GROUNDRULES

MINING

Mining

AGES 13-15

INTRODUCTION

As the demand for mined minerals increases, everyone—from students, to miners, to governments and global corporations—must understand how to work together to meet those needs while protecting the world in which we live.

Ground Rules: Mining Right for a Sustainable Future is a documentary film created by Caterpillar and Science North. It follows the development of new and operating mines as geologists, engineers and mine managers tackle complex problems. It draws on the experiences and achievements of modern mine sites to illustrate creative and core concepts of sustainable development and social responsibility.

This set of lesson plans was developed by Science North, commissioned by Caterpillar to accompany the *Ground Rules* film. It provides a tool for educators to further examine the themes and concepts presented in the film through a series of "hands-on" classroom activities. It introduces students to the various phases involved in mining, different types of mines, how ore is processed, how mineral deposits were formed, how modern mines can operate safely and sustainably, and why minerals are important to our everyday lives. This material also introduces students to a wide variety of mining careers.

The lesson plans have been designed to broadly complement the curriculum objectives for the United States, Canada, and Australia. However, the lesson plans are not region-specific and can be used by educators throughout the world. All of the lesson plans have strong linkages to the earth science curriculum, but many of the activities incorporate additional linkages to math, chemistry, data management, mapping, environmental studies, electricity, magnetism and problem-solving. The lesson plans can be easily adapted to meet specific local curriculum goals.

In each lesson plan, an introductory section provides the appropriate film chapter reference and describes the key concepts for the lesson. One or two activities are then described in a step-by-step format. These activities include experiments, demonstrations, games, building activities, and research projects. The lesson plans end with a discussion section that provides possible follow-up topics and questions for classroom discussion. Each lesson plan also includes curriculum linkages, a vocabulary list, a materials list, and approximate timelines for completion of each section. Teacher answer sheets or data sheets are appended, where appropriate.

The lesson plans are organized into five broad themes: Geology; Mining; Mining Processes; Ore Processing; and Minerals and Everyday Life. The lesson plans are further sub-divided into three age categories: 11 to 13 years; 13 to 15 years; and 15 to 18 years. In many cases, the same topics are covered in each age category. However, lesson plans in the older age categories contain additional activities, alternative age-appropriate activities, and/or enhanced complexity.

Theme: Mining

This theme teaches students about open pit and underground mining, including safety and environmental considerations. It also introduces students to a wide range of mining careers. Students will build models of open pit and underground mines, with increasing complexity in each age category. The 15 to 18 year-old students will build on these concepts to design a mine based on a cross-sectional diagram of a hypothetical ore body. Younger students will explore the potential safety hazards at mine sites, learn how to identify safety hazards, and learn about methods used by mining companies to keep their workers safe. All age groups will learn about environmental monitoring of water bodies at mine sites and will test up to four different water quality parameters through age-appropriate field and classroom activities.

Ground Rules – Online Viewing and Learning Resources

As noted, these lesson plans are designed to be used with *Ground Rules: Mining Right for a Sustainable Future*. Multiple options are available for using the film in your classroom:

- **Order a free copy of the Ground Rules DVD**, containing both the English, Spanish and French versions of the film, from the Caterpillar web site, http://www.cat.com/groundrules.

- **View the full-length version of the film** in English, Spanish, French, as well as English with Chinese subtitles, online at http://www.cat.com/groundrules.

- **View individual chapters of the film** in English, Spanish and French, as referenced by individual lesson plans, on our You Tube channel, http://youtube.com/catgroundrules.

The full set of these lesson plans is available at http://www.cat.com/groundrules, and additional information and activities will be posted there as they become available.

Finally, follow *Ground Rules* online! Share your classroom experiences, feedback and ideas with us. Post photos of your projects and tell us about your successes!

Facebook: http://tinyurl.com/yzhxrva

Twitter: http://twitter.com/catgroundrules

About Caterpillar
For more than 80 years, Caterpillar Inc. has been building the world's infrastructure and, in partnership with its worldwide dealer network, is driving positive and sustainable change on every continent. With 2008 sales and revenues of $51.324 billion, Caterpillar is a technology leader and the world's leading manufacturer of construction and mining equipment, diesel and natural gas engines and industrial gas turbines. More information is available at www.cat.com.

About Science North
Science North, which opened in 1984 and is located in Greater Sudbury, is Northern Ontario's most popular tourist attraction and an educational resource for children and adults across the province of Ontario, Canada. Science North's drawing power lies with its unique approach to learning. The science centre has become world-renowned for its unique brand of hands-on science education and entertainment experiences which involve people in the relationship between science and everyday life.

Science North's attractions include a science centre, IMAX® theatre, butterfly gallery, special exhibitions hall, a digital Planetarium, and Dynamic Earth – a second science centre that offers visitors an up-close look at mining and the geological forces that continually shape the Earth. The same philosophies used to teach visitors about science at Science North are incorporated into every exhibit at Dynamic Earth, which first opened in 2003. This mining and geology centre combines above and underground experiences that allow visitors to work and play with real mining equipment and technologies. The site is also home to Sudbury's famous Big Nickel.

An agency of the provincial government of Ontario, Science North is overseen by the provincial Ministry of Culture. More information is available at http://sciencenorth.ca.

MINING | AGE: 13 TO 15 | LENGTH:1.5 HR | CURRICULUM: earth science, mining

BUILDING AN OPEN-PIT MINE

Description

Students will build an open-pit mine and learn how ore is extracted from shallow ore bodies. They will stockpile the overburden and use it to reclaim the mine after operation.

VOCABULARY:

1. Open pit
2. Overburden
3. Benches
4. Slope
5. Truck route
6. Reclamation
7. Stockpile

MATERIALS:

- *Ground Rules* film
- Mixture of sand and pebbles
- Shredded paper or small wood chips
- Water
- Carving tools (scoops, spoons, spatulas, plastic knives)
- Ruler
- Large plastic or wooden boxes
- Small toy dump trucks and scoops
- Large buckets/pails (ore buckets)

Introduction (Length: 30 minutes)

Watch Chapter 2 “Modern Mining” and Chapter 4 “Engineering Challenges” of the *Ground Rules* film (also optional: Chapter 8 “Reclamation”). Chapter 2 shows an open pit copper mine in Chile, while Chapter 4 shows an open pit gold and copper mine in Papua Indonesia. Pause the film to look at the structure of the open pit mines featured in each of these film chapters.

Under what circumstances are open pits used? Ask the students what they notice about the structure of these open pit mines. Discuss the function of the benches or stepped sides of the pit. Discuss the width to height ratio of the open pit structures. What would happen if the pit was deep and narrow? Explain that an open pit mine has to be wider than its depth to maintain a safe structure.

What equipment is used in the open pit mine? How does the size of this equipment compare to the equipment used in an underground mine?

What was the greatest challenge in building the open pit mine in Papua Indonesia? The ore body is at the top of a mountain. In some ways, this poses as great or an even greater challenge than sinking shafts to mine underground. Discuss the similarities and differences of open pit mining at the top of a mountain versus mining a deposit that is deep below the earth’s surface (e.g., tramway to reach the top versus cage and shaft to reach the bottom; hauling the ore down the mountain versus hauling the ore up to the surface; building a road to the top versus sinking a shaft and digging tunnels underground). The blasting and loading processes to remove the ore are similar.






Activity (Length: 45 minutes)

The objective of this activity is to build a model of an open pit mine and then reclaim the mine site.

1. Divide the class into groups of 3 or 4 students. Each group will build a model of an open pit mine. The goal is to build an open pit mine as deep as possible within the constraints of the box width and allowing room for stockpiling of overburden for reclamation.
2. Fill a large box approximately half full with the sand-pebble mixture. Add some water and mix it in to make a mixture that can be molded. Spread the mixture flat and pack it down.
3. Cover the entire mine site with shredded paper or wood chips. This represents the overburden layer and surface coverings (trees, vegetation).
4. Begin to create your open pit mine by removing the overburden layer and stockpiling it somewhere within your box. This must remain in place until the mine is ready to be reclaimed.
5. Using a variety of tools, begin to carve out the open pit mine. Create the benches on the sides. Use a ruler to measure and build benches of uniform height and width. Remember to make some wider benches for truck routes.
6. Discard the material dug out from the mine into the ore buckets.
7. Dig as deep into the mine as you can before the sides get too steep.
8. Use the wider benches to create a truck route from the top of the mine to the bottom. Use the toy trucks to determine the sizes of the truck routes (must be wide enough for two truck lanes).
9. After all of the open pit mines have been created and viewed by the teacher and other students, each group should reclaim their mine site. Remember that there is not enough overburden to fill the pit and the structure of the pit is made of rock, so it cannot be simply flattened. Encourage the students to be creative.

Discussion (Length: 15 minutes)

What were the challenges involved in creating the open pit mines? How much time did it take to dig out the mine, build the benches and truck routes? Discuss how much time it would have taken you to do this using the toy trucks and shovels (i.e., when the scale of the equipment used is proportional to the mine). Discuss the importance of large equipment to increase the efficiency of the open-pit mining process. What are the challenges of operating such large equipment?

What were the challenges involved in reclaiming the open pit mine? Where did each group decide to stockpile the overburden? How did this decision affect the way the open pit mine was built and its final size? Which group was able to create the largest open pit mine? How did each group use the stockpiled overburden to reclaim the landscape? Explain that in some cases, the open pit is filled with water to create a lake or filled with waste rock and the overburden is used to reclaim the portions of the site where buildings or other mining structures were located. Some of the overburden may also be used to create safe contours on the sides of the open pit and to create a landscape that looks natural.

Visit cat.com/groundrules for more information, to provide feedback, to view the *Ground Rules* film on-line, or to order a copy of *Ground Rules* on DVD.

GROUNDRULES

MINING	AGE: 13 TO 15	LENGTH:1.5HR	CURRICULUM: earth science, mining

CROSS-SECTION MODEL OF AN UNDERGROUND MINE

Description

Students will build a cross-section model of an underground mine and learn how ore is extracted from deep ore deposits.

VOCABULARY:

1. Mine shaft
2. Headframe
3. Cage
4. Skip
5. Drift
6. Ventilation shaft
7. Stope
8. Ore body
9. Ore pass

MATERIALS:

- *Ground Rules* film
- Play dough (2 colors)
- Drinking straws
- Popsicle sticks, toothpicks
- Large squares of cardboard
- Markers and pencils
- Plastic knives and spoons
- String
- Small thread spools
- Miscellaneous craft items

Introduction (Length: 30 minutes)

Watch Chapter 5 “Going Underground” of the *Ground Rules* film. Pause on the animated picture of the underground mine. Ask the students what the vertical and horizontal tunnels are called. What is one way (shown in the film) that underground mining has been made safer in recent years? (remote controlled vehicles)

Under what circumstances are underground mines used? Describe the process of underground mining. What are the components of an underground mine? What is the purpose of the headframe? Describe the cables and winch system that are located in the headframe to lower the cage of miners into the mine and haul out the ore in the skip. What is the purpose of the ventilation shaft? Explain that the ventilation shaft can also be used as an emergency escape route.

How do workers access the ore body from the shaft? Discuss the process of tunneling into the rock to create drifts to access the ore body. What is a stope? Discuss the process of blasting to loosen the ore.

How is the ore removed from the mine? Discuss the use of ore passes to deliver the ore from various drifts to the bottom of the mine where it may be crushed and raised to the surface in the skip.

If there are local underground mines in your area, use these as examples to illustrate the concept of underground mining.






Activity (Length: 45 minutes)

The objective of this activity is to build a cross-section model of an underground mine, showing all of the features that are present in actual underground mines.

1. Divide the class into groups of 3 to 4 students.
2. Each group will use a square of cardboard as the base for their model. They will be creating a vertical cross-section of an underground mine.
3. Each group should begin by drawing a line a few inches from the top of the cardboard square. This line is the ground surface. Above this line, draw the mine headframe and any other surface features of the mine.
4. Spread a layer of playdough (approximately 1 inch or 2.5 cm thick) over the entire surface of the cardboard below the surface line. The playdough represents the underground rock and soil.
5. Using a plastic knife, draw an irregular shape into the playdough that starts somewhere below the surface and extends to the bottom of the cardboard. This shape will represent the ore body. Cut out the shape and replace it with a different color of playdough.
6. Using plastic knives, spoons, popsicle sticks, straws and any other useful tools to dig out the playdough, construct the main mine shaft that will deliver workers into the mine and haul out the ore.
7. Use string and thread spools to set up the cable and pulley system for the main shaft and headframe.
8. Create a cage and skip out of popsicle sticks or pieces of cardboard. Attach these to the strings.
9. Construct a series of horizontal drifts that will be used to access the ore body from the main shaft.
10. Construct a ventilation shaft and will vent exhaust from the drifts to the surface and act as an emergency exit.
11. Create stopes in places along the drifts to access the ore body.
12. Create an ore pass that connects each drift, so that the rock can be sent down to the crusher and skip.
13. Make miners with toothpicks and/or playdough (be creative). Add miners to your underground cross-section. What are the miners doing in various regions of the mine?
14. Add playdough or cardboard vehicles to your underground mine. Where would they be located and what are their functions?
15. Let the models dry to harden.

Discussion (Length: 15 minutes)

Each group can use their model to explain the process of underground mining. They should describe all of the physical structures in their model and their purposes.

Visit cat.com/groundrules for more information, to provide feedback, to view the *Ground Rules* film on-line, or to order a copy of *Ground Rules* on DVD.

Playdough Recipe

Combine 1 cup flour, ¼ cup salt, and 2 tablespoons cream of tartar with 1 cup water, 2 teaspoons food coloring and 1 tablespoon oil in a saucepan. Cook and stir 3-5 minutes, or until it sticks together in a ball. Knead for a few minutes on a lightly floured surface. Store in an air-tight container. You will need to make several batches of this recipe to have enough for this activity.

GROUNDRULES

MINING	AGE: 13 TO 15	LENGTH: 2 HR	CURRICULUM: earth science, chemistry, environment

MONITORING pH, TEMPERATURE, CONDUCTIVITY, D.O.

Description

Students will learn about environmental monitoring of water bodies at mine sites. They will test water quality parameters (pH, temperature, conductivity and dissolved oxygen) at a local water body.

VOCABULARY:

1. Acidic
2. Basic
3. Neutral
4. pH
5. Temperature
6. Water quality
7. Samples
8. Acid rain
9. Sulfur dioxide
10. Conductivity
11. Dissolved oxygen
12. Baseline water quality

MATERIALS:

- *Ground Rules* film
- Hand-held water quality probes (pH, dissolved oxygen, conductivity)
- Waterproof thermometer
- Hip or chest waders, rubber boots
- Life jackets
- Clipboard
- Optional: Small plastic bottles with lids
- Maps of the water bodies (can be hand drawn)
- Optional: GPS unit
- Field data sheets (provided)

Introduction (Length: 30 minutes)

Watch Chapter 7 “Mining and the Environment” of the *Ground Rules* film. This chapter shows an example of how potential environmental impacts of a mine site were minimized at the McArthur River Mine in Australia.

Ask the students to name some of the possible environmental impacts of a mine (for example: water quality, air quality, land disturbance, removal of vegetation/habitat).

What major environmental challenge did Xstrata have to overcome before it could open the McArthur River Mine? (re-routing of the river). Discuss the challenges associated with rerouting the river (maintaining biodiversity, maintaining natural features of a river channel, water quality).

What does an environmental technician do at a mine site? Explain that in this activity, the students will be the “environmental technicians” of a hypothetical mine site. They will collect water samples and test them for pH, temperature, conductivity and dissolved oxygen. These are the most common parameters tested for general water quality.



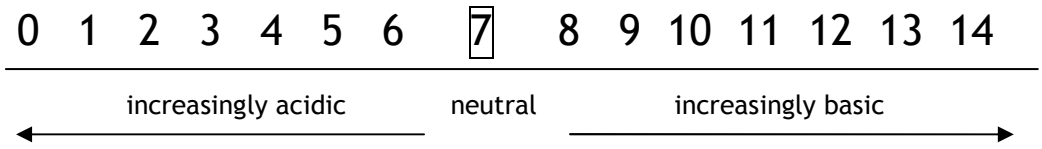



Temperature:
Why is water temperature important to measure? Abnormally warm water may reduce the ability of the water to hold dissolved oxygen which is necessary for aquatic life. Dissolved oxygen can also be measured directly with a special probe.

pH:
Review the pH scale and what is meant by the terms acidic, basic and neutral. The pH scale ranges from 0 to 14, with 7 being neutral. Numbers below 7 are acidic, while numbers above 7 are basic. The pH scale is logarithmic, so each number represents a 10-fold change. For example, a change from pH 7 to pH 6 means the acidity of the solution has increased by 10 times.

The pH of normal rainwater is slightly acidic (pH 5.6) due to the presence of carbon dioxide gas. The pH of many water bodies ranges from 6 to 8. Fish and aquatic organisms begin to be affected when the pH drops below 5.

pH Scale:



Conductivity:
Ask the students if they know what conductivity is and why it is measured to determine water quality. Conductivity is a measure of how well a liquid conducts electricity. Pure water has zero conductivity. The more ions that are in solution in the liquid, the more electricity it will be able to conduct. Sea water has a greater conductivity than fresh water. A conductivity meter can be used in water quality monitoring to measure the electrical conductivity of the water. This is an indirect measurement of the amount of ions (salts) that are in solution. Conductivity is usually measured in units of µS/cm (micro-siemens per centimeter).

Dissolved oxygen:
A special probe can be used to directly measure the amount of oxygen that is dissolved in the water. Dissolved oxygen is important for the survival of aquatic organisms. Dissolved oxygen is usually measured in units of mg/L (mg or gas per liter of water).

Explain that water quality monitoring at a mine site is conducted in order to evaluate possible changes that have occurred as a result of mining activities. Explain that each water body has a unique natural chemistry and therefore there is not a standard pH, conductivity or dissolved oxygen value that is considered “normal” for all water bodies. Therefore, before the mine site is developed, water quality in each local water body that may be impacted by the mine is tested, so that there is a record of what is “normal” for each water body. This is usually called baseline water quality. Then, after the mine is in operation, the water can be tested on a regular basis and compared to the baseline values to see if there has been a change in water quality. A change in any of these parameters may indicate a change in the chemistry of the water body.

Activity (Length: 60 minutes at field location + travel time)

The objective of this activity is to collect and test water samples from a local water body for pH, temperature, conductivity and dissolved oxygen.

1. Follow the manufacturer's directions to calibrate the pH, conductivity and dissolved oxygen meters in the classroom before going to the field location.
2. Visit a local water body (lake or stream). For safety reasons, avoid fast-flowing rivers. Bring small plastic bottles, a thermometer, water quality meters, maps, field data sheets, waders/rubber boots and life jackets.
3. For safety reasons, wear a life jacket at all times while water sampling.
4. Select three sampling sites. As accurately as possible, plot each sampling point on a map of the water body. Optional: use a GPS unit to collect coordinates at each site. These can be used to accurately plot the sampling location on a topographic map.
5. At each site, hold the thermometer in the water for a minute. Record the temperature on the field data sheet. Take three readings. Record the individual readings. When you return to the classroom, calculate the average reading.
6. Test the pH, conductivity and dissolved oxygen using the hand-held probes. Take three readings. Record the individual readings. When you return to the classroom, calculate the average reading.
7. At each sampling point, record any observations on the data sheet that may be important to interpreting the information, such as clarity of the water, potential nearby pollution sources, runoff water entering the water body, etc. If applicable, pollution sources can be plotted on the maps as well.
8. Optional: Collect a sample of water in a small plastic bottle from each site. Seal tightly. These can be used to retest parameters in the classroom or to conduct further experiments.
9. Return to the classroom.
10. Calculate the average field readings and record on the data sheet.

Discussion (Length: 30 minutes)

How did the water quality compare between sites along one water body? If there was a difference, ask the students which site they think is potentially more polluted. Why? Did they observe any potential pollution sources that might affect water quality at that site?

How might a mine site affect the temperature of a nearby water body? This could occur if the mine discharges warm water into a local water body. Explain that modern mines have a responsibility to protect the environment surrounding the mine. If they discharge water to the environment, they must ensure that the quality and temperature of the water is suitable to protect aquatic organisms and their habitat.

How might emissions from a mine site affect the pH of a nearby water body? Explain that a chemical called sulfur dioxide is released to the air during the smelting process. In the atmosphere, sulfur dioxide combines with water and produces acid rain. When acid rain falls onto a water body it can make the water acidic over time. Explain how modern mines install pollution control equipment to minimize the amount of sulfur dioxide released.

Which is potentially more polluted? Why?

a) a site with high conductivity or a site with low conductivity
b) a site with high dissolved oxygen or a site with low dissolved oxygen

Visit cat.com/groundrules for more information, to provide feedback, to view the *Ground Rules* film on-line, or to order a copy of *Ground Rules* on DVD.

Field Data Sheet

Site 1

Parameter	Reading 1	Reading 2	Reading 3	Average
temperature				
pH				
conductivity				
dissolved oxygen				

Observations:

Optional: GPS Coordinates _____

Site 2

Parameter	Reading 1	Reading 2	Reading 3	Average
temperature				
pH				
conductivity				
dissolved oxygen				

Observations:

Optional: GPS Coordinates _____

Site 3

Parameter	Reading 1	Reading 2	Reading 3	Average
temperature				
pH				
conductivity				
dissolved oxygen				

Observations:

Optional: GPS Coordinates _____

GROUNDRULES

MINING | AGE: 13 TO 15 | LENGTH: 2 HR | CURRICULUM: earth science, careers

MINING CAREERS

Description

Students will explore the different types of careers available in the mining sector. They will identify careers shown on the *Ground Rules* film and write job descriptions. They will conduct mock interviews for various mining careers.

VOCABULARY:

1. Career
2. Geologist
3. Engineer
4. Safety Inspector
5. Technician
6. Trades
7. Laborer
8. Apprentice
9. Job description
10. Skills

MATERIAL:

- *Ground Rules* film
- Pens and paper
- Resource books or internet access
- Optional: guest(s) from a local mining company

Introduction (Length: 45 minutes)

Watch the entire *Ground Rules* film one chapter at a time. Each chapter explores a unique aspect of mining:

Chapter 1: Exploration
Chapter 2: Open pit mining and ore processing
Chapter 4: Engineering and open pit mining
Chapter 5: Underground mining
Chapter 6: Community relations
Chapter 7: Environmental aspects of mining
Chapter 8: Reclamation
(note that Chapter 3 does not specifically include any mining occupations)

Pause the film after each chapter to allow the students to record their answers. Ask the students to list as many mining jobs as they can for each chapter (those that are shown in the film, plus any others they can think of). Review the answers and make a master list of potential mining careers on the board. Discuss the number and variety of positions available.






Activity I (Length: 30 minutes)

The objective of this activity is to identify what skills are necessary for various mining careers.

1. Have each student identify a mining career that they are interested in.

2. Using resource books, internet access, or discussions with friends and relatives that are employed in the mining industry, each student should identify the following:

    a. The day to day activities involved in this position.
    b. The skills required to perform work duties.
    c. The education and training required for the position.
    d. The safety training required for the position.

3. Divide the students into pairs. Using the job descriptions identified in #2, have one person of each pair pretend to be the applicant and one person pretend to be the employer. The students will conduct a mock interview by taking turns asking questions. After 15 minutes, the pairs should switch roles.

Activity II (Length: 30 minutes)

The objective of this activity is to learn about specific local mining careers.

1. If possible, invite a guest(s) that works in a local mining industry to visit the classroom.
2. Before the classroom visit, students should prepare a list of 5 questions they would ask the visitor(s) to find out more about the type of work they do.

Discussion (Length: 15 minutes)

Discuss the variety of options that are available for jobs in the mining industry. Ask the students who played the role of employer whether they would have hired the applicant. Why or why not?

Visit cat.com/groundrules for more information, to provide feedback, to view the *Ground Rules* film on-line, or to order a copy of *Ground Rules* on DVD.

GROUNDRULES

MINING | AGE: 13 TO 15 | LENGTH: 2 HR | CURRICULUM: earth science, mine safety

MINE SAFETY AND MINING ACCIDENTS

Description

Students will explore the potential safety hazards at mine sites and learn about methods used by mining companies to keep their workers safe. In the second activity, they will research a major mining disaster and discuss the lessons learned from it.

VOCABULARY:

1. Hazard
2. Personal protective equipment (PPE)
3. Safety measure
4. Safety training

MATERIALS:

- *Ground Rules* film
- Mine safety cards
- Masking tape
- Paper and pencils
- Resource books or internet access

Introduction (Length: 30 minutes)

Watch Chapter 2 “Modern Mining” and Chapter 5 “Going Underground” of the *Ground Rules* film. Both of these chapters address many safety protocols that are used in modern mines.

As a class, identify some of the safety hazards in open pit mining and underground mining. Make a list of the hazards on the board. What are some of the protective items miners wear to keep themselves safe? Explain that these items are called personal protective equipment or PPE for short.

Activity I (Length: 30 minutes)

The objective of this activity is to determine the appropriate safety measures to implement for each mining hazard.

Preparation:

1. Prepare a series of mine safety cards (one safety measure per card).

Activity:

1. Place the cards face down at the front of the class.
2. Ask the students to come up one by one and take a card.
3. Each student must tape the card on the board beside a mining hazard that can be prevented by implementing the safety measure on the card.






Activity II (Length: 30 minutes)

The objective of this activity is to research a major mining accident. Students can work alone or in pairs.

1. Using resource books or internet access, research a major mining accident that happened in your country, state or province. If possible, have each student or group research a different mining disaster.
2. When did the accident occur?
3. How many people were killed or injured?
4. Identify the safety hazard and why the accident happened.
5. Could the accident have been prevented? How?
6. What effect did that accident have on the miners? the mine? the community?
7. What was learned from this accident? What safety measures were implemented to prevent it from happening again?

Discussion (Length: 30 minutes)

Activity I:
Review the answers as a class. Are there any errors? Could some of the cards be placed beside another hazard? Discuss the importance of health and safety training prior to working at a mine site and the importance of "thinking safety" at all times during mining.

Activity II:
Have each group present their findings to the class. Discuss the lessons learned from the accidents and how modern mines are operating more safely. Also discuss the inherent dangers involved in mining and that even with strong safety protocols, accidents can and do still occur.

Visit cat.com/groundrules for more information, to provide feedback, to view the *Ground Rules* film on-line, or to order a copy of *Ground Rules* on DVD.