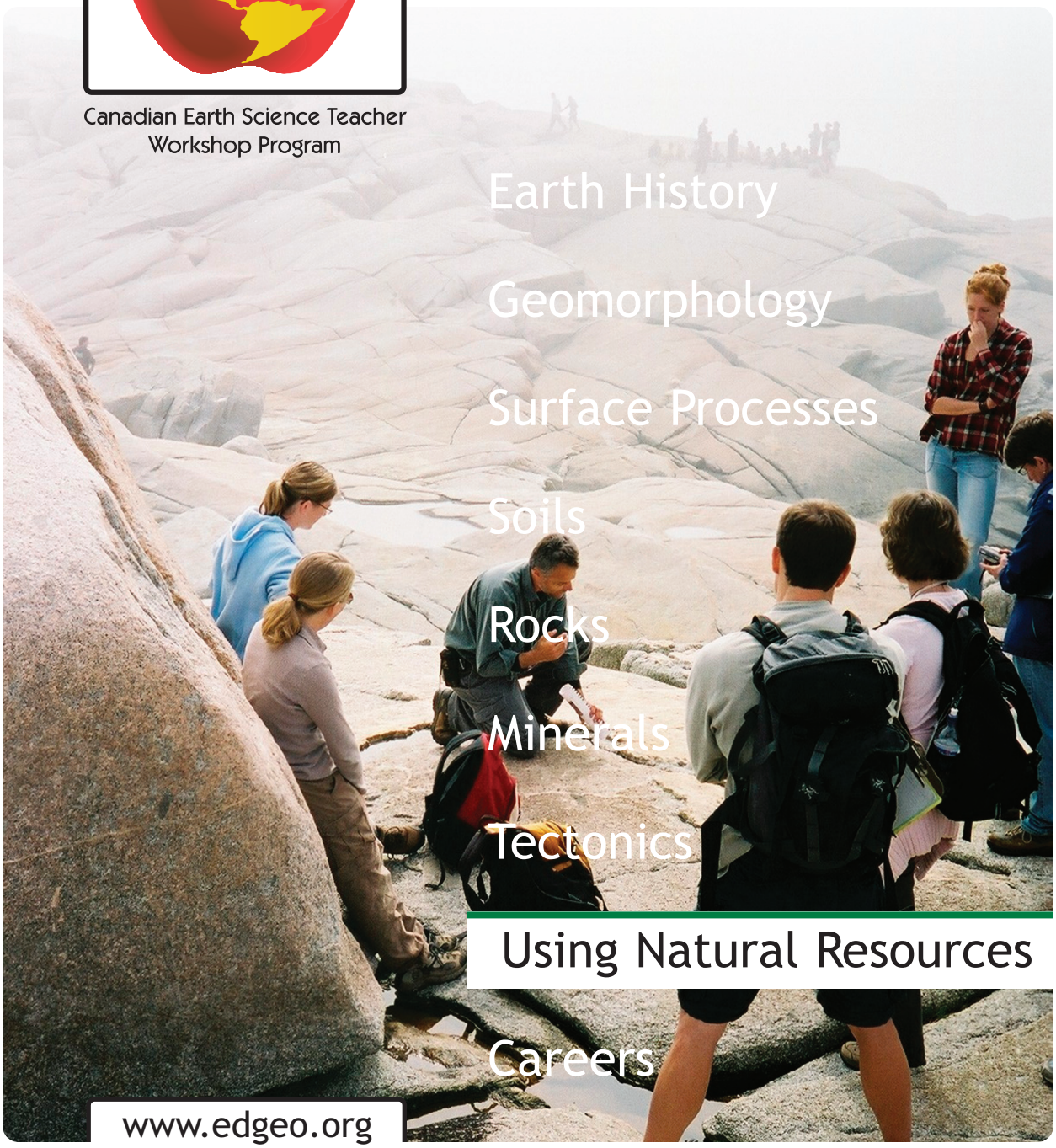
EdGEO

Canadian Earth Science Teacher Workshop Program

Bringing Earth Science to Life



Earth History

Geomorphology

Surface Processes

Soils

Rocks

Minerals

Tectonics

Using Natural Resources

Careers

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Where do Things Come From?

Students match everyday products to the types of natural resources (animals, plants, fossil fuels or minerals) used to make them.

Explanation

Natural resources are materials occurring in nature that can be used for economic gain, i.e. made into consumer goods. Natural resources include plants (trees, crops), animals, fossil fuels (oil, coal, gas), and rocks and minerals. Canada's natural resource industry is the backbone of our economy and among the most productive, high-tech sectors in the global economy.

We use rocks and minerals for every conceivable purpose. Early humans used them for tools, weapons and building materials. Today, every product we use comes from plants, animals, minerals or fossil fuels, or combinations of them. By far the most common product source is minerals. Even products that are not made directly from minerals are manufactured using metal machines, and all metals are made from minerals.

Materials

Cards showing everyday items

Caution

None

Time

Short

Grouping

Any format

Preparation

Prepare cards with photographs or names of everyday items. See the resource list for examples.

Prompt

Set out a potted plant and a piece of rock. Ask students how important each of these items are. Which is the most valuable? Could we live without either of them?

Delivery

1. Distribute cards to the students and have them identify each product as coming from animals, plants, minerals or fossil fuels.
2. Play a game where students place their cards into category piles, or line up under category signs, or record them onto a master chart. Many products are made from combinations of natural resources and will appear in more than one category.

Questions for Discussion

Which category of natural resource do we use the most?

Which resources are renewable and which are non-renewable?

Extension

Have students list all the items they use in a single day and categorize them by source.

Resources

Animals	Plants	Minerals	Fossil Fuels
Milk	Wooden desk	Window	Plastic bottle
Hamburger	Paper	Computer	Computer
Leather shoes	Cotton jeans	Paint	Paint
Wool sweater	Peanuts	Brick	Telephone
Fur coat	Apples	Telephone	Sneakers

Rocks Around Us

Students undertake a walking tour of their local area looking for rocks being used in the community.

Explanation

Stonehenge was built about 2000 years ago in southern England. Some of the giant stones that make it up are arranged to line up with the sun and the moon on the summer and winter solstices (the longest and shortest days of the year), so it is thought that Stonehenge was used to help keep a calendar. There are many other structures similar to Stonehenge in England, but it is, by far, the best known.

Medicine wheels are created by First Nations peoples who live in the prairies of Canada and the United States. Medicine wheels are made of stones and usually have two or more of the following characteristics:

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

Medicine wheels vary in size, and most are associated with ceremonies like the Sun Dance that involve large groups of people.

Inuksuk are created by the Inuit people of northern Canada. They resemble a human figure made of stones, and are markers to guide hunters and travellers.

Materials

"Rocks Around Us" Walking Tour sheet (see Resources)
Pencils

Caution

Be alert for traffic and water hazards.

Time

Medium

Grouping

Small group, whole group

Preparation

Plan a walking route that includes all the examples of how rocks are used in the community as building materials, as set out on the walking tour sheet. Reproduce a walking tour sheet for each student.

Prompt

Show a photograph of Stonehenge. Ask students to speculate as to when it was built. Who built it? How might they have done it? Ask where they think we use rocks and stone today.

Delivery

Escort students on a walking tour of the neighbourhood to find examples of rocks used as building materials. Ask them to record, on their activity page, where they saw each example and to draw a quick sketch showing how the rock was being used.

Questions for Discussion

What advantages do rocks have as a building material?

What disadvantages do rocks have as a building material?

What challenges do you think the Inuit face when they build an Inuksuk?

Where are rocks used for practical purposes?

How are rocks used for decorative or symbolic purposes?

Extensions

Research and write a report on the construction of a large project built of stone, e.g. Stonehenge, the Great Wall of China, the Parliament Buildings in Ottawa, a public building in your community.

Use small stones to build a model Inuksuk or Stonehenge without using glue, as neither structure has cement holding it together.

Interview a First Nations Elder about medicine wheels. Ask how they were first created and about their role in spiritual life and ceremonies.

Look at where rocks are being used in your community. For each example that you see, tell where you found it and draw a picture of it.

	Where	Picture
Rocks used to make a path		
Rocks used to make a chimney, fireplace or barbecue		
Rocks used to make a wall		
Rocks used to make a floor		
Rocks used to make a fountain or bird bath		
Rocks used to edge a pond		

Rocks and Minerals Everyday

Students identify products they use in their daily activities, and discover the rocks and minerals used to make them.

Explanation

Natural resources are materials occurring in nature that can be used for economic gain, i.e. made into consumer goods. Natural resources include plants (trees, crops), animals, fossil fuels (oil, coal, gas), and rocks and minerals. Canada's natural resource industry is the backbone of our economy and among the most productive, high-tech sectors in the global economy.

We use rocks and minerals for every conceivable purpose. Early humans used them for tools, weapons and building materials. Today, every product we use comes from plants, animals, minerals or fossil fuels, or combinations of them. By far the most common product source is minerals. Even products that are not made directly from minerals are manufactured using metal machines, and all metals are made from minerals.

Materials

List of products and natural resources (see Resources)
Paper

Caution

None

Time

Medium

Grouping

Individual, pairs

Preparation

Reproduce the list of products and resources for each student.

Prompt

Display a sample of quartz. Ask how many students have used this mineral today? Prompt them to consider that quartz is the source of silica, which is used in the manufacture of glass, computer chips, plastics and many other things.

Delivery

1. Have students divide a large sheet of paper into three parts, labelled morning, afternoon and evening.
2. In each part, ask students to write down what things they might be doing at these different times of day.
3. Distribute the list of products and natural resources.
4. Direct students to fill in each section of the day with products they would use, and the resources needed to make those products. Products can be repeated as necessary.

Questions for Discussion

Is there any activity that you do that does not use rocks or minerals?

What other products can we add to our lists that use rocks or minerals?

Extensions

Display everyday items and samples of the rocks and minerals they contain.

Separate these products from the corresponding resources, and see if students can match them again.

Resources

Natural Resources in Everyday Products

Product	Rocks or Minerals Used to Make the Product
Aquarium	Silica, sand, gravel
Bike	Petrochemicals, iron, chromium, nickel, aluminum
Bike helmet	Copper, zinc, iron, petrochemicals
Bread and cereals	Gypsum, salt, limestone
Car or bus	Clays, dolomite, metals, magnesium, silica, lead, nickel, chrome, iron
Carpet	Limestone, dolomite, barite
Ceramic tile	Limestone, gypsum, clay, aluminum
Clothes	Petrochemicals, aluminum
Computer	Silicon, copper, chromium, iron, nickel, silver, mercury, carbon, zinc, lead, tin, lithium, cadmium, rare-earth elements
Concrete	Limestone, clay, shale, gypsum, aggregates
Cosmetics	Talc, mica, kaolin, bentonite, calcite, dolomite, iron oxide, chrome oxide, manganese, soda ash, sulphur, titanium dioxide, gold
Countertop	Titanium dioxide, calcium carbonate, aluminum hydrate
Crayons	Petrochemicals, gypsum
Door key	Brass, copper, zinc, iron, chrome
Drinking water	Filtered by: zeolite, fluorite, silver
DVD player	Silicon, copper, chromium, iron, nickel, silver, mercury, carbon, zinc, lead, tin, lithium, cadmium, rare-earth elements
Eavestrough	Zinc, iron or silica, borate, limestone, soda ash, feldspar
Electrical wires	Copper, aluminum, tin, zinc
External walls	Clay or stone
Fertilizer	Phosphorous, magnesium

Fridge	Fluorspar, silica, tungsten, chrome, aluminum, antinomy, beryllium, copper, iron, nickel, lead, tin, titanium, zinc
Gasoline	Oil direct from ground; drilling requires barite, diamonds, metals
Glass	Silica sand
Golf clubs	Graphite, titanium
Heat	Coal, oil or gas
Insulation	Silica, feldspar, vermiculite
Internal walls	Gypsum, clay, calcium carbonate
Jewellery	Gold, silver, platinum, nickel, chrome, diamond, garnet, opal, topaz
Kitty litter	Zeolite, volcanic rock, clay
Light bulbs	Tungsten, silica, copper, aluminum
Linoleum	Calcium carbonate, clay, wollastonite
Medicines	Barite, calcium carbonate, zinc oxide, salt, gold, mercury
Microwave oven	Steel, copper, silica, aluminum, beryllium, iron, molybdenum, nickel, titanium, tungsten, zinc
Mirror	Silica sand, silver
Money - coins	Gold, silver, nickel, chrome, aluminum, brass, copper
Money - paper	Kaolin, clay
Nails and screws	Iron ore, zinc
Paper	Kaolin, clay, titanium dioxide, sodium sulphate, soda ash
Paper clips	Iron, clay, limestone, zinc
Pen	Barite
Pencil	Graphite
Planting soils	Vermiculite, perlite, gypsum, zeolite
Plates and dishes	Gypsum, limestone, clay, silica

Plumbing	Copper, zinc, nickel, chrome, tin, lead, iron, petrochemicals
Pop can	Aluminum
Porcelain toilet	Limestone, gypsum, clay
Pots and pans	Aluminum, iron, steel
Power tools	Zinc, copper, iron, molybdenum, tungsten, chromium, vanadium
Roads	Sand, gravel, crushed stone, iron oxide, limestone
Roof	Silica, borate, limestone, soda ash, feldspar, talc
Sandpaper	Garnet, diamond
Siding	Aluminum or silica, borate, limestone, soda ash, feldspar
Stove	Steel, copper, silica, aluminum, beryllium, iron, molybdenum, nickel, titanium, tungsten, zinc
Sunscreen	Titanium dioxide
Swimming pool	Diatomite, zeolite, salt
Telephone	Silica, copper, chromium, iron, nickel, silver, mercury, carbon, lead, zinc, tin, rare-earth elements
Television	Silicon, copper, chromium, iron, nickel, silver, mercury, carbon, zinc, lead, tin, lithium, cadmium, rare-earth elements
Toothpaste	Calcium carbonate, limestone, sodium carbonate, zeolite, silica, fluorite
Vitamins	Zinc, lithium, iron
Watch	Silicon, copper, chromium, iron, nickel, silver, mercury, carbon, zinc, lead, tin

Physical Separation of Minerals

Students design a process to separate the four components of a mixture containing iron filings, salt, sand and sawdust.

Explanation

Most economic natural resources are not found in the Earth in a native (pure) state, but are extracted from mineral-bearing rocks and processed to extract the resource. There are many physical and chemical separation techniques, and these are continually being redesigned to improve efficiency and percentage returns, or to diminish any environmental impact. Each extraction process is specific to the mineral being extracted and the host rock.

Materials

Student Activity Page
Iron filings
Salt
Sand
Sawdust
Magnet
Filter paper
Beakers/containers
Additional separation equipment (see Preparation)

Caution

Review each student's proposed method for separation before the actual procedure is carried out. Modify where needed to ensure safe practice.

Time

Long

Grouping

Pairs, small groups

Preparation

1. Reproduce copies of the Student Activity Page and provide a range of suitable laboratory equipment to inspire the students' methods. Set out the laboratory materials listed above, plus other common equipment (e.g. measuring cylinders, ammeter, pH test strips).

2. Fill small containers with a mixture of iron filings, salt, sand and sawdust.

Prompt

Show students a sample of pyrite or chalcopyrite, along with some copper wire. Explain that pyrite and chalcopyrite are both copper ores, and that copper rarely exists in a pure form in the Earth. Pyrite and chalcopyrite must be processed to extract their copper content. Processing uses the physical or chemical properties of an economic mineral like copper to separate (or extract) it from its host ore.

Delivery

1. Distribute the Student Activity Page and prepared mixtures.
2. Allow time for students to complete their observations and plan a separation process for each of the four components in their mixtures.
3. Encourage students to observe the four separate components carefully to establish the physical properties of each that would be useful for designing a separation process. Be prepared to offer hints and instruction about laboratory techniques, such as those suggested in the sample method. Note: the sample method is not intended as a prescriptive solution, and there is plenty of room for student design and innovation.
4. Approve the planned methods and provide students with the equipment they need to carry out their methods.

Questions for Discussion

How important is the sequence of the steps that you have chosen? How might you change the sequence and still have successful results?

How effective was your method?

Extension

Research a mineral resource and its separation process, e.g. copper, nickel, gold, diamond.

Resources

Sample Separation Method:

1. Wrap a magnet in a plastic bag and pass it through the mixture. When all the iron filings have been collected, turn the bag inside out to contain iron filings.
2. Add water to the mixture to dissolve the salt. Filter the solution to separate salt (in liquid form) from the sand and sawdust. Allow the liquid to evaporate to collect the salt crystals.
3. Add new water to the sand and sawdust mixture. The sawdust will float, and the sand will sink. Decant off the top part of the liquid containing sawdust. Filter to collect the sawdust.
4. Filter the remaining liquid to collect the sand.

You are going to design a process that will separate the four components of your mixture: iron filings, salt, sand and sawdust.

Materials

Mixture for separation: iron filings, salt, sand, sawdust
Beakers/containers
Separation equipment of your choice

Instructions

1. From your experience or observation, describe the properties of the four parts of the mixture. Add additional properties if you wish.

	Density		Solubility	Magnetism	
Iron filings					
Salt					
Sand					
Sawdust					

2. Based on the properties that you have described, design a series of steps that will separate the mixture into its four parts.

Step	Substance separated

3. Have your process approved, and then carry out the steps that you have designed. Show the four separated substances as the result of your process.

Mineral Resources in our Community

Students investigate and locate the natural resources extracted in their region and describe what they are used for.

Explanation

Many of the natural resources used to make the products we rely on everyday are produced in Canada. The mineral resource industry is an important part of our national economy.

Materials

Provincial or regional mineral resource map
Paper or notebook
Pencil or pen

Caution

None

Time

Medium

Grouping

Individual, pairs

Preparation

Obtain copies of a mineral resources map of your region from your provincial or territorial government office. In many jurisdictions, these maps are free to educators.

Prompt

Ask students to list what industries are in their region, and to describe the types and locations of these activities.

Delivery

Direct students to:

1. Identify from the map all the mineral resources extracted in their region.
2. Set up a chart with 3 columns labelled “Natural Resource,” “Location(s) Where Extracted” and “Uses.”
3. Complete the resource and location columns in the chart.

4. Use textbooks or the Internet to list the uses of these mineral resources.

Questions for Discussion

How many of these mineral resources are used to make things that we have in our classroom?

Are these resources renewable or non-renewable?

Which of these resources is the most valuable. Which is the least valuable?

What has been the impact on our region of extracting these resources?

Extensions

Arrange a field trip to an extraction site.

Study samples of the rocks or minerals being extracted, and the products made from them.

Drilling for Oil

Students participate in a simulation of drilling to find an oil field. They produce a map and cross-section from the information observed from the core that they produce through drilling.

Explanation

The main way to get samples of rock from beneath the Earth's surface is through drilling. A drilling rig is set up at the desired location and a drill bit, usually coated with tiny industrial diamonds (the hardest mineral), is rotated in the ground and gradually penetrates through the layers of rock (strata). In a normal drilling situation, small chips of the rocks that the drill passes through are returned to the surface for analysis. These are called **cuttings**, and Earth scientists study the cuttings to learn more about the physical characteristics of the rocks, their chemistry and their age. Significant physical characteristics are the porosity and permeability of the rocks.

If the Earth scientist thinks that more detailed knowledge of the properties or relationships of the rock layers is required, then continuous rock sampling or **coring** is carried out during the drilling. The resulting **cores**, which are long, thin tubes of rock, provide a complete record of the rock that the drill bit passed through. Coring is an expensive process, so it is only undertaken when there is an expectation of a good economic return.

Materials

Marble cake mix
Green food colouring
Large cake pan
Frosting
1-2 cm diameter plastic aquarium tubing cut into 10 cm lengths, or large, clear plastic straws
Unlined paper for cross-section and map
Plates and forks (optional)

Caution

If students are to eat the cake, ensure hygiene is maintained.

Time

Medium

Grouping

Small group, whole group

Preparation

1. Follow directions for preparing the marble cake mix.
2. Take the white batter and place in half of the cake pan. Place the chocolate batter in the other half and overlap it onto the white batter so that you have white "sandstone" on one side, chocolate "shale" on the other side and overlapping colours in the middle. (See Resources for illustration of how cake should be constructed.)
3. Use several drops of green food colouring in an area of a few centimetres across on top of the white batter. Stir it into this area to create a green "oil pool" sitting within the white "sandstone." This is the target oil you will be looking for later in the activity.
4. When cake is done, frost it. Mark off 12 sections as drilling areas

Prompt

Display the frosted cake, and tell students that they are going to explore and map this area to find oil.

Delivery

1. Divide students into twelve groups.
2. Give each group a drill (plastic tube or straw).
3. Invite one group at a time to choose a drilling location on the cake. Tell them they can only have one hole in each drilling area because of government regulations that require space between drill holes.
4. Have them push the tube into the cake.
5. Students examine the core they bring up to see if they encountered any oil (green cake).
6. Students take a note of their drilling area and save their straw and place it in a row with the other groups' straws. These will be their core samples from which they will later draw their cross-sections.
7. On their unlined page, students will create a map of the oil field by marking the location of their drill hole and labelling it as either dry (no oil) or as a well (oil). They will quickly discover that drilling near another oil well is no guarantee of success.

8. Using information from all the drill holes, have students complete their map of the oil field and draw a cross-section of what the rocks might look like underground by using the information from their cores (see Resources for examples).
9. Eat the oil field (optional).

Questions for Discussion

How many holes did we need to drill to find the oil?

What if we had chosen different locations for our drill sites?

What controls the number of drill holes?

Extensions

Investigate other exploration methods used in oil exploration.

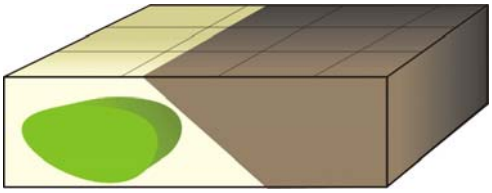
Research how oil is extracted and refined.

Discover all the products that use oil.

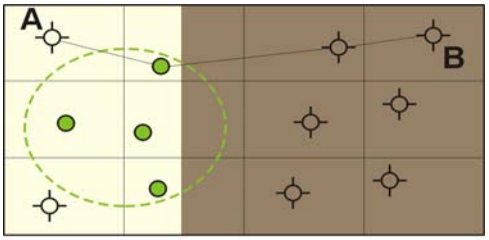
Resources

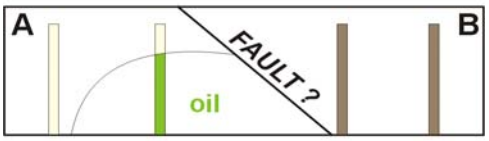
Examples of Cake Model and Student Results

1. Oil field (prior to frosting cake)



2. Oil Field Map and Cross-Section





Producing well . . . .
Dry hole . . . . . .

Getting Petroleum to You

Students match descriptors of activities in the petroleum industry to concerns about these activities and to possible solutions to these concerns.

Explanation

Extracting and using any natural resource has an impact on the environment. The oil and gas industry takes steps to reduce any environmental impact, and works with legislators and communities to deal with their concerns.

Materials

Petroleum activity, concern and solution cards (see Resources)

Caution

None

Time

Short

Grouping

Small group, whole group

Preparation

Reproduce and cut out all the cards.

Prompt

Show pictures of oil wells and products made from oil. Ask students what must be considered when choosing to use a natural resource.

Delivery

1. Distribute one card to each student. Explain that the cards each represent a petroleum activity, a concern about this activity, and a possible solution to the concern.
2. Ask students to find the two people who hold cards that match theirs.
3. When three students have a match, verify it, and tell them to copy the activity, concern and solution into their notebooks.

Questions for Discussion

Which activities do students feel have the largest impact?

What are their opinions about the possible solutions?

What other ideas do they have for dealing with the concerns?

Extension

Investigate other natural resource industries and how their activities impact the environment.

Resources

Petroleum Activity	A Concern	A Possible Solution
Pipelines are used to transport oil and natural gas across the country.	Sometimes people are unaware there is a pipeline underground and may break it while digging. Resulting oil and gas spills can be harmful for plants, animals and humans.	Pipeline routes are marked with signs that say, "Call before you dig" to alert people to pipeline locations. The routes are also checked for leaks.
Petroleum Activity	A Concern	A Possible Solution
Oil is transported by pipeline, barge, and tanker ship or tanker trucks.	Accidents can occur when transporting oil. This may cause oil to spill into the water, on roads or on land. This can harm plants, wildlife and humans.	Higher safety standards, more worker training and better equipment are used to help prevent oil spills from occurring.
Petroleum Activity	A Concern	A Possible Solution
Natural gas containing sulphur is called sour gas.	If natural gas with sulphur is burned, the sulphur combines with water vapour in the air. This contributes to acid rain, which can damage trees and lakes, and threaten wildlife.	Petroleum companies are now able to remove almost 99% of the sulphur found in natural gas. Manufacturers can use sulphur to make fertilizers, pesticides and other products.

Petroleum Activity	A Concern	A Possible Solution
To process crude oil and natural gas, large refineries or natural gas plants are built.	Refineries and natural gas plants take up a large area of land, and may take away from the beauty of the area. They may also cause some odour problems.	The petroleum industry tries to limit the number of refineries or gas plants built, by using current facilities to full capacity.
Petroleum Activity	**A Concern**	**A Possible Solution**
Sometimes trees must be cut down to carry out exploration.	Cutting trees to create an access road to complete an exploration survey can affect wildlife by changing habitat. Allowing vehicles, snowmobilers or hunters to use the access roads can also disturb the wildlife.	Petroleum companies sometimes use helicopters to conduct exploration to reduce the impact on habitat. This reduces the number of trees cut and the number of access roads built.
Petroleum Activity	**A Concern**	**A Possible Solution**
Sometimes pipelines have to cross rivers.	Construction of pipelines over rivers causes rocks to fall into the water. This can harm fish and other river wildlife.	Pipelines can be built beneath rivers to reduce the impact on wildlife.
Petroleum Activity	**A Concern**	**A Possible Solution**
Wells are used to remove crude oil and natural gas from the ground.	Sometimes the pressure in a well can cause a blowout: an uncontrolled flow of gas or oil. Blowouts can harm plants, animals and humans.	A blowout preventer has been developed that can be installed in wells to control the pressure levels so that blowouts do not occur.

Petroleum Activity	A Concern	A Possible Solution
Mining oil sands involves clearing vegetation and moving large amounts of earth.	Mining oil sands has an impact on natural habitats and wildlife. To reach the oil sands, an extremely large area of surface vegetation and underlying soil are removed.	Oil sands companies are responsible for reclaiming the land by replacing the soil and replanting native plants and grasses.
Petroleum Activity	**A Concern**	**A Possible Solution**
When a new area is to be explored for crude oil and natural gas, roads must be made to bring in equipment to set up a well for drilling.	Building roads and wells may mean a loss of habitat for animals.	Petroleum companies try to share roads with each other and with forestry companies to reduce the impact on the environment.

Operating a Mine

Students simulate the extraction and separation of a mineral resource. After mining the site, they will then reclaim the site.

Explanation

Two common procedures used to separate minerals from rocks take advantage of the physical properties of the sought minerals. When mixed with liquid, heavier or denser minerals sink and can then be separated from lighter minerals. This process is called **heavy media separation**, and it could be used to separate heavier chalcopyrite from lighter quartz when mining for copper and nickel. If the valuable minerals are magnetic, they can be separated from other rock and minerals by passing the crushed ore under a powerful magnet. This procedure is called **magnetic separation**.

When reclaiming a surface mine, even if all the **waste rock** (rock devoid of valuable mineralization) were replaced into the mine, the depression formed by mining would not be refilled completely. There are, however, a variety of options available: for example, the wall of the depression can be contoured to gentle slopes or the surface can be covered with topsoil, then grass and trees planted to create a naturalized landscape or environment. In some cases, mined-out surface mines and rock quarries have been turned into recreational lakes, public parks, rock gardens, farmland and housing sub-divisions. In one particularly innovative mine reclamation, a limestone quarry in Ontario's Niagara Peninsula was turned into a vineyard.

Mining companies use grass, plants and trees to stabilize slopes and reduce soil erosion. As the plants and trees mature, animal species diversity increases in the area. The habitat reclamation process is closely monitored by scientists from many disciplines.

Materials

Model Mine (See Preparation)
Spoons

Caution

Clean up spills immediately.

Time

Long

Grouping

Pairs, small groups

Preparation

1. Prepare one model of a surface mine for each group of students. There is considerable flexibility in the materials that may be used -- the general principle being to have a valuable mineral that must be separated from a non-valuable ore (the waste or country rock) component. Suggestions are given in the table below. It is possible to substitute the different valuable assets into alternate country rock.

Valuable target mineral/rock	Separated by	Waste or Country Rock
Magnetic beads	A magnet	Sand or gravel
Paper clips	A magnet	Potting soil
Dried beans	Physical picking with fingers or tweezers	Pasta
Large sunflower seeds	Sieve, physical picking with fingers or tweezers	Small-grain bird seed
Coloured beads	Sieve, physical picking with fingers or tweezers	Rice
Peanuts in shells	Crushing and sieving	Peanut shells

2. Build the model surface mine
   a. In small container (~250 ml), mix a 4 (200 ml) to 1 (50 ml) ratio of country rock/waste material and valuable target mineral/rock.
   b. Lay brown construction paper or fabric on top of the rock to represent soil
   c. Place tree and grass cut-outs or magazine pictures of natural habitats on top of the soil
3. Put the mine in a wider environment (Optional)
   a. Rest the smaller container inside of a larger container (750 ml or 1 L).

b. Fill the area outside of the inner container with the same country rock material. Make sure that the rim of the inner container can be seen after filling.

c. Submerge the small containers in a sand table, making sure the rims can be seen.

Prompt

Show illustrations or videos of surface mine sites. Identify the equipment and methods being used.

Delivery

1. Give each group a model surface mine and explain that they will mine it for valuable mineral.
2. Ask students to draw a picture of their model, so that they have a record of what it looked like before mining, and have them make a group list showing the steps they will follow to mine and later reclaim their mine.
3. Have students extract the mineral mixture from the smaller container, and then separate the target valuable materials from the country rock. You will need to instruct students on the method to use, depending on the materials you chose for the models.
4. Instruct students to complete a drawing of their model during mining.
5. Have students reclaim the surface mine by returning all of the country rock material to the pit, minus the valuable minerals.

Questions for Discussion

What steps did you follow to extract the rocks and minerals?

How has mining changed the land?

What have you done to reclaim the land after mining?

Extension

Investigate examples of mine reclamation projects.

Chocolate Chip Mining

Students simulate mining extraction by removing chocolate chips from cookies. They investigate the relative amounts of valuable mineral and waste rock for different methods.

Explanation

Most economic mineral resources are not found in the Earth in a pure (native) state, but are extracted from mineral-bearing rocks. A wide range of physical and chemical separation techniques exist, and these are constantly being redesigned to improve efficiency and percentage returns or to diminish any environmental impact. Each extraction process is specific to the mineral being extracted and to the host rock.

Materials

Chocolate chip cookies
Selection of "mining" equipment: toothpicks, plastic forks, pestle and mortar, bamboo skewers, tweezers, etc.
Balance scales
Graph paper
Ruler
Measuring cylinder
Student Activity Page

Caution

If students are to eat their cookies, ensure hygiene is maintained.

Time

Medium

Grouping

Individual, whole group

Preparation

Collect a selection of mining equipment for students to choose (see Materials).

Reproduce the Student Activity Page.

Chocolate Chip Mining

Prompt

Tell students that they are mining engineers who design extraction methods for the mining industry. They will be given a valuable ore rock. The mineral, which they need to extract, looks like dark brown chunks and the waste rock like paler, crumbly material.

Delivery

Give students their activity page and direct them to:

1. Plan and design a method for mining the mineral, and record their method on the handout.
2. Record the mass and volume of their cookie. You may need to instruct them how to estimate volume using the graph paper for area, multiplied by the thickness of the cookie.
3. Mine their cookie, separating the mineral from the waste rock, taking care not to lose any pieces.
4. Record the mass and volume of both the mineral (chips) and the waste rock (cookie).
5. Share their data with 3 other miners to complete data for 4 mines.

Questions for Discussion

Does each cookie contain about the same amount of valuable mineral?

Which method produced the most mineral and the least waste rock?

Is it possible to return the waste rock into the hole made during mining?

Extensions

Try another method for extracting the mineral and compare the results.

Investigate extraction and separation methods for different resources.

You are a mining engineer and you need to design an extraction method to separate a valuable mineral (chocolate chip) from its host rock (cookie). In order to decide which is the most effective method you need to investigate the relative amounts of mineral and waste rock that result by comparing your method with those of three of your colleagues.

Describe the Mining method you will test:

Data Comparing Mining Methods

Mine	Mass of Cookie	Volume of Cookie	Mass of Mineral Chips	Volume of Mineral Chips	Mass of Waste	Volume of Waste
1						
2						
3						
4						