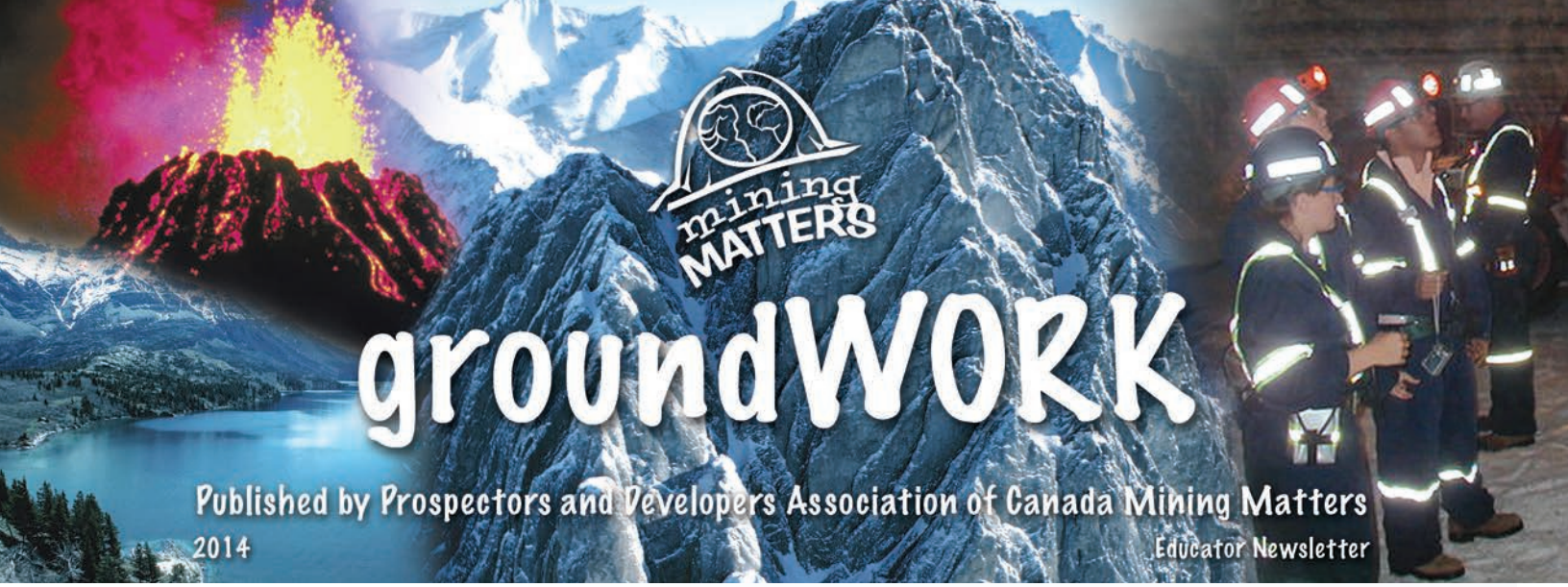


Contents

Celebrating 20 Years!

In 2014, *Mining Matters* celebrates 20 years of commitment to broaden students' understanding of Earth science and the vital role rocks, minerals, and metals play in everyday life, and to increase awareness of the many career opportunities in the minerals industry.

Looking back, we recall the original *Mining Matters* classroom resource being developed in response to the lack of school curriculum or age-appropriate resources for Earth science education. Three teachers designed an informative, activity-based resource about minerals, metals, rocks, and the mining sector for Ontario grades 6 and 7. Rock and mineral samples included, the unit was available in English and French, along with a training workshop to ensure its effective implementation in the classroom.

By August 1995, 600 *Mining Matters* kits had been given to Ontario teachers. The response was overwhelming, and by 1999, more than 2,000 kits were distributed. How proud we were when we received the Conference Board of Canada's 1996 – 1997 Partnership Focus Award for our education initiative promoting science literacy at the elementary and secondary school levels.

In 2002, we delivered our first program specifically designed for Aboriginal youth. Eighteen students from six communities gathered for a week-long, classroom-based experience in Nunavut. In 2008, we delivered our first *Mining Rocks* Earth Science Camp, marking the beginning of our highly successful Aboriginal Education and Outreach Programs.

Today, *Mining Matters* is known for exceptional educational resources that complement curriculum expectations across Canada. Last year, more than 60,000 students, teachers and members of the public benefited from *Mining Matters* programming. Here are some highlights:

- 1,300+ Aboriginal youth and adults took part in *Mining Rocks* Earth Science Programs
- 25,557 students participated in educational workshops
- 1,456 teachers trained to implement *Mining Matters* curriculum kits in their classrooms
- 32,000+ members of the public benefited from our Outreach programs
- 2 new *Mining Matters* publications rolled out in English and French: *What is a Mine?* colouring book and *Power to the People* poster
- 2 *Mining Matters* posters were translated to Ojibway, Cree, and Oji-Cree: *From Northern Lights to Urban Trails* and *Cutting Edge*

Since inception in 1994, *Mining Matters* has reached over 550,000 teachers, students, and members of the general public. We have come a long way. Please join us as we continue to innovate, evolve, and reach new milestones on the journey ahead.

What Is Your Earth IQ?

We all have an IQ, or Intelligence Quotient. But have you ever heard of an Earth Intelligence Quotient? There are things that every citizen of the planet should know, and they should have learned them young. It all starts with educating students. Teachers can inspire students to reconnect with our planet Earth. Teachers need to look for opportunities to incorporate information about Earth into existing curriculum: interesting facts about its structure, its surficial and internal processes, and its resources and their uses.

Keep in mind a simple statement:
If it cannot be grown, it must be mined.

Godfrey S. Nowlan Ph.D., Research Scientist with Geological Survey of Canada and author of *The Earth and its People: Repairing Broken Connections* says the following:

Humans are losing touch with the Earth. They tend to ignore the strong linkages between Earth resources and the level of civilization they enjoy. They also tend to ignore the forces of Earth processes, rendering themselves insensitive to natural processes and hazards. The disconnection is strongest in the developed first world of which Canada is a part. Earth scientists hold the key knowledge to repair this disconnection between the Earth and its people. It is critical that we place more of a social context on Earth science, especially as it is communicated to the public. We need to re-establish the connections between our well-being and the Earth resources that make it possible. We also need to educate society about how Earth processes affect our everyday life. By the same token, we also need to elaborate more of the social context of Earth sciences to students of Earth sciences.

Earth scientists hold the key knowledge to repair the disconnection between the Earth and its people. It is critical that we place more of a social context on Earth science, especially as it is communicated to the public.

Nowlan suggests 10 things Canadians should know about the Earth:

1. Earth functions through a complex of systems: Earth's internal workings (Geosphere), life on Earth (Biosphere), Water (Hydrosphere) and Air (Atmosphere). They interact in complex ways with intricate feedbacks, often with surprising results.
2. The Earth is old (4.6 billion years old—an unfathomable amount of time).
3. Life on Earth has been evolving for 3.5 billion years (at least).
4. Earth is constantly moving and changing; changes are at different scales, continuous or sporadic and gradual or catastrophic.
5. Some Earth processes can be hazardous (earthquakes, volcanoes, landslides).
6. Human activity has changed the Earth.
7. Earth provides all the resources we all use every day (we are dependent on Earth for all of the materials we manufacture and for all of our energy needs).
8. Earth resources are precious and we should conserve them.
9. Earth Scientists conduct research to understand the planet better and to discover resources of use to humankind.
10. Earth is best appreciated outdoors.

Earth Quiz: Do You Really Know Your Planet?
http://www.space.com/15351-earth-quiz-planet.html

During a week-long Earth science professional learning event, we asked teachers at different education levels to list 10 things students should know about Earth by the time they graduate.

Their responses are collectively represented in the Wordle* below:

**A Wordle is an image cloud of words generated from the text that the user provides. The clouds give greater prominence to words that appear more frequently in the source text.*

We also asked elementary students attending the Ancaster Gem and Mineral Show what 10 things people should know about the Earth.

- Earth is very old – *Gavin, age 9, grade 4, Alexander's Public School*
- Mining is very hard; mining has improved – *Rayyan, age 9, grade 4, Alexander's Public School*
- There is more water then (sic) land; it is a sphere – *Rachel, age 8, grade 4, Alexander's Public School*
- Minerals are everywhere – *Natasha, age 9, grade 4, Alexander's Public School*
- The Earth forms rocks – *Danielle, age 9, grade 4, Sacred Heart P.S.*
- The Earth is full of oxyon (sic) – *Jesse, age 9, grade 4, Sacred Heart P.S.*
- It's round and beautiful – *Malachi, age 9, Rehoboth Christian School*
- The Earth has 4 layers; the Earth has 7 continents – *Ethan, age 9, Rehoboth Christian School*

It would seem, by comparison, that the students and the educators who teach them are rediscovering the connections between the Earth and our well-being.

Mining Matters School Programs at the PDAC Convention

Since 2007, *Mining Matters* has presented a two-day, hands-on learning school program for elementary and secondary students at the Prospectors and Developers Association of Canada (PDAC) International Convention, Trade Show and Investors Exchange in downtown Toronto, Ontario.The four-day annual Convention, held at the Metro Toronto Convention Centre, is the world's largest annual mineral exploration convention.

This learning opportunity is beneficial to all students, but may be of greatest interest to those interested in geology, engineering, geography, natural resource management, mining, Aboriginal studies and environmental practices related to land use. The Trade Show hosts over 1,000 exhibitors. Students visit the Trade Show and chat with exhibitors, exposing them to the immense scope of the mineral exploration and mining industry.

Teachers that use *Mining Matters* resources in their classroom and are interested in providing their students with this unique opportunity are encouraged to write a letter stating interest to *Mining Matters* Manager of Teacher Training and School Programs. Letters, written on school letterhead, must be received by the end of June each year to be considered for the following year's event.

New Colouring Book: What is a Mine?

Mining Matters is pleased to announce that our *What is a Mine?* colouring book, for children ages 6 to 12 years, is now available in English and French. Mighty Miner, or MM for short, takes children on an exploratory adventure, using pictures and a story enhanced by a word search, maze, and connect-the-dots activities, to answer the question "What is a Mine?" *Mining Matters* thanks Barrick Gold for their generous contribution and support. Children will love this fun and informative book. For copies, email **info@miningmatters.ca**. Copies may also be downloaded at **www.miningmatters.ca**

New Poster: Power to the People!

Our third in a series of original *Mining Matters* posters, *Power to the People* is now available. This new Mining Makes It Happen publication explores alternative energy sources and technology that can reduce our dependence on gas and oil. It shows how metals, minerals, and the people in the mining and minerals industry are key components in bringing alternative energy technology to the people. For hard copies, contact us at **info@miningmatters.ca**. An online interactive version will soon be available; watch for it in 2015.

Field Trip Subsidies For You

Mining Matters offers a Field Trip Subsidy Program to enrich Earth science learning. Teachers who have completed an in-service workshop and use a *Mining Matters* resource kit in the classroom may apply for the subsidy. The subsidies, up to $500 each, are intended to help offset the cost of transportation and entrance fees to stone, sand and gravel, mining, and geoscience venues. Applications will be considered on a first-come, first-served basis.

To learn more and download an application form, go to **www.pdac.ca/mining-matters/school-programs/teachers/field-trip-subsidy**

Field Trips Aplenty

Field Trip of Many Wonders

Rob Millard, Notre Dame Catholic High School, Carleton Place, ON
Meghan Packard, SES 4U student

Students have many misconceptions about mining and related industry. Telling them about the industry and the advances made can only go so far. Showing them the scope of mining, goes much, much further. I had the opportunity to take students to the Mining for Society (M4S) show in Toronto in May. Unlike most schools visiting the show, we drove from Carleton Place, near Ottawa.

Using a Field Trip Subsidy from Mining Matters to help defray costs, I was able to deliver a fun, informative field trip to 35 students: my grade 12 Earth and Space class, some grade 10 science students, and our Envirothon Team.

I gave students an information booklet that I had prepared to help explain the geology of the route, the importance and history of each site, assignments to be completed at each venue, and even an eye spy game with prizes to be won.

Leaving at 6:15 am, we set off for Toronto, breaking up the long drive with a series of educational stops. Our route took us from the Ottawa Embayment through the Grenville Metasedimentary belt and into the sedimentary basin around Lake Ontario.

Meghan carries on the story:

At our first stop, the Deloro Mine, we learned about the gold mining process and the effect on the surrounding environment. With no environmental laws in place at the time of operation, the mine site became contaminated. Gold is no longer mined there, but arsenic and other hazardous wastes were left behind. Today's environmental and safety laws called for the government to act. The mine site is now being reclaimed, being made into a park and the water made safe once again.

Next, we visited the Marmoraton Iron Mine, which began production in 1955 and provided nearly 520,000 tons of ore pellets before closing in 1978. To access the iron, 35 metres of limestone and sandstone had to be removed. The mine pit is 1/3 km wide, 1/2 km long, and 213 metres deep, and has been left to fill with water, creating an artificial lake. Plans to reclaim the site completely have been put on hold as the area is now used as a limestone quarry. The artificial lake was beautiful and the surrounding paths allowed for more observation of the surrounding geology.

Next up, the Scarborough Bluffs, a remnant of glacial history. Sixty thousand years ago, the land was weighted down by the continental glaciers, forming a solid deposit of silt, clay, and sand. Over the years, Ontario Lake currents eroded the bluffs, causing concern to the residents living above the formation. To stabilize the bluffs, a barrier was created on the surrounding lake bottom. The barrier was extremely successful and is now beautiful Bluffers Park.

We finally arrived at the M4S Show in Toronto. It featured six pavilions: Exploration, Mining, Processing, Products and Fabrication, Sustainability and Safety, and Education and Careers. Each pavilion offered a variety of activities and learning opportunities.

The exploration pavilion demonstrated tools, maps, and technology used in mineral exploration. The mining pavilion showed what follows a successful exploration—this included mine development, mineral extraction and mining methods. The next pavilion taught about mineral processing. This included activities with magnets, electrical currents, and acidity tests to help with mineral separation. Pavilion four featured products and fabrication. We learned about the many daily uses of mined minerals, such as toothpaste and cell phones. The sustainability pavilion taught how communities are sustained by mining, as well as the reclamation process of mines no longer in use. At the safety pavilion, I learned about how safe the mining industry really is. I could see historical and modern-day rescue equipment and learn how some of the most important safety gear is used. The final pavilion, education and careers, showed the many job opportunities associated with the mining industry, and taught me that not all mining jobs involve working underground. I learned how to get involved in the mining industry after high school.

The M4S experience was very educational and rewarding. The show proved wrong many preconceived notions about mining and it being dirty, dangerous work. After visiting the M4S exhibits, I have a better outlook on mining and can even consider working in the mining industry in the future.

Our last stop was the Royal Ontario Museum (ROM), in downtown Toronto. At the ROM, we saw the mineral gallery, which had hundreds of amazing and rare minerals of all different types, including gold, dioptase and serandite. We learned more about minerals and where they're found. We also visited other exhibits, including dinosaurs and mammals. Exploring the ROM was fascinating.

Our visit to Toronto was a very long and tiring day, but gave us great memories and new discoveries. The experience greatly enhanced my understanding of geology and the mining process and the Earth and Space Science course.

Visiting the U of Waterloo Earth Science Museum

Aimee Partlow, Aberfoyle Public School, Guelph, ON

After spending a week on the Teachers' Mining Tour last summer, I thought my grade 4 students needed to take a field trip of their own. My week-long trip, which included going 1500 m underground in a mine, wasn't going to be feasible for them, but I knew just where to take my students for a taste of mining and geology. The University of Waterloo Earth Science Museum offers free programs to school groups. I decided to take advantage of the *Mining Matters* field trip subsidy to pay for the bus. If you are a teacher and haven't taken advantage of the tour or *Mining Matters* professional development and resources, I strongly recommend it. (It might mean a free trip for your students too).

At the beginning of May, I got on the bus with 36 students and 10 parent volunteers and headed off to the museum. We were treated to an excellent program put on by Peter Russell and Corina McDonald, the outgoing and incoming curators of the museum. I first met Peter when I was about the same age as my students, and he encouraged my own growing interest in geology. Several years, collecting trips, and boxes of 'treasures' later, I'm still just as excited as I was back then. So, it was a treat to take my students to the museum and watch Peter share his bubbling enthusiasm with a new generation of kids. I met Corina more recently, and I can assure you the museum is being left in good hands.

My students were delighted by the many activities. They learned about mining in Ontario, from the nickel in Sudbury to the silver in Cobalt. Then, they donned hard hats to visit the mining tunnel in the museum and push the plunger for a simulated rock blast. There was also some

gold panning, a scavenger hunt through the atrium, and a picnic lunch in the rock garden. Both the students and parents commented on how much they enjoyed the trip. I now have specimens coming in for identification and questions about where else parents can take their kids to foster the interest. Several students gave me minerals instead of chocolates at the end of the year. I think we may have some future geologists in the making, or at least a few kids who won't take gneiss rocks for granite!

Rock Odyssey to the ROM

Ms. Hopkins and Ms. Nicholl, Thorncliffe Park Public School,Toronto, ON

In March, we headed downtown, riding the TTC to the Royal Ontario Museum. We took a scenic walk through Philosopher's Lane, noting the many rocks used to construct the university and museum buildings. This was the beginning of an outstanding day of exploration, observation, and connections to our grade 4 Earth Science Unit on Rocks and Minerals.

Photo by B.Boyle

We began with a guided tour through the ROM's Gem and Mineral Gallery. The enormous meteorite fascinated our students. Questions abounded as they tried to connect their prior knowledge of minerals and rock types to this specimen of unknown origin. Our students' level of thinking and questioning greatly impressed the ROM tour guides… and their teachers!

In the Gallery, students saw a huge slab of mica the size of a Smartboard! They were dazzled by precious gemstones. Question-mark-shaped gypsum, moss-like minerals, and minerals spanning every colour in the rainbow really "wowed" them. Such an impressive and expansive collection greatly enhanced our students' appreciation of geology and Earth science. Perhaps this learning opportunity inspired some of them to consider a career in mining and the geosciences.

From there, we ventured behind the walls of the public galleries to the Rock and Mineral lab. Through hands-on experiences, students consolidated their prior knowledge of rock and mineral properties, using unique and high quality specimens. Once again, they demonstrated their enthusiasm as they tested for hardness, streak, magnetism, and density. Walking to the lunchroom, the building and galleries "came to life." Rocks here, minerals there, fossils on the floor….

This incredible learning opportunity would not have been possible without the generous *Mining Matters* Field Trip Subsidy. Our "Rock Odyssey" exploration broadened our students' understanding of the possibilities in the fields of mining and geology. How can one quantify the power of a $500 subsidy? Ms. Hopkins' and Ms. Nicholls' classes say "Thank you!!"

Geology in the Yukon

Kristin Innes-Taylor, Selkirk Elementary, Whitehorse, YK

In June 2013, I took my Grade 5 class to the Whitehorse Copper Belt, where we spent three hours with Sarah Laxton, geologist from Yukon Geological Survey. We examined three old copper mine sites, collected specimens, and examined different rock formations. It was an amazing field trip. Students were captivated and expanded their knowledge base to the geology unit I had just taught. Thanks, *Mining Matters*, for making this trip possible. It was a fabulous learning trip. My students now have a better understanding of why we having mining and how important it is to our daily lives.

Exploring the Bonnechere Caves

Robert Barter, A.Y. Jackson Secondary School, Kanata, ON

Each year, I take my grade 11 physical geography class on several field trips, since I believe real learning happens when students make connections between the classroom and the real world. I am a former exploration and mine geologist who made the switch to teaching several years ago. I try to give my students a passion for Earth science and an understanding of how geology affects our daily lives, from the products we use to the landscape that surrounds us.

In May 2013, we visited the Bonnechere Caves in Eganville, Ontario (about 100 km up the Ottawa Valley from Kanata). At the caves, we had a guided tour as well as an introduction to the Ordovician fossils that are common in the area. The students spent part of the morning fossil hunting and many found some treasures to bring home.

We then went spelunking. Students crawled underground through some tight passages and learned about cave formation and karst topography. For many, this was their first time underground. I explained how underground mining works and what it is like to work deep underground. Many were surprised by the temperature difference from the surface as well as the humidity underground.

Back in Ottawa, we drove to Shirley's Bay on the Ottawa River to compare the Ordovician limestone outcrops there to the units we saw in Eganville. Seeing the water was high due to heavy rains, we discussed river systems and river morphology. We also looked at some of the local glacial erratics, which led to further discussions about the glacial history of the Ottawa region. The trip was a great success and the students came back with a better understanding of their local geology. Several have already told me that they are considering studying Earth science when they finish high school.

Up until 1957, leaving our planet to explore beyond the atmosphere was science fiction. On July 20, 1969, men walked on the moon. That was the day nine-year-old Canadian Chris Hadfield decided to become an astronaut. On February 8, 2013, live from the International Space Station, Commander Hadfield performed *Is Somebody Singing*, a song he co-wrote with Ed Robertson of the Barenaked Ladies, in unison with nearly a million Canadians coast-to-coast, mostly students. Throughout his five-month orbit, he also captivated the world with stunning photos and commentary, via social media. Clearly, one of Canada's most famous astronauts is now doing his fair share of inspiring young minds. *An Astronaut's Guide to Life on Earth*, written by Hadfield and released in 2013, will serve to inspire even more.

For those who follow in Hadfield's footsteps, there will be options. Exploring to gain understanding of the planets, the stars, and whole galaxies could be one of them. In fact, Voyager 1, launched unmanned in 1977, has travelled past Jupiter and Saturn and, at more than 18.67 billion kilometres from the sun, in August 2012, became the first spacecraft to enter interstellar space.

Exploring for answers about our own planet and to find new resources might be other options. Scientists in the United States and Canada are currently planning a mission to explore an asteroid whose path will make it a near-Earth object (NEO). NEOs are comets and asteroids that have been nudged by the gravitational attraction of nearby planets into orbits that allow them to enter the Earth's neighbourhood. The asteroid will come within 448,794 km of Earth (our moon is approximately 384,403 km distant). With a launch date set for September 2016, the OSIRIS-REx spacecraft will conduct a return sample mission: travelling to the asteroid, gathering samples, and returning to Earth. For details, see http://osiris-rex.lpl.arizona.edu/

OSIRIS-REx

O = Origins: Study primitive asteroids to learn about the origins of the Solar System

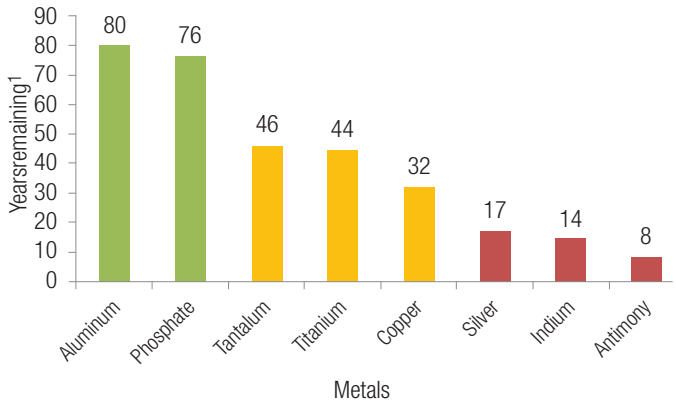
SI = Spectral Interpretation: Compare ground-based and spacecraft observations

RI = Resource Identification: "Prospect" for future human uses

S = Security: Better predict hazardous impacts

REx = Regolith Explorer: Map and explore the asteroid's "soil" in detail

Resource Identification could tell us what metals and minerals and non-renewable resources might be found elsewhere in our solar system. Non-renewable resources are naturally occurring substances that must be mined, quarried or pumped from underground. On Earth, we are extracting them more quickly than natural processes can replace them. If production continues to grow at current rates, and no new reserves are found, the years are numbered for some important resources. The following table represents a worst-case scenario but highlights the need for action, if not from us, then from our children and grandchildren. Locating other sources is becoming more and more necessary.



Finding valuable ore deposits is a challenge, especially when the surface you are studying is in space. Sample return missions could help test the viability of off-world mineral exploration. Also, planetary scientists, or off-world geologists, can study the composition of extraterrestrial bodies from afar, providing the scientific community with information that could increase the success of these missions. Knowing that elements and compounds reflect and absorb at different wave lengths of radiation, they can look at the reflection spectrums coming from a particular body and determine its surface composition.

There are hundreds of thousands of asteroids in our solar system, ranging in size from a few to hundreds of kilometres, with most being relatively small. OSIRIS-REx will travel to a near-Earth C-type (carbonaceous) asteroid: carbon-rich and containing remnants of the original planetary building blocks. S-type (silicaceous) and M-type (metallic) asteroids are common and could be even more economically relevant, since they contain a significant fraction of iron, nickel, and cobalt, as well as rare metals such as gold and platinum.

A new start-up space mining company called Planetary Resources intends to explore those asteroids for minerals and increase the access between Earth and deep space. Based in Seattle, Washington, it offers high school students paid internships, believing that young people who show promise could become full-time employees after college. To learn more, go to www.planetaryresources.com

Those who explore space for knowledge will further the possibility of mining in space, and those who search for resources will certainly increase our knowledge of "the final frontier." Just as Chris Hadfield realized his dream, other visionaries intend to do the same, searching for knowledge and riches among the stars.

Niobium: A Transition Metal

Niobium (Nb), a soft, rare, transition metal used in today's high tech metals, has links to the ancient stories of Greek mythology. It was named after Niobe, daughter of King Tantalus, after whom the element tantalum is named; the two elements occur together in the mineral columbite. Niobe boasted that she had more children than the goddess Leto. In anger, Leto's sons Artemis and Apollo killed all but one of Niobe's seven children. Mourning her loss, she turned to stone.

Niobium is a member of the group of Vanadium transition elements. It has high melting and boiling points and superconductivity properties and is corrosion resistant. It is an alloying agent, which when added to another material creates a material with substantial benefits. Steel made with niobium is stronger, lighter in weight, and corrosion resistant, making it desirable for use in the automotive, gas pipeline, and construction industries.

The transition elements are located in the centre of the periodic table. Because they possess the properties of metals, the transition elements are also known as the transition metals. Their d electrons are loosely bound, which contributes to their high electrical conductivity and malleability.

Niobium found in Brazil and Canada accounts for about 99 per cent of total reported niobium production. Niobium occurs in the minerals pyrochlore and columbite. Pyrochlore is mined primarily for its niobium content. Pyrochlore ores are mined using two main types of mining methods, either in isolation or as a combination: open-pit is the prevalent method in Brazil while underground mining is used at the Niobec mine in Canada. Mining columbite for other minerals produces niobium as a by-product.

Niobium in the form of standard grade ferroniobium represents over 90 per cent of niobium production. Its primary uses are alloying steels, rocket construction, aircraft and space machinery, radio engineering, electronics, chemical apparatus, and atomic energy. It is also used in refractory materials, optical glass, and catalysts. Future uses could include superconducting technology, magnets, and superalloys.

The use of niobium dates back to 1925 when it was used to replace tungsten in tool steel production. By the 1930s, niobium was being used to prevent corrosion in stainless steels. With the primary production of niobium, it became a key element in the development of modern engineering materials, and its usage has steadily increased with further advances in the metallurgical field.

Niobium facts: Melting point 2,468°C; boiling point 4,927°C; specific gravity 8.57

Learning Opportunities outside the Classroom

For Teachers

Since 2007, *Mining Matters* has coordinated a special event for teachers at the Annual PDAC International Convention, Trade Show and Investor's Exchange, held in March, in Toronto, Ontario. This is the World's largest annual mineral exploration convention. The program for the day features guest speakers, workshops, and visits to the Trade Show Floor. For more information, contact *Mining Matters* Teacher Training and School Programs Manager **Janice Williams** at **416-863-6463, ext. 322**.

Stonehammer Geopark, North America's first Global Geopark, located in Southern New Brunswick, is a geological park where you can experience a billion years of Earth's history. Its landscape has been created by the collision of continents, the closing and opening of oceans, volcanoes, earthquakes, ice ages and climate change. http://stonehammergeopark.com

In September 2014, the Stonehammer Geopark will host an International Geopark Conference, which will have a strong outreach component. Go to www.stonehammergeopark.com/teachers.html for updates.

Earth Science across Canada

The **Johnson GEO CENTRE** is a geological interpretation centre located on Signal Hill in St. John's, Newfoundland and Labrador. www.geocentre.ca/about-geo/

At the **New Brunswick Museum**, in St. John, New Brunswick, explore Our Changing Earth to discover New Brunswick's place in Earth history. www.nbm-mnb.ca/

At the **Montreal Science Centre**, discover permanent exhibitions, temporary exhibitions and special events that explore science and technology through a variety of interactive means. www.montrealsciencecentre.com/

The **Nature Science Museum** in Sherbrooke, Quebec, features changing exhibitions as well as virtual exhibitions. Witness the birth of the Appalachian Mountains and cross the lava fields. Feel the continents shift and the glaciers retreat as the Earth trembles and the temperature soars, then plunges… You'll never see the Eastern Townships quite the same way again! www.naturesciences.qc.ca/en/museum/exhibits-ans-shows/

The **Mineral and Mining Museum of Thetford Mines**, in Thetford Mines, Quebec, highlights the mining history and exceptional minerals around Thetford Mines, including the history of asbestos, its discovery, its use, and its controversy. A tour reveals the place of discovery of the "stone cotton" in 1876. www.museemineralogique.com/

Science North, in Sudbury, Ontario, maintains the second- and eighth-largest science centres in Canada: Science North, featuring an IMAX® theatre, digital Planetarium, butterfly gallery, and Special Exhibits Hall; Dynamic Earth, an Earth science centre. www.sciencenorth.ca/

The **Cobalt Mining Museum**, in Cobalt, Ontario, boasts the world's largest display of native silver ore.
www.cobalt.ca/index.php/historic-cobalt/mining-museum

Elliot Lake, Ontario, was once touted as the Uranium Capital of the World. The **Elliot Lake Nuclear and Mining Museum** stands as a tribute to the town's mining heritage.
www.cityofelliotlake.com/en/recleisure/museum.asp

Winnipeg's **Manitoba Museum** allows visitors to discover Manitoba's geological history in the fossils of the Ordovician Sea. http:/manitobamuseum.ca/main/visit/museum-galleries/earth-history-gallery/

Regina's **Saskatchewan Science Centre** goes hands-on managing water in its Field of Streams exhibit and illustrates the connection of soil, rocks, minerals, and erosion to agriculture in its Richardson Ag-grow-land exhibit. www.sasksciencecentre.com/

The **Canmore Museum and Geoscience Centre** in Canmore, Alberta, tells the stories of "our mountains and our communities."
http://cmags.org/

The new **Syncrude Environment Gallery** in **Telus World of Science – Edmonton** won the CASCADE award for the Best Exhibit or Show – Large Institution, presented by the Canadian Association of Science Centres (CASC). The centrepiece of the gallery is Science on a Sphere, a six-foot diameter projection system used to visually enhance presentations on environmental science. Four other areas of the gallery present interactive exhibits among four themes: Ice Detectives, Rock Hounds, Eco Explorers, and Storm Trackers. www.telusworldofscienceedmonton.com/

The **Atlas Coal Mine National Historic Site**, in Drumheller, Alberta, is famous for fascinating underground tours, train tours, and tipple tours.
www.atlascoalmine.ab.ca

Calgary's **Telus Spark**, opened in 2011 and described as a "new kind of Science Centre," features an interactive Earth and Sky Gallery. Play in a stream, dig a canyon, or cause an avalanche; experience the forces of nature that shape our neighbourhoods and our world.
www.sparkscience.ca/

The **Britannia Mine Museum**, a multi award-winning museum near Squamish, B.C., presents awe-inspiring sights and memorable family experiences. www.britanniaminemuseum.ca

Science World in Vancouver, B.C., offers Our World: The BMO Sustainability Gallery. Delve into how your choices create a sustainable future by exploring electricity, water consumption, and waste. Learn how our everyday decisions can affect the world around us.
www.scienceworld.ca/

Resources For You

Websites

Start creating, sharing, and exploring great visual content today at www.visual.ly. For example, take a look at the following:

- Uranium: The Metal of Tomorrow
  http://visual.ly/uranium-metal-tomorrow
- Mining in Ontario: A Dependable Engine of Growth
  http://visual.ly/mining-ontario-dependable-engine-growth
- 50 Unbelievable Facts about Earth
  http://visual.ly/50-unbelievable-facts-about-earth

Manitoba Mineral Resources lets kids explore rock origins, rock lore, Aboriginal Earth wisdom, and more at Manitoba Rocks!
www.manitoba.ca/iem/min-ed/index.html

The Royal Ontario Museum (ROM) and Parks Canada have launched a Burgess Shale online exhibition, as part of the Virtual Museum of Canada. The website provides an immersive journey into the world of the bizarre prehistoric creatures that formed the foundation for all animal life on Earth half a billion years ago. www.burgess-shale.rom.on.ca/

On www.facebook.com/AmazingGeologist, a group of geoscientists explores, posts, explains, and discusses geology. Look for interesting photos and explanations of worldly wonders as well as simplified geological principles and theories. They also have a Twitter account, https://twitter.com/AmazinGeologist

Learn how to make an *Our Dynamic Earth* pop-up book demonstrating plate tectonics. Watch videos to show you how to create an interactive book showing our dynamic Earth. http://earthpopupbook.weebly.com/

Teachers of Earth and environmental sciences in grades 8 – 12 will welcome *Earth Science Puzzles: Making Meaning from Data* (e-book) by Margie Turrin and Kim Kastens. This activity book, centred on six "data puzzles," fosters critical-thinking skills in students and supports science and math standards. http://www.nsta.org/store/product_detail.aspx?id=10.2505/9781936137565

Follow *Mining Matters* on Twitter https://twitter.com/MiningMattersCA and see what we have to offer on www.slideshare.net/MiningMatters

Publications

NRCan Posters look at an underground mine, a surface mine, a concentrator, and the smelting refining process.
http://www.nrcan.gc.ca/minerals-metals/business-market/3828

A Rock Is Lively, by Dianna Hutts Aston, Sylvia Long (2012). This book showcases a variety of rocks in all their splendour, from dazzling blue lapis lazuli to volcanic snowflake obsidian.
www.goodreads.com/book/show/14553643-a-rock-is-lively

Jump into Science: Rocks and Minerals, by Steve Tomecek, Kyle Poling (2010)
Tomecek's illustrated guide for kids surveys Earth's astounding variety of rocks and minerals and the fascinating ways people have transformed them into usable materials.

The Story of Earth: The First 4.5 Billion Years, from Stardust to Living Planet, by Robert M. Hazen (2012)
Senior Carnegie Institution researcher and national bestselling author Robert M. Hazen reveals how the co-evolution of the geosphere and biosphere—of rocks and living matter—has shaped our planet into the only one of its kind in the Solar System, if not the entire cosmos.

Why Geology Matters: Decoding the Past, Anticipating the Future, by Doug Macdougall (2011)
Volcanic dust, climate change, tsunamis, earthquakes—geoscience explores phenomena that profoundly affect our lives. Doug Macdougall makes clear the science that provides important clues to the future of the planet.

Project Earth Science: Geology (Revised 2nd Edition), by Paul D. Fullagar and Nancy W. West (2011)
Recommended by the National Science Teachers Association in the USA, this book is "a must-have book for every teacher of geology!"

A History of Earth in 100 Groundbreaking Discoveries, by Douglas Palmer (2011)
Douglas Palmer, science writer and freelance journalist, based in Cambridge, England, specializes in the history of life, especially human evolution and Earth's environments.

Multimedia

Rock 'n Learn Earth Science: This science DVD covers the Solar System, weather and the water cycle, types of rocks, properties of minerals, volcanoes and plate tectonics, weathering, and alternative energy. Good for Earth Sciences grades 3 – 8
http://rocknlearn.com/html/earth_science.htm

Epic Rock is Ian Tamblyn's 2013 release (free) album of geology songs: the result of writing 12 songs for a geology conference. Download and enjoy! www.tamblyn.com/album_epic_rock.html

Cambrian Explosion is a great song performed by Brighter Lights, Thicker Glasses. www.youtube.com/watch?v=EMwxwRA9Xr8

Dinotasia: Based on cutting-edge paleontology and the latest fossil records, this 2012 documentary presents a series of vignettes about dinosaurs. www.youtube.com/watch?v=evN40S-K9LQ

Careers

Mining Your Future is a TV Mini-Series showcasing the diverse career opportunities in B.C.'s mineral exploration and mining industry. Hosts Danielle and Maggie follow three unique jobs each week for eight weeks, allowing you to discover, first-hand, over 20 of the 120 top-paying jobs in the province. www.miningyourfuture.com/videos

Global CareerMine lists new mining jobs and employers looking for qualified candidates every day. www.infomine.com/careers/

From Millwrights to Assayers, Buyers to Chemical Engineers, the Mining Association of B.C. (MABC) is the place to find B.C.'s best mining industry career opportunities. www.mining.bc.ca/job-board

TalentEgg lists itself as Canada's most popular online career resource and job board for students and recent graduates.
http://talentegg.ca/career-guides/mining/

Minerals and Fireworks

Minerals and their influence are everywhere, even in our holiday celebrations. Thousands "oooh" and "ahhh" as they watch spectacular fireworks displays marking occasions such as Canada Day, Victoria Day, Jean Baptiste Day (Quebec), and even Halloween (B.C.).

What makes those spectacular fireworks colours? Each colour is produced by a specific mineral compound. Bright greens are made with barium. Deep reds are a product of strontium and blues come from copper. Yellows require sodium.

More colours can be created by mixing compounds. Strontium and sodium together produce a brilliant orange. Titanium, zirconium, and magnesium alloys combine to make a silvery white. Copper and strontium mix to yield a lavender hue.

Certain minerals are used for special effects. Iron filings and small particles of charcoal produce gold sparks. For a loud flash, fine aluminum powder is the fuel to choose. Larger particles, such as small flakes or granules, give a longer, shower-like effect. Magnalium, a magnesium-aluminum alloy, can produce a tiny series of silvery-white flashes. Aluminum, antimony sulfide, and perchlorate are some flash mixtures.

WHERE challenge

Water **H**azards **E**nergy **R**esources **E**nvironment

Understanding these subjects, the core of geoscience studies, is key to effectively living and managing our lives on this Earth. We invite students to explore them in the WHERE Challenge. The WHERE Challenge, a national contest, promotes the awareness of non-renewable resources among Canadian youth. Students ages 9 to 14 discover and creatively tell us why non-renewable resources are so important in everyday life.

Mining Matters and Kinross Gold would like to thank all those teachers and students who participated in the 2014 challenge and congratulate them for their efforts and creativity. They learned, "Do you know what's in your pencils, your shoe laces, your toonies?" Ask our 2014 WHERE Challenge winners; they know! National winners are listed to the right.

"I have learned how important non-renewable resources are to everyone on Earth…I also learned that almost everything that matters to me (entertainment, clothes, sports, and even some food items) contain non-renewable resource."

—Julie Krug-MacLeod, WHERE Challenge Best Overall Winner in the 9 to 11 age category

Entries are welcome in French and English. To learn more about the Challenge and to see all national and regional winning entries, go to www.earthsciencescanada.com/where

2014 WINNERS

NATIONAL WINNERS (9 to 11 years)

BEST CREATIVE
What is a pencil made of? ($250)
Emily Liu and Katrina Stanfield
Toronto, Ontario

BEST RESEARCH
From the Earth to Our Kitchen ($250)
Taeya Nial and Jaiden Csintalan
Maple Ridge, British Columbia

NATIONAL WINNERS (12 to 14 years)

BEST OVERALL
Brace yourself for an Adventure out of this World ($500)
Julie Krug-MacLeod
Saskatoon, Saskatchewan

BEST CREATIVE
What's in a Crayon? ($250)
Katie Sell
Georgetown, Ontario

BEST RESEARCH
The Secret of the Stuffed Animal ($250)
Famke Alberts
Georgetown, Ontario

SCHOOL WINNERS

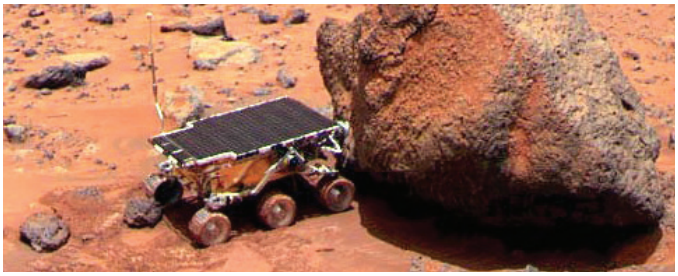
Montgomery School
Saskatoon, Saskatchewan
($750)

Georgetown District High School
Halton Hills, Ontario
($750)

Queen of All Saints School
Coquitlam, British Columbia
($750)

Robotics in Mineral Exploration

Looking for mineral resources these days involves some of the highest-tech equipment developed on the planet; robotic technology holds the key to the industry's future. Mining companies are going deeper underground, to the bottom of the sea, and into space to find mineral resources, all environments that challenge a human presence. Robotics is proving to help us meet that challenge, without risk to ourselves, allowing us to explore for knowledge and resources previously unattainable.



Pathfinder's Sojourner Rover is taking its Alpha Proton X-ray Spectrometer measurement of the Yogi Rock (NASA). This instrument measured the elements in the rock. http://commons.wikimedia.org/wiki/File:Pathfinder01.jpg

In February 2012, CBC News reported that Greg Baiden of Sudbury was on site at a copper mine in Chile testing a $3 million mining robot he helped design and build. The teacher of robotics and mine automation at Laurentian University and CEO of Penguin Automated Systems is getting attention from around the world for the invention. The robot can accurately determine dimensions of excavations underground, improve the quality of mining work, and allow workers to see exact locations of drill holes and tunnels underground without physically travelling there. Baiden originally designed the robot with safety and mining disasters in mind. He calls it "a reconnaissance robot" that can cover difficult terrain where people might not be able to go, survey the ground, test the air, and carry a load.

In space, robotic exploration is and will be key to learning about the celestial bodies in our solar system and beyond. Robots can physically sample and measure their rocks and surface soil, allowing us to gain tremendous knowledge from afar. For example, the Osiris-REx mission (see Space: The Final Frontier, page 6) aims to robotically collect samples from a near-Earth asteroid. Robotic tools on the last three generations of NASA's Mars Landers have collectively completed 300 excavations of Martian dirt and rocks. A water-prospecting robot has been developed to explore water and gas resources discovered as ice on the Moon that could be used by future colonists. The Canadarm, the robotic arm developed for NASA's Space Shuttle Program, deployed, captured and repaired satellites, positioned astronauts, maintained equipment, and moved cargo.

Oceans and seas cover approximately 71 per cent of the Earth's surface, covering potentially rich mineral deposits. Underwater exploration poses challenges just as does working in Earth orbit or on the surface of Mars, but robotic technologies can also be adopted to tackle the difficulties of the deep. The 2013 Deep Sea Mining Summit, held in London, England, featured remotely operated vehicles (ROVs), deep water technology, and other robotic innovations. Canadian mining company Nautilus Minerals is on track to develop the world's first oceanic precious-metal mine, off the coast of Papua New Guinea, 1,600 metres below the ocean surface. Countries such as Japan and South Korea are very interested in deep sea mining. In August 2013, South Korea successfully tested its first-ever deep sea mining robot, and hopes independent underwater mining of manganese ores can begin as early as 2015.

Today, mineral exploration and mining draw upon the expertise of many scientific disciplines, from geology to computer science, chemistry to high-tech robotics: something to keep in mind for those considering career options. Also interesting to note, as we redefine the extent of our reach with such technology as robotics, the very metals and minerals that we look for make possible the innovations that can take us to the next level.

Did You Know: Uses for Rocks in Ancient Times

PIGMENTS: Some pigments, such as ochre and iron oxide, have been around since prehistoric times. Azurite is a pigment used since medieval times, mined from deposits in Saxony and France. It was a major source for the blues in medieval paintings and even Japanese works. Before the industrial revolution, most pigments were technically limited, using naturally found minerals or organic substances. Many of the most important substances mined were for pigments.

MEDICINE: Drug treatments likely started with plants but the concept of using rocks or minerals to treat diseases came soon after. Having seen grazing animals lick the soil around an old ocean bed for salt, people eventually tried it themselves. Nephrite, one of two types of jade, was once believed to be a cure for kidney stones.

COSMETICS: Cosmetics were important to nearly every early society, including Persians, Egyptians, Greeks, Romans, and Chinese. For example, both Galena (lead sulphide) and Stibnite (antimony sulphide) were used to make kohl, an eye cosmetic for people in the Middle East and surrounding areas.

ACTIVITY: Engineer and Build an Underground Mine Model

Engage your students and stimulate their imaginations with this engineering challenge. Student groups build their own models of an underground mine and use them to show how to extract ore *(a mixture)* from the ground to obtain the desired mineral *(a pure substance)*. Activity duration is two to three hours.

A poster series produced by the Minerals and Metal Sector of Natural Resources illustrates many aspects of mining and mineral processing. The four posters look at an underground mine, a surface mine, a concentrator, and the smelting refining process.
http://www.nrcan.gc.ca/minerals-metals/business-market/3828

Showcase your Mine! *Mining Matters* invites teachers and students to send us pictures of the finished "mines." We'd love to show off your work on our website.

Background

Mining is a temporary use of the land during which valuable material from the Earth is **extracted** (removed). When the rock is valuable because it contains metal or minerals, it is called an **ore body**. If the ore body is buried deep in the Earth, miners must dig tunnels to the ore body. Such an operation is called an **underground mine**. The *vertical tunnel* to the area of the ore body is called a **shaft**. Inside the shaft an elevator **(cage)** is used to transport the miners and equipment from the surface to the underground workings and a bucket **(skip)** is used to lift the broken rock and ore from underground. Other vertical tunnels called **ventilation shafts** bring fresh air to the mine. *Horizontal tunnels* called **drifts** provide access from the shaft to the ore body. **Explosives** such as dynamite are used to break up the rock. Broken rock is loaded into a *scoop*, a large machine that combines a front-end loader and a truck. It is driven back to the shaft where the **ore** is dumped and lifted to the surface in the skip.

Mined ore contains metals and minerals of value as well as other minerals of no value. The two are often evenly mixed in the ore and must be separated to form a **concentrate** of the valuable mineral. After separation, the minerals of no value are usually called **tailings**.

The **first step in separating** the valuable minerals almost always involves **crushing the rock** to a fine powder. The rock is broken up in large crushers and pulverized in large rotating drums containing hard balls or rods. The process of producing the fine powder is called **milling** and the process takes place in a **mill**. This process is like grinding wheat or oats to make flour.

Two procedures are commonly used to separate the valuable and non-valuable minerals from the milled ore. When mixed with liquid, heavier minerals sink and therefore can be separated from lighter minerals. This procedure is called **heavy media separation**. This process could be used to separate heavier chalcopyrite from lighter quartz. If the valuable minerals are magnetic, they can be separated from the minerals of no value by passing the crushed ore under a powerful magnet. This procedure is **magnetic separation**.

Once the valuable metals have been separated or concentrated, the leftover material (rock fragments, dust, and chemicals) is called **tailings**. Mining companies work hard to ensure that these tailings are managed effectively and responsibly. Such efforts are necessary because the real-life tailings might contain dangerous chemicals that could escape into streams and lakes. Some tailings contain minerals such as pyrite. As pyrite is exposed to water from rain and other sources, it can make the water somewhat acidic. This acid water can drain into streams and lakes and negatively affect the fauna and wildlife.

In the early part of the century, people, including mining people, did not understand that material such as tailings could cause serious damage to the environment. Now, mine tailings are kept in specially designed ponds. The base of the pond is lined with heavy plastic or dense clay. Any water leaving the pond is chemically treated to remove acids or dangerous chemicals. The tailings are eventually covered with soil and planted with grass and trees. Strict government rules are applied to tailings. Some mining companies have even stricter internal rules.

After underground mining is completed, the **reclamation process** includes filling all the opened areas with sand, cement, or waste rock. The shafts are **capped** (plugged) and the buildings at the surface are removed. The small areas used for the buildings are replanted with grass and trees and very little evidence of the mine remains.

Materials

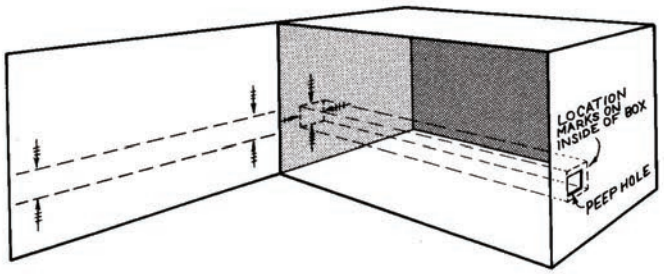
Construction	Materials Needed for Each Group
Mine Site	Cardboard box
Headframe	Cardboard/construction paper/popsicle sticks
Buildings on Site	Cardboard/construction paper/miniature toy buildings
Trucks	Construction paper/miniature toy trucks
Trees	Construction paper/miniature toy trees/twigs
Shaft	Cardboard/construction paper/cardboard tubes
Cage/Skip	Cardboard/construction paper/string
Ventilation Shaft	Cardboard/construction paper/cardboard tubes
Drift	Cardboard/cardboard tubes
Ore host rock	Aluminum foil
Mineralization	Mixture of 50 ml flour, 50 ml water, 20 ml iron filings. Iron filings may be purchased from a provider of scientific supplies and equipment
Rock	Construction paper/newspaper/painted fibrefill
Other supplies	Masking tape or duct tape, paint, flashlight

Safety Matters

This activity requires that iron filings be mixed with flour and water. It is very important that the dish and mixing equipment used to prepare this mixture are cleaned *while the mixture is still wet*. NEVER dispose of iron filings down the sink. When airborne, iron filings present a health hazard by irritating the lungs and eyes. **Care should be taken to ensure that only the teacher handles unmixed iron filings**. Eye protection must be used. Respiration protection should not be needed in normal laboratory handling. Spills can be swept up and iron filings may be reused or placed in the garbage.

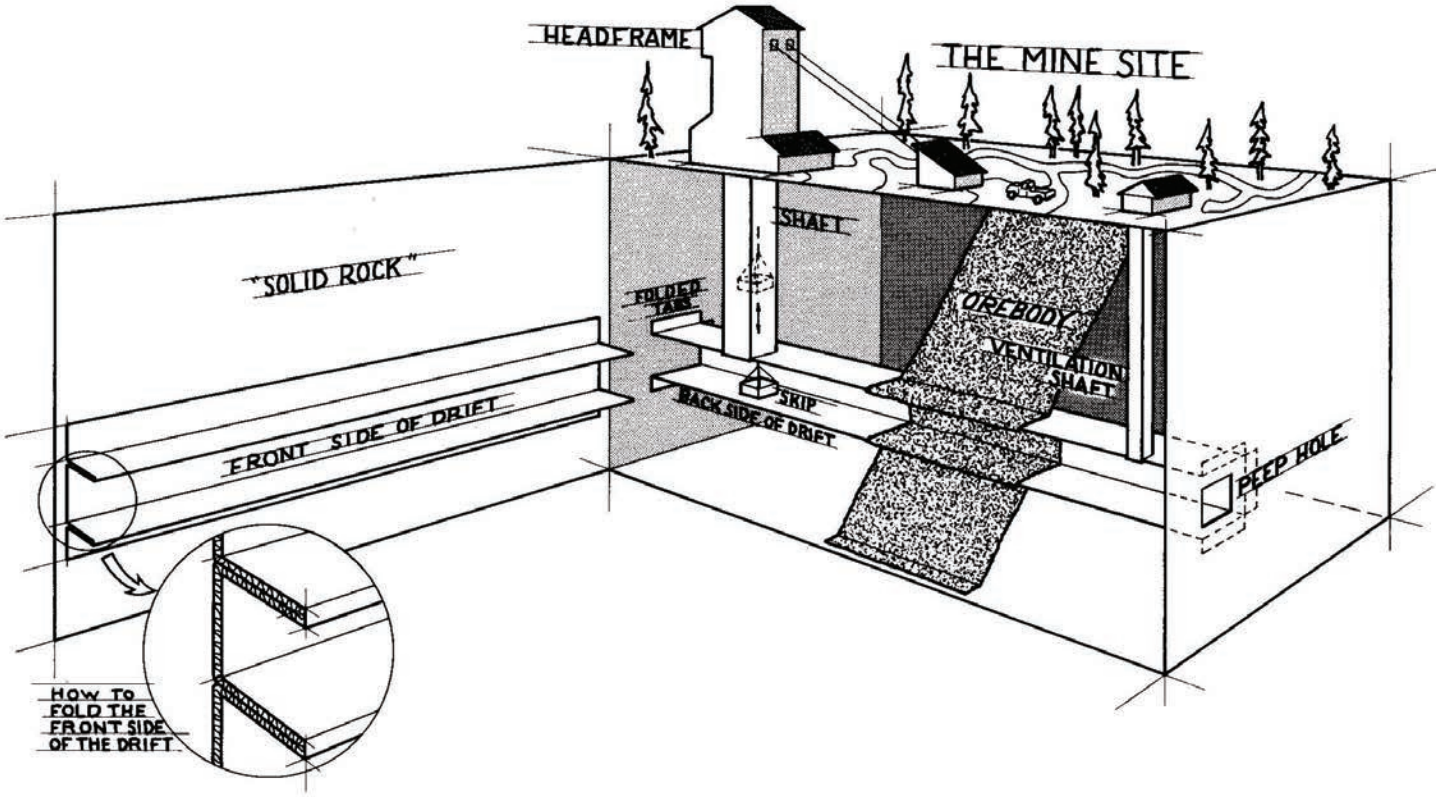
Activity 1: Building a Mine

1. Prepare your box, the mine site, by taping all sides closed.
2. Cut open one side of the box to make a "door."
3. Locate the position of a drift by measuring and drawing horizontal lines on the inside of the "door." Draw corresponding marks on the insides of the sides of the box as shown below. Cut a "peep hole" out of the right side of the box at your marks.



4. Your drift has two sides (back side and front side). Create both sides of your drift by either folding cardboard as shown in the completed model illustration or by cutting a stiff cardboard tube in half lengthwise. To get a straight edge when folding cardboard, it helps to use a strong straight edge, like the edge of a tabletop.
5. Using your drift location marks as guides, glue the front side of the drift to the "door." Attach the back side of the drift by gluing the folded tabs at both ends to the sides of the box. Ensure that the back side of the drift lines up with the "peep hole."
6. Make a shaft out of cardboard by folding four sides into a tube or by using a round cardboard tube. Make a hole in the top of the box slightly larger than the shaft, directly above the left end of the drift.
7. Cut a corresponding hole in the top of the drift. Lower the shaft through the surface to the top of the drift at the hole. In a real mine, the shaft is dug down through solid rock to the drift level and then the drifts are dug horizontally.
8. Make a smaller ventilation shaft in your mine by repeating Steps 6 and 7 on the right end of the drift.
9. Make a headframe (building at the top of the shaft) and place it over the shaft hole. A small building for fans should be made for the top of the ventilation shaft. Make a cage/skip out of string and construction paper. Be sure that it is small enough to fit through the shaft.
10. It's time to make the orebody! Take a sheet of aluminum foil (ore host rock) long enough to extend from the top of the box to the bottom of the box with at least 15 cm extra. Fold the foil to a width approximately 10 to 15 cm. Tape the foil to the inside of the box top and to the top of the drift. Press the foil into the drift along the top, back and bottom allowing the remaining foil to extend to the bottom of the box. Secure with tape at the bottom of the drift and box.
11. Have your teacher prepare the flour, water, and iron filing mixture (mineralizaton) as indicated in the Materials table. Spread the mixture on the foil before it gets too dry! Be sure to spread the mixture on the foil in the drift also. Allow this mixture to dry. The dish and mixing equipment used to prepare the mixture should be cleaned while the mixture is still wet. NEVER dispose of iron filings down the sink.
12. While the orebody is drying, carefully fill the remaining open spaces in the box with shredded newspaper or painted fibrefill. This will give the impression that the drift is actually passing through solid rock. Complete your model by painting the surface and placing trees and trucks to represent a real mine.
13. When the "door" of the model is closed, peek into the mine by shining a flashlight into the "peep hole." This really gives you the feeling of being underground.

Diagram of completed model



Activity 2: Mining Operations

1. Extract the mineralization (dried flour paste mixture) from your mine by chipping the ore from the host rock. Transport the ore to the skip and raise it to the surface.
2. Devise a method to recover the iron filings from the other mined material, remembering that iron filings are made from magnetite, a very heavy and magnetic mineral.
3. Think of ways to safely manage the leftover material (tailings) after you separate the iron filings from the flour paste mixture (e.g. water filtration, disposal methods). NEVER dispose of iron filings down the sink.
4. Use your model to deliver a presentation to your classmates about the processes of mining and milling. Describe how ore is taken from the ground (mined) and processed (milled).

Extensions

1. **Discuss:** Talk about the various challenges associated with underground mining. Research and deliver a presentation explaining how technology is being used to mitigate some of these challenges. Identify real life examples of these solutions in place.
2. **Compare:** How would your mine model change if you were asked to build a surface mine? Would the challenges be the same or different?
3. **Consider:** What happens if the valuable mineral was not magnetite (iron filings) but diamonds?
4. **Problem Solve:** Can you find a way to move the ore from the shafts underground to the surface? Are there any components of the model that can be mechanized?

ROCKS, MINERALS, METALS AND MINING WORD SEARCH

Mining is an important part of the Canadian economy. Locate and circle all of the words from the list below. All the words are hidden vertically or horizontally - in both directions. Use the remaining leftover letters to find a secret catch phrase.

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

AGATE
AMETHYST
BASALT
CADMIUM
COPPER
CRYSTAL
DIAMOND
FELDSPAR
GABBRO
GEM
GNEISS
GOLD
GRANITE
GYPSUM
HALITE
HEMATITE
IRON
LEAD
LIMESTONE
MAGNETITE
MARBLE
METALS
MICA
MINE
MINERALS
MINING
NICKEL
QUARTZITE
RHYOLITE
ROCKS
SANDSTONE
TIN
ZINC

Answer on page 16

Gem and Mineral Shows across Canada

Bancroft 51st Rockhound Gemboree
July 31 – Aug 3, 2014 North Hastings Community Centre, 103 Newkirk Blvd., Bancroft, ON
http://rockhoundgemboree.ca/

Nova Scotia Gem and Mineral Show and Sale
August 15 – 17, 2014 Lion's Recreation Centre, Western Ave., Parrsboro, NS
http://fundygeological.novascotia.ca/what-see-do/gem-mineral-show

Gem and Mineral Club of Scarborough Annual Wonders of the Earth Show
September 13 – 14, 2014 Don Montgomery Community Centre, 2467 Eglinton Ave. E., Scarborough ON www.scarbgemclub.ca/

Ottawa Lapsmith & Mineral Club Annual Gem & Mineral Show
September 20 – 21, 2014 Nepean Sportsplex, 1701 Woodroffe Ave., Ottawa, ON
http://olmc.ca/gemshow.htm

Fraser Valley Rock & Gem Club Annual Rock & Gem Show
September 20 – 21, 2014 Old Age Pensioners Hall, 3015 273 St., Aldergrove, BC

Ancaster Gem, Mineral, Bead and Jewellery Show
September 26 – 28, 2014 Marritt Hall Complex, 630 Trinity Rd., Ancaster, ON
www.ancastergemshow.com

Kingston Lapidary and Mineral Club Annual Gem Storm
October 18 – 19, 2014 Portsmouth Olympic Harbour, 53 Yonge St., Kingston, ON
www.mineralclub.ca/

5th Annual Calgary Gem, Mineral, Fossil and Jewellery show
October 31 – November 1, 2014 Calgary Chinese Cultural Centre, 197 First St. SW, Calgary, AB www.calgarygemshow.com/

University of Waterloo Gem and Mineral Show
October 24 – 25, 2014 Earth Sciences Museum, 200 University Ave. W, Waterloo, ON
https://uwaterloo.ca/earth-sciences-museum/about-earthsciences-museum/gem-and-mineral-show

Montreal Gem and Mineral Club 54th Annual Show
November 7 – 9, 2014 Place Bonaventure, 800 De La Gauchetière, Montréal, QC
www.montrealgemmineralclub.ca/pages/AnnualShow-Set.html

Mining Matters Mine Game Activity Answer:

Mining matters to everyone

Contact Information

904–1200 Eglinton Avenue East
Toronto, ON M3C 1H9

Tel: 416-863-6463 • Fax: 416-863-9900
Email: schoolprograms@miningmatters.ca
Website: www.miningmatters.ca

Mining Matters prides itself on building long-term partnerships with teachers by providing relevant, accurate and authentic Earth science resources for the classroom, designed by teachers for teachers. Since 1994, this charitable organization has reached more than 550,000 teachers and students, as well as the public with education about geology and mineral and energy resources. It has promoted an awareness of the importance of rocks, metals, minerals and mining through the dissemination of information and the development and distribution of educational programs and materials.

General Director
Heather Douglas

Manager, Aboriginal Education and Outreach Programs
Barbara Green Parker, OCT

Manager, Teacher Training and School Programs
Janice Williams, OCT

Assistant, Teacher Training and School Programs
Kelly McBride, OCT

Coordinator, French Programs
Julie Lépine

Operations and Events Coordinator
Laura Anonen

Publications Editor
Victoria Stratton

groundWORK Contributors
Robert Barter
Kristin Innes-Taylor
Robert Millard
Susan Nicholl
Aimee Partlow
Victoria Stratton
Janice Williams