

## How we mine: Teacher Background

Many things that people use are made from minerals and metals. In order to have these things the minerals or metals to make them can come from recycled materials or are mined. The recycling of metals provides a small percentage of the materials demanded by consumers. Therefore to provide for this demand particularly in developing countries minerals are mined and processed. Australia has large and accessible deposits of iron ore, gold, copper, silver, lead, zinc and nickel as well as the energy resources - coal and uranium. These provide over 30% of Australia's commodity exports. The mining and processing of these minerals occupies 0.05% of Australia's land mass.

The extraction of Australia's mineral and energy resources is highly regulated with activities carried out in accordance with many Federal and State Government regulations.

In this activity, students develop an understanding of the processes involved from finding the minerals to producing a saleable product.

### In this lesson students will:

- describe the processes involved in discovering, extracting and processing minerals
- explain how the practices applied in the mineral industry contribute to sustainability

## Lesson Level Strands

- Science Understanding: Chemical sciences; Earth and space sciences
- Science as a Human Endeavour: Use and influence of science

## Lesson Outcomes

- Students will find out about each mining process, arrange them in correct order.
- Students will be provided with a greater understanding of the sustainability of mining practices.

## Preparation List

- Make Labels or write on board Processes Involved in a Mining Operation - Processing Ore, Rehabilitation, Approvals Process, Mining, Monitoring, Exploration, Environmental Assessment, Community Consultation
- Processes involved in Mining Operation Information Cards
- [How we Mine Student Activity](#)
- Access to computers/library to source images of processes.

## Activity Sequence

1. Design labels, or write the following on the board - Processing Ore, Rehabilitation, Approvals Process, Mining, Monitoring, Exploration, Environmental Assessment, Community Consultation.
2. Ask the class to number these on the board, from the beginning to the end of the mining process, or alternatively ask eight students to position themselves, with assistance from the class, in the correct sequence of the mining process.
3. Conduct the following jigsaw activity:
4. Print the summary work sheet [Processes involved in a Mining Operation](#).
5. Form 8 student groups and allocate each group one of the mining processes Students study the information on their process/activity and underline the most important information.
6. Form new groups, ensuring that each new group has a representative from each of the mining processes. Each student describes their assigned process to the new group using their underlined information as a focus.



7. To conclude, ask 8 students, each with one process, to stand side by side in what they now believe is the correct order of mining.
8. Students complete the [How we Mine Student Activity](#).

### Additional Resources

For more information click onto the [Minerals Council of Australia mining case studies](#).



## Processes Involved in a Mining Operation

### Exploration

Geoscientists explore for minerals lying buried under the Earth's surface by gathering as many clues as possible. An exploration licence is required before any exploration can be carried out.

Geoscientists use various methods including taking rock and water samples, drilling, maps, satellite images, aerial surveys and testing to determine the size, quality and shape of the mineral deposit. Geophysicists assist them by using ultra modern equipment both on the ground and from aircraft to interpret the information. Geochemists analyse the soil and water content present in the area under examination.

Many factors are taken into consideration before deciding whether a mineral deposit will be mined.

### Mining

Companies use the most cost effective, safe and environmentally sound way of mining the ore (rock containing valuable quantities of minerals).

Underground mining is used when the ore body is too deep below the earth's surface, or where is not appropriate to mine on the surface. Access to the mine is via a large sloping tunnel (decline) or via a vertical shaft. Large machinery is often taken underground and assembled in an underground workshop.

Open pit/open cut mining is used when an ore body is close to the surface. Soil and rock are removed first to uncover the ore body. Controlled explosives are used to break up the rock. Heavy earth moving equipment is used to scoop up the broken rock and ore and to load it onto large trucks. These then transport it out of the pit to the processing plant. Mining engineers and Mine Geologists oversee these operations.

### Processing Ore

The mined ore is processed to separate the valuable minerals from the surrounding unwanted rock (gangue) to give us the required minerals. The first step involves crushing and grinding it into smaller particles.

Next, the ore is concentrated and purified via a number of processes requiring the addition of chemicals, water and heat in a furnace. These processes are called smelting and refining. Metallurgists, Processing and Chemical Engineers are responsible for these processes that eventually produce metals such as gold, nickel, copper, lead and zinc.

### Approvals Process

Any company wanting to set up a mining operation has to first prepare and submit extensive and detailed plans covering the nature and impact of all stages of the proposed operation and how these impacts will be managed and minimised. This involves developing and submitting to government an Environmental Impact Statement and an Environmental Management Plan.

An Act of Parliament, namely the Australian Environmental Protection and Biodiversity and Conservation Act provides a framework for protecting our environment via a series of regulations, approvals and permits. Without prior approval, an operation cannot proceed. Depending on the nature of the activity, these approvals involve Federal, State and Local Governments.

Environmental Scientists employed by mining companies play a major role in preparing these.

### Monitoring

All aspects of the mining operation that can affect the surrounding environment or the health and safety of the work force and surrounding communities are measured, monitored and reported on a regular basis. One important example is checking the quality and storage of the slurry of waste water and fine crushed rock left over from the processing stage of the operation. This material is stored in a specially designed tailings dam where it can evaporate. All waste water is either recycled or stored on site so that it cannot enter the surrounding waterways.

Noise and dust levels are also carefully monitored and minimised, as too are all gas emissions. This work is also the responsibility of the Environmental Engineers and scientists working on site.



### **Environmental Assessment**

An environmental assessment is a detailed study of a mine site and the areas immediately adjacent to it. All aspects of the natural and built environment are observed and investigated. For example where there is a water course through the mine site, tests would be conducted to find out about water chemistry and the life supported by the creek/river. Tests are taken at several locations and over a long period of time. The assessment identifies what components of the natural and human environment are likely to be affected by the mining process so that strategies to minimise or eliminate impact can be put in place. Environmental assessment occurs before, during and after the mining operation.

### **Community Consultation**

This process involves talking to the local community about how they are likely to be, or are being affected by the mine operation. It is conducted before, during and after the mining operations. A social scientist or company community relations officer often conducts community information sessions or visits individual homes in order to ensure that the local community members know that their needs are being considered. Community Consultation often happens on a broader scale before the mine begins operation as people from further afield are asked to comment on the potential for the mine to begin work.



The following steps are involved in mining and processing minerals.

- Approvals Process
- Community Consultation
- Environmental Assessment
- Exploration
- Monitoring
- Processing Ore
- Mining
- Rehabilitation

1. In your workbook, construct a flow diagram showing the correct sequence for the above processes.
2. Refer to the [EnviroSmart case studies](#) to help you.
3. Provide a definition for each process
4. Provide an image for each process
5. What steps can companies take to mine and process minerals in a sustainable way?
6. Why is it important to mine in a sustainable way? Answer in terms of:
  - a. **Economic sustainability** - ensuring the operation makes enough money to be profitable and that the community benefits through employment, business opportunities and improvements to local infrastructure such as roads, housing and schools)
  - b. **Environmental sustainability** – ensuring that the air, energy, land, waste and water aspects of the operation are managed safely and that once mining is finished, the land can have future uses.
  - c. **Social sustainability** – ensuring the health, safety and well-being of employees working on site and making sure members of the local community are informed and engaged in the process in an appropriate manner.

