Mining
From Exploration to Rehabilitation
For Teachers

Introduction

Mining has a long and diverse history; both the mining techniques employed and developed over time and the influence mining has had on human development throughout the ages. Mining – From Exploration to Rehabilitation explores the various processes required to mine an ore. It follows the steps involved from exploration of the raw product, through the mining process involved, to environmental rehabilitation. Four main mining processes are shown: underground mining, strip mining, open pit mining and solution mining. Interviews with industry experts from Rio Tinto and Stawell Gold Mines provide clear information on the multifaceted mining process.

Timeline

00:00:00 History of mining
00:02:36 Ores and minerals
00:06:39 Mineral exploration
00:09:11 The mining process
00:15:00 Rehabilitation
00:18:28 Conclusion
00:18:49 Credits
00:19:29 End program

Related Titles

The Rock Cycle

Recommended Resources

http://www.science-teachers.com/
http://www.mining-technology.com/links.html
http://www.minesurveyor.net/links.php
Student Worksheet
Active Viewing Guide

Chapter 1 – History of mining

1. What did the earliest mining involve?

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_________________________________________________________________________________
_________________________________________________________________________________

2. Why did humans develop more intensive systems of mining?

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_________________________________________________________________________________
_________________________________________________________________________________

3. The mining of rare metals, ores in low concentrations or hard to mine ores, although time consuming and expensive can be justified commercially. What does this mean?

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4. Since early man, humans have altered their mining techniques? Why?

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Chapter 2 – Ores and minerals

1. What is an ore? Give an example of an ore mined today.

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_________________________________________________________________________________
_________________________________________________________________________________
2. Minerals are generally classified as inorganic. Explain what this means. Why are the resources of coal and oil not classified as inorganic ores?

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_________________________________________________________________________________
_________________________________________________________________________________

3. Mineral deposits are formed over time. List the three main processes involved in forming mineral deposits.

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_________________________________________________________________________________
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4. How long does it take to form a mineral?

_________________________________________________________________________________

5. Explain what a non renewable resource is.

_________________________________________________________________________________
_________________________________________________________________________________

6. Rare minerals such as rubies or diamonds are called __________________________

7. Identify at least 3 examples of valuable ores needed in today's world.

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Chapter 3 – Mineral exploration

1. Outline three major steps involved in the search for new mineral deposits.

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_________________________________________________________________________________
_________________________________________________________________________________
2. If a geologist says an area is prospective what does that mean?

________________________________________________________________________

3. To do assay work the geologist performs tests to evaluate what about a mineral/ore?

________________________________________________________________________

4. What do the letters EIS stand for?

________________________________________________________________________

5. EIS are carried out to determine what factors about a prospective mine?

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6. The first stage of a geological survey involves 4 steps: They are:

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________________________________________________________________________
Chapter 4 – The mining process

1. Complete the following table on the four processes of mining.

<table>
<thead>
<tr>
<th>Mining Process</th>
<th>Example of Mineral Mined</th>
<th>Reason for Process</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Gold, diamond, nickel, silver</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Coal, bauxite, sand, gravel</td>
<td></td>
</tr>
<tr>
<td>Open pit mining</td>
<td>Ore close to surface</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ore needs to be dissolved into an easily removable substance</td>
<td></td>
</tr>
</tbody>
</table>

2. Leaching involves the use of a solvent. What function does the solvent perform?  

_________________________________________________________________________________

3. Fill in the blanks:

Froth __________ involves grinding up an __________ very fine, then attaching the desired mineral to __________, which float to the __________. It requires making the mineral __________ so it is repelled by water.

Chapter 5 – Rehabilitation

1. Explain what happens to a mine site when mining a mineral is no longer feasible.

_________________________________________________________________________________

2. Rehabilitation of a mine involves many processes. List and explain three.

_________________________________________________________________________________

_________________________________________________________________________________
Extension Activities

Chapter 1 – History of mining

1. Throughout history minerals have played an important role in the development of the human race. Investigate one particular ore and relate its importance to the development of society at the time.

2. Compare the methods of mining used through time to present day.

3. Select an appliance and make a list of materials used in its manufacture. What percentage of this appliance depends on mining?

4. Explore the history of a mining community. What is the relationship between the mining operation and the community? Create a concept map showing the mine and its effect on the individual and small town.

5. Do a group project on a mine in your own region. What type of mining or extraction takes place in your region? Don't forget the mining of rock and aggregates such as limestone, gravel, rock quarries, etc. Are there abandoned mines? Find out about the history of mining in your area. Interview someone who has worked in the industry. Gather photographs, maps, and information related to local mining. Create a presentation that illustrates your research.

Chapter 2 – Ores and minerals

1. Minerals, temperature and forces all play a role in the formation of the Earth and ores. Select one of the following topics to research. Present your findings in a written, oral or multimedia report.

   Topics:
   - Igneous Rock
   - Sedimentary Rock
   - Metamorphic Rock
   - The Rock cycle
   - Geological Time
   - Weathering processes
   - Soil formation and types
   - Structure of the Earth
   - Plate Tectonics
   - Electro-refining
   - Earthquakes
   - Volcanic activity
   - Faulting and Folding
   - Mountain Building
   - Subduction zones
   - Fossilisation
   - Crystallisation
   - Froth Flotation

2. Predict what would happen if a resource became scarce. Specify the resource and make a list of at least ten things that would

3. Select a mineral and make a poster of its uses. Create your poster as an advertisement for the mineral and include a slogan.
Chapter 3 – Mineral exploration

1. You are a geologist looking for new discoveries. Write a story on your adventures. Include the equipment you have for your exploration, and the geological features you encounter.

2. Use the list below of mining related terms for a variety of activities including:
   a) Create a cross word or search a word puzzle.
   b) Conduct an internet scavenger hunt: The goal is to find an image or definition for each term.
   c) Group the words under appropriate headings such as “ores and minerals”, “types of mining”, “mining processes”, “people and places”, etc. compare your choices with others in your class and learn more about the terms you are unfamiliar with.

<table>
<thead>
<tr>
<th>mine</th>
<th>underground</th>
<th>room &amp; pillar mining</th>
<th>long wall mining</th>
<th>surface mining</th>
<th>open pit mining</th>
</tr>
</thead>
<tbody>
<tr>
<td>copper</td>
<td>coal</td>
<td>drilling</td>
<td>tunnelling</td>
<td>hard rock mining</td>
<td>quarry</td>
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<tr>
<td>Rocks</td>
<td>anthracite</td>
<td>bituminous</td>
<td>auger</td>
<td>tailings</td>
<td>smelter</td>
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<tr>
<td>ore</td>
<td>Gold Rush</td>
<td>cave-in</td>
<td>Minerals</td>
<td>double-jacker</td>
<td>amalgam</td>
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<tr>
<td>vein</td>
<td>inclines</td>
<td>methane</td>
<td>bear-hole</td>
<td>ultraviolet</td>
<td>borehole</td>
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<tr>
<td>prospecting</td>
<td>gold</td>
<td>silver</td>
<td>salt</td>
<td>underground</td>
<td>geology</td>
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<tr>
<td>diamond</td>
<td>precious metal</td>
<td>ferrous</td>
<td>nonferrous</td>
<td>extractive industry</td>
<td>placer mining</td>
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<tr>
<td>dredging</td>
<td>strip mining</td>
<td>quarrying</td>
<td>panning</td>
<td>sluicing</td>
<td>hydraulic king</td>
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<tr>
<td>dragline</td>
<td>shaft</td>
<td>adit or slope</td>
<td>smelting</td>
<td>refining</td>
<td>drifts</td>
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<tr>
<td>gangue</td>
<td>geologist</td>
<td>metallurgist</td>
<td>equipment</td>
<td>mine inspector</td>
<td>reclamation</td>
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</table>
Chapter 4 – The mining process

1. Explore the locations of mines throughout the world, the mineral mined, and method of mining used. Complete the following table. Be sure to include at least three different locations, minerals and mining methods.

<table>
<thead>
<tr>
<th>Location of Mine</th>
<th>Mineral Mined</th>
<th>Method of Mining</th>
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<tbody>
<tr>
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</tbody>
</table>

2. Select a mineral and make a flow chart of the processes involved in the extraction, refining and purification to the final product.

3. Create A Mining Map. Begin with a map of your state, Australia or another continent. Then find out what types of mining are occurring within the region. Identify the different types of mining that are taking place. Display your information on a 'Mining Map.'


5. Construct a model of a mine. Visit some of the mining websites to learn about the different types of mines.
Chapter 5 – Rehabilitation

1. In teams role play a conflict that may arise when a mineral is located in an environmentally sensitive area or on culturally significant land. Identify all interested parties and their possible viewpoints.

2. Do an environmental impact statement for a mining operation you are about to develop. State the ore to be mined, method of mining and geological conditions of the area.

3. Write an argument to a development committee on a proposed mining operation in an environmentally sensitive area. Justify the importance of its development.
**Suggested Student Responses**

**Active Viewing Guide**

**Chapter 1 – History of mining**

1. What did the earliest mining involve?
   The digging of ores and minerals by hand to make tools and weapons for personal use; for coinage and/or jewelry

2. Why did humans develop more intensive systems of mining?
   Answers could include any of the following:
   - To enter more remote areas
   - To obtain harder to reach ores and minerals
   - To increase productivity
   - For greater purity of ore
   - To increase yield

3. The mining of rare metals, ores in low concentrations or hard to mine ores, although time consuming and expensive can be justified commercially. What does this mean?
   The financial return on these ores exceeds costs involved in mining. Their necessity to industry makes its economically feasible.

4. Since early man, humans have altered their mining techniques? Why?
   Answers could include any of the following:
   - We have become more sophisticated in our uses of minerals and ores.
   - We have developed more intensive mining and industrial techniques.
   - We have developed needs and uses for more types of ores and minerals.
   - We have evolved in our commercial need and require larger amounts.

**Chapter 2 – Ores and minerals**

1. What is an ore? Give an example of an ore mined today.
   An economically feasible mineral to mine and process. Examples are copper, gold, salt, zinc, iron ore

2. Minerals are generally classified as inorganic. Explain what this means. Why are the resources of coal and oil not classified as inorganic ores?
   Inorganic materials are made up of non living substances. Both coal and oil have come from living materials such as plants and animals that have fossilised.

3. Mineral deposits are formed over time. List the three main processes involved in forming mineral deposits.
   - Weathering
   - Underground processes
   - Liquids carrying minerals become trapped and caught

4. How long does it take to form a mineral?
   Millions of years

5. Explain what a non renewable resource is.
   A resource that once it is used up is no longer available and cannot be replaced
6. Rare minerals such as rubies or diamonds are called **gems**.

7. Identify at least 3 examples of valuable ores needed in today's world.
   - Lithium
   - Iron ore
   - Silicon
   - Ceramics
   - Gold
   - Platinum

**Chapter 3 – Mineral exploration**

1. Outline three major steps involved in the search for new mineral deposits.
   - **Exploration by geologists either by foot or air**
   - In depth geological study of the mineral source and area
   - Samples of the ore is taken and examined to determine its composition and viability for mining

2. If a geologist says an area is prospective what does that mean?
   **The area is likely to provide valuable mineral deposits**

3. To do assay work the geologist performs tests to evaluate what about a mineral/ore?
   **To determine the mineral components and their quality.**

4. What do the letters EIS stand for?
   **Environmental Impact Statement**

5. EIS are carried out to determine what factors about a prospective mine?
   **To determine all the potential impacts of a mine to an area (eg, land, water, air quality, flora and fauna, community impact such as traffic and population)**

6. The first stage of a geological survey involves 4 steps: They are:
   - Finding the mineral
   - Taking samples
   - Doing a feasibility study
   - Writing an Environmental Impact Statement
Chapter 4 – The mining process

1. Complete the following table on the four processes of mining.

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<th>Example of Mineral Mined</th>
<th>Reason for Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underground Mining</td>
<td>Gold, diamond, nickel, silver</td>
<td>Ores are deep in the ground</td>
</tr>
<tr>
<td>Strip Mining</td>
<td>Coal, bauxite, sand, gravel</td>
<td>Materials are lose or finer and close to the surface</td>
</tr>
<tr>
<td>Open pit mining</td>
<td>Marble, sandstone, coal, gold</td>
<td>Ore close to surface</td>
</tr>
<tr>
<td>Solution Mining</td>
<td>copper</td>
<td>Ore needs to be dissolved into an easily removable substance</td>
</tr>
</tbody>
</table>

2. Leaching involves the use of a solvent. What function does the solvent perform?  
   To adhere to the mineral and float it to the top of a solution.

3. Fill in the blanks:
   Froth floating involves grinding up an ore very fine, then attaching the desired mineral to bubbles which float to the surface. It requires making the mineral hydrophobic so it is repelled by water.

Chapter 5 – Rehabilitation

1. Explain what happens to a mine site when mining a mineral is no longer feasible.  
   It is shut down and rehabilitated

2. Rehabilitation of a mine involves many processes. List and explain three.  
   Answers could include any three of the following
   - Mining plant is demolished
   - The original vegetation is replanted
   - New soil is put over the surface
   - Waste rock dumps are shaped and flattened out
   - If sulfides are present they are mixed with clay and back filled with either water or soil
   - The area is fenced off
   - Waste rock is mixed with concrete to stabilise the mixture
   - Tailings are dealt with by an earthen cap then covered in topsoil and vegetation