igneous** rocks are formed.
8. ___ **Metamorphic** ___rocks include quartzite, slate, and marble.
9. ___ **Sedimentary** __ rocks include sandstone, limestone and shale.
10. When sediment settles on the bottom of oceans and lakes __ **Sedimentary** __ rocks are formed.
11. _ **Metamorphic** __rocks are formed by heat and pressure.
12. _ **Sedimentary** __rocks can be made of pieces of shells or corals.
13. Rocks formed when magma cools above the Earth’s surface are called extrusive ____ **Igneous** _____ rocks.

CREATIVE WRITING IDEAS

Activity #1 and 2 Rock Poetry
Ask students to write acrostic poems using the word Mineral or Fossil. Handouts on following pages

Activity #3 Rocks and Music
Rock Sayings -what is a song lyric or saying you have heard? (e.g., we will rock you)

Activity #4 Letter Writing
Write a persuasive letter:

1. To your teacher about a field trip location you want to visit to learn about rocks and minerals (e.g., beach, volcano, mine)
2. To your community about the importance of protecting the Niagara Escarpment or other natural wonders near your home
3. To your parents about local areas you would like to explore (e.g., local parks or trails)

Activity #5 Finding Words
Write the word Sedimentary, Igneous, or Metamorphic on the board. Ask students to come up with as many words as possible using the letters from the word on the board. Examples below.

Sedimentary	Igneous	Metamorphic
• dynamite • daytime • admire • meditate • mean • east • dime • men • yard • sat • mat	• genius • noise • gone • sing • sung • song • ego • use • in • go • no	• impact • armpit • pirate • actor • chart • tame • met • mat • pet • the • hat

ACROSTIC POEM #1

Name:_____

Complete the following poem by writing a statement that starts with the first letter shown below.

M_____

I_____

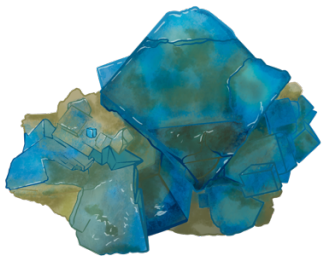
N_____

E_____

R_____

A_____

L_____



ACROSTIC POEM #2

Name:_____

Complete the following poem by writing a statement that starts with the first letter shown below.

F_____

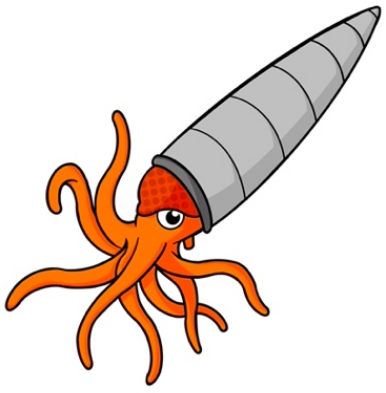
O_____

S_____

S_____

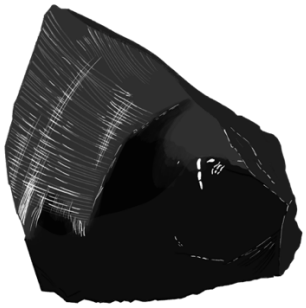
I_____

L_____



ROCK SAYINGS

What is a song lyric or saying you have heard?



LETTER WRITING

Date _____

Dear _____,

_____

_____

_____

_____

_____

_____

_____

_____

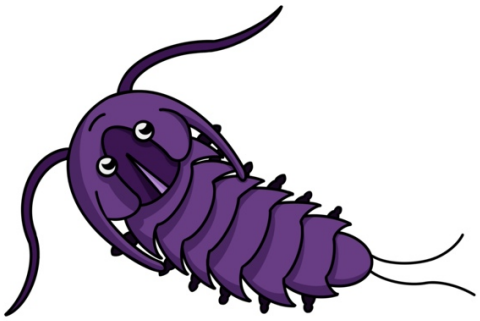
_____

_____

_____

_____

Sincerely _____



MINERAL SCAVENGER HUNT

How many rocks and minerals do you have at home? Put a check mark on the line next to each item that you find:

____ Hammer (iron, nickel)

____ Bathroom sink (clays, petroleum products)

____ Cosmetics (e.g. talcum powder, mica, limestone, silica, talc, zinc)

____ Computer or Cell Phone (gold, silica, nickel, aluminum, zinc, iron)

____ Pencils (graphite, clays)

____ Windows (nepheline, syenite, silica)

____ Stoneware plate or pottery (clays)

____ Chalk (limestone)

____ Jewellery (most gemstones are minerals, and so are silver and gold)

____ Table salt (halite)

____ Bicycle (barite, iron, nickel and petroleum products)

____ Plastic shower curtain (petroleum products)

____ Bathroom mirror (nepheline syenite, silica, silver)

____ Books (limestone, clays)

____ Deodorant (aluminum)

____ Mattress springs (hematite)

____ Cast-iron pan

____ Rechargeable batteries (silver)

____ Drinking Glasses (quartz)

____ Stainless appliances (chromite)

ROCKS OF CANADA

Describe three different rocks and where you could find them in Canada.

What is the rock?			
What is the rock type? (ex. igneous)			
Describe the rock.			
Where can you find it? Draw on the map.			

FOSSILS OF CANADA

Describe three different fossils and where you could find them in Canada.

What is the fossil?			
Describe the fossil.			
Where can you find it? Draw on the map.			

GEOLOGICAL TIME

Chalk Geological Timeline

The Earth is 4.6 billion years old and you can use chalk outside or tape inside to create your own geological timeline. Measure 4.6 metres using metre sticks and then mark off each billion years. Place important events in geological time along the timeline as chalk drawings or illustrations on paper.

Other ways to think about geological time

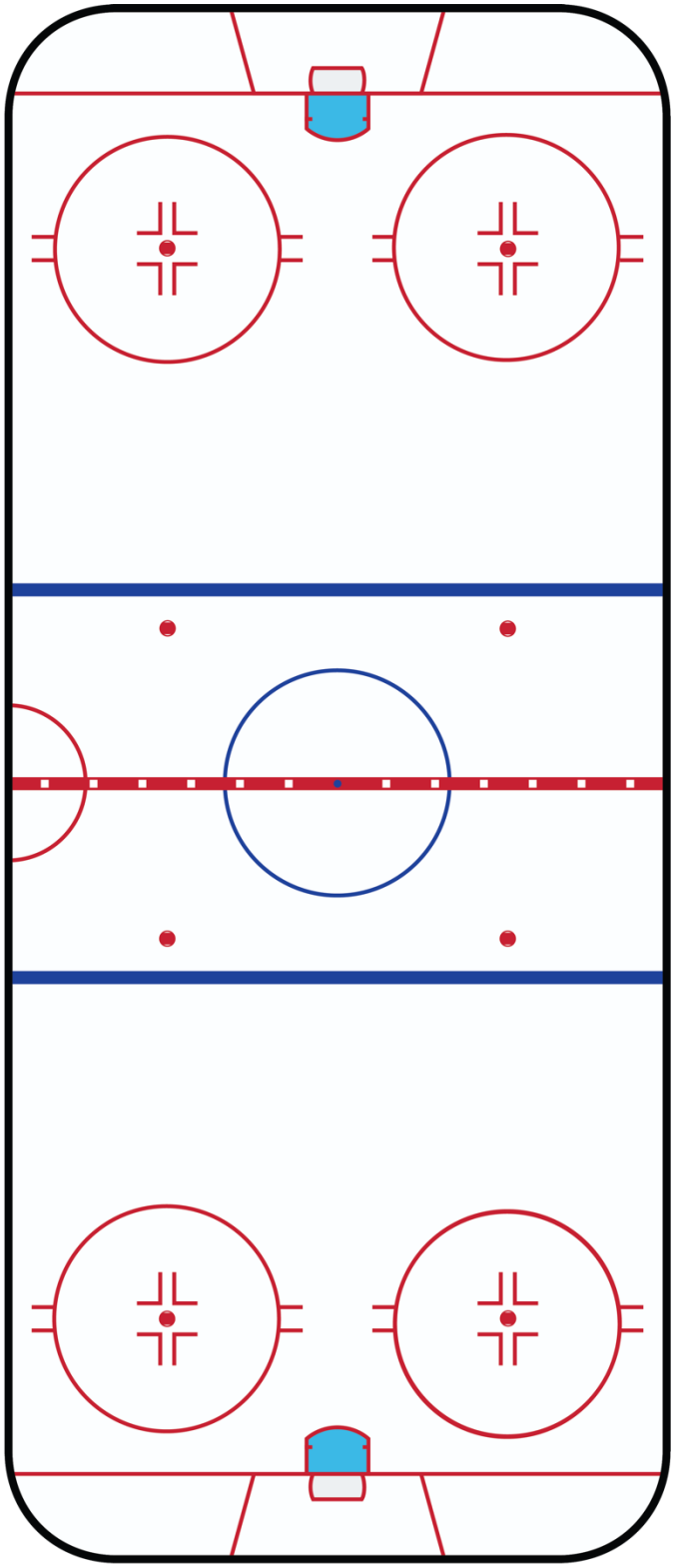
Print out a calendar and have students fill in important events in geological time. You can also compare to a hockey rink (61 by 30 m) with rough estimates.

Event	**Age**	**Calendar**	**Hockey Rink**
Earth forms	4.6 Ga	Jan 1	0 m (boards)
Earliest Life appears on Earth	3.6 Ga	Apr 2	Top of Face off circle
Oxygen on Earth	2.4 Ga	Jun 28	Center Ice
Life gets Big	570 Ma	Nov 15	
First Animals	510 Ma	Nov 19	Face off circle
First plants	470 Ma	Nov 27	Middle of the Face off circle
Life moves onto land (e.g., Tiktaalik)	425 Ma	Dec 1	
Coal Swamps, giant creepy insects	360 Ma	Dec 3	
Great Dying-Permian mass extinction	250 Ma	Dec 11	Goal line
Dinosaurs	200 Ma	Dec 17	Behind your net
Dinosaur extinction	66 Ma	Dec 25	
Age of Mammals	65 Ma	Dec 26	
Ice Age	2.6 Ma	Dec 31	
Humans arrive	200,000	Dec 31 11:30	Into the boards
Pyramids built	4,000	Dec 31 11:59.9	

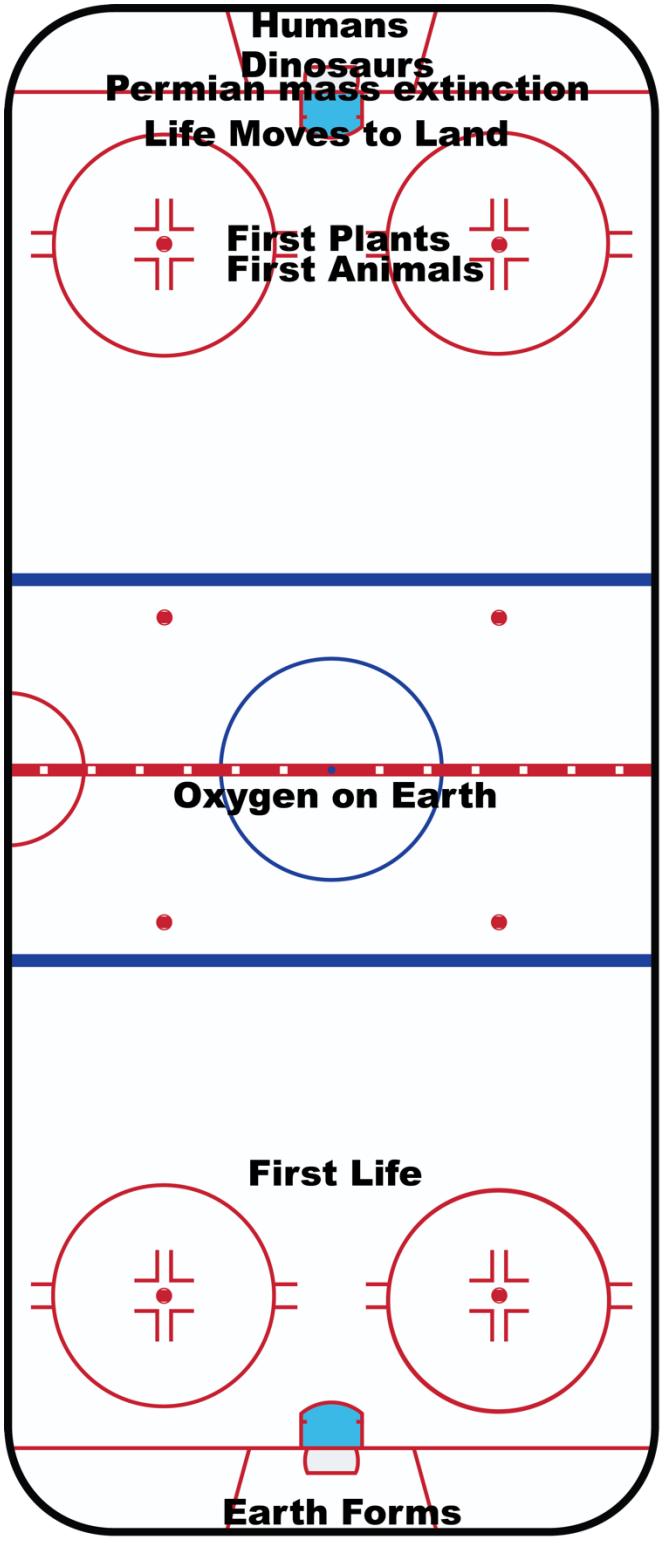
*Ga-billions of years, Ma-millions of years

GEOLOGICAL TIME HOCKEY RINK

Follow your teacher's instructions to add important geological events to the hockey rink.



GEOLOGICAL TIME HOCKEY RINK KEY



IGNEOUS ROCK TAG

This activity can be enjoyed outside or in the gym. It is adapted from the National Park Service (see full references) and can help your students learn about the rock cycle. The instructions below are based on a group of 30 students, but feel free to adjust the number of students in each role to fit with your class.

Instructions:

1. Divide the space into two areas (e.g. half the gym) and tell students one side will be above the Earth's surface and the second area will be below the Earth's surface.
2. Half of the students will be magma below the Earth's surface. The other group of students will be lava above the Earth's surface.
3. Choose three students in each area to be cooling and one to be heating. You can use gym pinnies or flags to identify these students.
4. The students can move freely around their area (inside or on the Earth's surface). The cooling students try to tag the magma/lava students and turn them into rock. When tagged these students freeze in place.
5. The heating student runs around and tags the frozen students. The rocks are heated and the students become magma/lava again rejoining the game.
6. After a few minutes switch the roles of the students.

Discussion Questions

Before the game, ask students:

1. Why would you have to freeze when you are tagged by a cooling student?
   Answer: Cooled magma/lava turns to rock
2. What happens when rock is heated?
   Answer: melts and becomes magma/lava
3. What is the difference between the people who are magma vs. lava?
   Answer: magma inside the Earth, lava on the Earth's surface

Adapted from: National Park Service, 2025. Geology Rocks! Keweenaw National Historical Park Michigan. Available at: https://home.nps.gov/kewe/learn/education/geology-rocks-activities.htm

ROCK IDENTIFICATION

Junior Geologist Record Card
Name:_____

STATION 1-How Hard is a Rock?

Scratch Test	Specimen No. 1	Specimen No. 2	Specimen No. 3
Fingernail			
Penny			
Nail			
Overall Hardness (e.g., 2.5)			

STATION 2-Can you draw with a Rock?

Streak Test	Specimen No. 1	Specimen No. 2	Specimen No. 3
Did the rock make a streak on the tile?			
What colour was the streak?			
Did the rock make a streak on the paper			

Junior Geologist Record Card
Name:_____

STATION 3-Does the rock fizz?

Acid Test	Specimen No. 1	Specimen No. 2	Specimen No. 3	Specimen No. 4	Chalk
Did the rock fizz when you put it into vinegar?					
Describe what you see.					

STATION 4-What colour is your rock?

Colour Test	Specimen No. 1	Specimen No. 2	Specimen No. 3
What colour was the rock from far away?			
Colours found			
Did the rock sparkle?			
Can you see through the rock?			
Did it have spots?			
Does it have streaks?			

Junior Geologist Record Card
Name:_____

STATION 5-Identify the rock

	Specimen No. 1	Specimen No. 2	Specimen No. 3
How much does your rock weigh?			
What is the circumference of your rock?			
Describe the texture of your rock (shiny, dull, smooth, sharp).			
Special features to describe your rock.			

Do you think your rock is igneous, metamorphic, or sedimentary?
_____

Where could the rock have formed?

a. Volcano
b. Inside the Earth
c. Ocean
d. River
e. Mountains

ART ACTIVITIES

Build paper models: https://www.usgs.gov/educational-resources/geologic-paper-models
Build a Nautiloid paper model using the downloadable instructions and templates on the USGS (United States Geological Survey) website. Students can colour and assemble their own Paleozoic fossil that would have lived in the same ocean Lily. Nautiloid fossils can be found in the Niagara Escarpment.

Prehistoric Life Colouring Book: https://www.nps.gov/subjects/fossils/coloring-book.htm
This colouring book, created by the National Park Service, includes 40 drawings of ancient animals with 10 additional images available on their website. Take a look at a few of the following creatures that lived during the Paleozoic Era:

1. Endocerid Cephalopod (website): This creature is a nautiloid.
2. Edrioasteroid (website): These creatures are part of the same group as sea stars, sea urchins, and sea lilies (crinoids like Lily). They lived in the ocean during the same time as Lily, but not always in the same habitats.
3. *Pycnocrinus multibrachiatus* (colouring book): Crinoid like Lily

Volcano Mini Crayola Book: https://www.crayola.com/free-coloring-pages/print/volcano-mini-book-coloring-page/

ROCKS AND MINERALS REVIEW QUIZ #1

- A **geologist** is a scientist who studies **rocks** and **minerals**.
- The Earth is a gigantic ball of liquid and solid rock.
- No two rocks are exactly alike.
- **All rocks** are made up of **two or more minerals**.
- **Minerals** are made up of the **same substance throughout**.
- There are **three types** of rocks:
    - Igneous
    - Sedimentary
    - Metamorphic
- Rocks and minerals are classified according to their properties including colour, shape, size, texture, and weight.
- Standard tests used by geologists to classify rocks:
    - **streak test** – rock is rubbed on tile to see what colour of dust is left behind
    - **acid test** – rock is placed in vinegar to see if it fizzes
    - **hardness test** – **Moh's scale** from 1 to 10 is used to compare the hardness of a rock with talc (1) the softest and a diamond (10) is the hardest.
    - **colour test** – the colour of rocks varies depending on the minerals present
- Sedimentary Rock
    - Made of particles of older rocks or plants and animals.
    - Broken up by a natural process called **"weathering"**
    - Sediment is **eroded** meaning carried to seas and oceans by rivers, the larger sediment particles settle first because they are heavier.
    - **Erosion** can create **landforms** in sedimentary rocks including **waterfalls** like Niagara Falls
    - **Sandstone** is made from sand that settles in layers at the bottom of oceans or rivers.
    - **Limestone** is made from the shells of plants and animals.
    - **Fossils** can be found in sedimentary rocks.
    - A scientist who studies fossils is called a **paleontologist.**
- Igneous Rocks
    - "**igneous**" means from **fire or heat**.
    - It is extremely hot deep inside the Earth.
    - **Magma** is hot, molten rock **below** the Earth's surface that cools to form **intrusive, igneous rocks.**
    - **Lava** is hot, molten rock **above** the Earth's surface that cools to form **extrusive, igneous rocks.**
    - **Granite is an important igneous rock.**

QUIZ #1: ROCK AND MINERALS

Name: _____

Word Bank

Mineral	Rocks	Sandstone
Geologist	Paleontologist	Quartz
Sedimentary	Igneous	Metamorphic

1. There are three types of rocks:

_____

_____

_____

2. Who studies rocks and minerals?

_____

3. Who studies fossils?

_____

4. All _____ are made up of two or more minerals.

5. _____ are made of the same substance throughout.

6. _____ is a rock while _____ is a mineral.

7. Rocks and Minerals are classified by:
   a. Hardness
   b. Size
   c. Weight
   d. All of the above

8. Geologists group rocks using the tests below:
   a. Streak Test ____ Vinegar is added to see if it fizzes
   b. Colour Test ____The colour of rocks
   c. Acid Test ____Scale from 1-10 is used
   d. Hardness Test ____Rock is rubbed on tile to see what colour the dust is left behind

9. Using the hardness test, the softest material is:
   a. diamond
   b. topaz
   c. talc

10. Using the hardness test, the hardest material is:
   a. diamond
   b. topaz
   c. talc

11. Fossils can be found in this type of rock:
   a. Igneous
   b. Sedimentary
   c. Metamorphic

12. Magma is _____ molten rock.
   a. Hot
   b. Cold

13. Basalt is a common _____ rock.
   a. Igneous
   b. Sedimentary
   c. Metamorphic

14. _____rocks are made from sand that settles in layers at the bottom of the ocean.
   a. Igneous
   b. Sedimentary
   c. Metamorphic

ROCKS AND MINERALS REVIEW QUIZ #2

Metamorphic Rocks

- **Metamorphic** means to **have been changed.**
- All metamorphic rocks began as igneous or sedimentary rocks.
- **Heat and pressure** change igneous rock and sedimentary rocks into metamorphic rock.
- **Limestone** is changed into **marble** when it is heated by magma.
- **Quartzite, slate and marble** are metamorphic rocks.

Crystals

- When minerals form slowly, they take on specific crystal shapes
- Crystals can be cut and polished in a special way to make them shine and sparkle.

Gemstones

- A gemstone is a mineral or crystal that has been cut and polished.
- Emeralds, rubies, sapphires, and diamonds are considered the most precious gemstones.
- Years ago, the diamond was not popular because it was colourless and people valued stones that were colourful.
- A birthstone is a gemstone that represents a month of the year.

Mining

- Rocks that contain useful minerals, such as iron and aluminum are called **ores**
- Removing ores from the Earth is called mining, which is an important industry in Canada
- Two of the most common ways to mine are:
- Open – pit mining (digging in open pits at the surface)
- Underground mining (digging in underground tunnels that the miners get to by using an elevator)
- In 1991, rocks containing diamonds were discovered in the Northwest Territories.
- Canada is the third largest producer of diamonds in the world and some are marked with a tiny polar bear.

Pros (the good side)	Cons (the bad side)
Provides jobs	Mines can destroy plants and animal habitats and food sources
New technology is making mining safer	Working in mines is often dangerous
New rules and regulations mean that mines must protect the environment	Poisonous liquids from the mines can get into rivers and lakes

QUIZ #2: ROCK AND MINERALS

Name: _____

Word Bank

quartzite	metamorphic	marble
slate	igneous	heat
pressure	sedimentary	magma

1. _____ means to have been changed.

2. All metamorphic rocks began as _____ or _____rocks.

3. _____ and _____ change igneous and sedimentary rocks into metamorphic rocks.

4. Limestone is changed into _____ when it is heated by _____.

5. Two metamorphic rocks are _____ and _____.

6. When minerals form slowly, they take on the shape of _____.
   a. Sedimentary rocks b. Igneous rocks c. crystals

7. When some crystals are cut and polished they can become:
   a. marble b. gemstones c. slate

8. Years ago people valued stones that were colourful and _____ were not popular.
   a. sapphires b. rubies c. diamonds

9. Which two were considered to be precious gemstones?
   a. sapphires b. soapstone c. diamonds

10. Some gemstones are very expensive because they are very _____.
    a. colourful b. rare c. small

11. Place the letter on the line that best describes the word.

a. Underground mining	____stone represents month of the year
b. Ore	____some Canadian diamond marked with this
c. Polar bear	____digging at the surface
d. Open pit mining	____3rd largest producer of diamonds
e. Elevators	____discovered in Northwest Territories in 1991
f. Diamonds	____digging in tunnels
g. Canada	____rocks that contain useful minerals is called
h. Birthstone	____used to transport miners

12. There are pros and cons to mining. Please list one of each.

Pros (the good side)	Cons (the bad side)

QUIZZES ANSWER KEYS

ANSWER KEY Quiz #1

1. Sedimentary, metamorphic, igneous (in any order)
2. Geologist
3. Paleontologist
4. Rocks
5. Minerals
6. Sandstone, quartz
7. D
8. c, b, d, a
9. c
10. a
11. b
12. a
13. a
14. b

ANSWER KEY Quiz #2

1. Metamorphic
2. Igneous, sedimentary
3. Pressure, heat
4. Marble, magma
5. Slate, quartzite
6. Crystals (C)
7. Gemstones (b)
8. Diamonds (c)
9. Sapphires (a) and rubies (c)
10. rare (b)

11. Place the letter on the line that best describes the word.

a. Underground mining	_**h**_stone represents month of the year
b. Ore	_**c**_some Canadian diamond marked with this
c. Polar bear	_**d**_digging at the surface
d. Open pit mining	_**g**__3rd largest producer of diamonds
e. Elevators	_**f**__discovered in Northwest Territories in 1991
f. Diamonds	_**a**__digging in tunnels
g. Canada	_**b**__rocks that contain useful minerals is called
h. Birthstone	_**e**__used to transport miners

12. There are pros and cons to mining. Please list one of each.

Pros (the good side)	Cons (the bad side)
• **Provides jobs** • **Supports new tech (phones, laptops)** • **New rules/regulations make it safer** • **Supports renewable tech**	• **Mines can destroy plants/animals/habitats/food sources** • **Working in mines can be dangerous** • **Poisonous liquids from mines can get into rivers and lakes**

Posters

Mining Matters Posters: https://miningmatters.ca/type/posters

Minerals of Canada: https://miningmatters.ca/resource/minerals-canada

Critical Minerals: https://miningmatters.ca/sites/default/files/2024-04/ENG-CriticalConnections.pdf

Mining Posters: https://miningmatters.ca/resource/mining-posters-nrcan

Fossils of Ontario Guide: https://miningmatters.ca/resource/fossils-ontario-guide

Rocks of Ontario Guide: https://miningmatters.ca/resource/rocks-ontario-guide

Rock Cycle: https://miningmatters.ca/resource/rock-cycle

Geological Society Posters: https://www.geolsoc.org.uk/Posters

Geoscience for the future:
https://www.geolsoc.org.uk/~/media/shared/documents/education%20and%20careers/Resources/Posters/Geoscience%20for%20the%20Future%20poster.pdf?la=en

Rocks in our solar system:
https://www.geolsoc.org.uk/~/media/shared/documents/education%20and%20careers/Resources/Posters/Year%20of%20Space%20poster%20FINAL.pdf?la=en

Minerals in a Smartphone:
https://www.geolsoc.org.uk/~/media/shared/documents/education%20and%20careers/Resources/Posters/Minerals%20in%20a%20smartphone%20poster.pdf?la=en

Plate Tectonics:
https://www.geolsoc.org.uk/~/media/shared/documents/education%20and%20careers/Resources/Posters/Plate%20Tectonics%20Poster%202024%20Edit%20KS2%20KS3.pdf?la=en

Resources

Rocks and Mineral Resources to learn more:
Mining Matters Activity Book: https://miningmatters.ca/resource/mining-matters-activity-book

The World of Mineral & Crystals (Cranbrook Institute of Science in partnership with Michigan Mineral Society):
https://www.michmin.org/_files/ugd/ceb2d5_547c282e0c264e41bdf861af2d6ffdaa.pdf

Earth and Space Science PBS LearningMedia for Teachers:
https://home.nps.gov/kewe/learn/education/geology-rocks-activities.htm
Example: Rock cycle video

University of Waterloo Earth Sciences Museum: Mining in Canada
https://uwaterloo.ca/earth-sciences-museum/resources/mining-canada

Teacher-Friendly Guides to Earth Science for US Regions
https://www.priweb.org/science-education-programs-and-resources/teacher-friendly-guides

Fossil Resources to learn more:
Paleontology Society Hands-On Classroom Activities:
https://www.paleosoc.org/educational-resources
Example: Measuring Fossils, educational brochures (e.g., Crinoids)

Paleontological Research Institution Fun Fossil Activities:
https://www.priweb.org/blog-post/fossil-activities
Example: Junior illustrator Activities, Brachiopod vs. Bivalve

Blue Mountains Public Library & Craigleith Heritage Depot Junior Palaeontologist:
https://www.thebluemountainslibrary.ca/museum/educational-programming/junior-naturalist
Example: Junior Palaeontologist activity books for ages 4-6, 7-9, 10-13

Collins, J.J., and Lindstrom, K., Getting into the Fossil Record:
https://ucmp.berkeley.edu/education/explorations/tours/fossil/

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