PRIME

future mining careers

TEACHER WORKBOOK

2023

NSW MINING

Regional Development Australia

HUNTER

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Introduction

The PRIME Program is a collaboration between RDA Hunter, NSW Minerals Council, and delivered in partnership with industry to Hunter Region High Schools to promote mining career and education pathways. The program includes the implementation of mining-specific content, scenario-based learning activities and real-world problem solving in the classroom. This Teacher Workbook complements the Student Workbook which is designed for Stage 5 students to help them appreciate how Science and Geography apply across the lifecycle of a mine, and the types of skills and jobs required to support mining operations.

The NSW Geography Syllabus provides opportunities for students to explore how the practices of Aboriginal Peoples, as the oldest, continuous cultures in the world, support the sustainable use of environments. Aboriginal cultural heritage matters are present across the life cycle of a mine, from exploration to rehabilitation and should be explored within the workbook content. We encourage you to seek involvement from appropriate local knowledge holders and/or Aboriginal education staff within your school to assist with the delivery of the PRIME program, to provide students with opportunities to view mining through multiple perspectives.

Reflection and evaluation are important elements of the learning process, particularly for STEM (Science, Technology, Engineering and Mathematics) focused subjects. Although this workbook does not contain explicit opportunities for students to reflect on their thinking and processes, it is something we encourage you to do in your classroom delivery of the Program.

This workbook contains a variety of learning activities, experiences, and sample answers:

- Virtual Reality
- Google Maps
- Research
- Interactive
- Debate
- Comprehension

At the end of the workbook, you will find 4 exciting project briefs designed by industry for students to work with their classmates on to find a solution. These solutions will be presented to industry representatives.

Where possible, this workbook duplicates the **Student Workbook** and provides suggested answers in **red**.

The Program commenced in 2019 and has been delivered in High Schools in 2020 and 2021.

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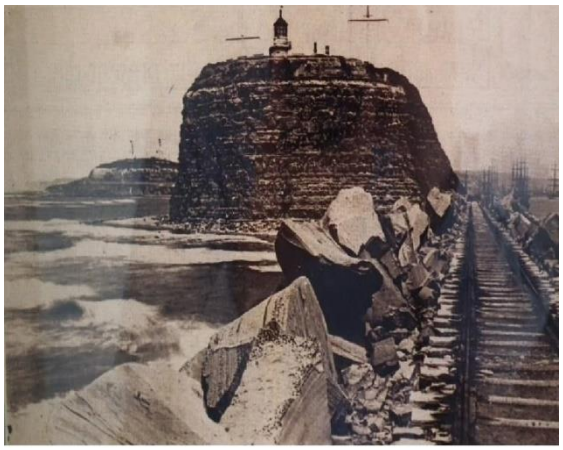
Mining History

READING ACTIVITY

Read the information below and answer the ten questions in your workbooks

Mining is a vital industry in NSW supporting jobs in Sydney and in mining regions. Mining has played an important role in economic development in NSW for more than 200 years, providing jobs, independence, and prosperity to the people of the state.



Coal mining in Australia began near Nobbys Head in Newcastle in the 1790s. Coal was Australia's first commodity export with the first coal shipment leaving Newcastle in 1799.

Newcastle and Wollongong with their bustling ports, as well as towns like Broken Hill, drove the NSW economy from the late 1800s onwards.

Today, Newcastle is the world's largest coal export port, exporting around 160 million tonnes per year to export markets across Asia.

South of Sydney, Illawarra has been supported for decades by the economic activity generated by mining of the region's high-grade coking coal, supporting major industries like steel production and manufacturing, since the first mining operation began in 1848.

The Illawarra remains one of the leading producers of steel and steel products in the Southeast Asian region, with Port Kembla facilitating coal and steel exports.

Gold was discovered near Orange in the Central West in 1851, sparking a gold rush. Gold and Copper mining operations began at Cadia Hill in 1870, which is now the site of Newcrest Mining's Cadia Valley operations, one of Australia's largest gold mines.

Many NSW regional centres were established with the support of mining and continue to prosper, including Newcastle, Broken Hill, Wollongong, Cessnock, Muswellbrook, Lithgow, Orange, Gunnedah and Cobar.

Singleton, for example, was first settled in the 1820s but began to thrive when the first mine opened in 1860, ultimately becoming the biggest service town for mining in the Hunter Valley.

To this day, there are thousands of NSW businesses that support the mining sector and many of them are headquartered in regional towns.

From its convict origins, mining has become a strategically important industry in NSW, supporting thousands of jobs and generating economic activity and taxes and royalties that support the development of government infrastructure and essential services like schools, hospitals and police.

ANSWER THE FOLLOWING QUESTIONS:

1. Where did Coal Mining start? Nobbys Head Newcastle, in the 1790s
2. In what year did the first coal shipment leave Australia? 1799
3. How many tonnes of coal are exported each year from Newcastle? 160 million tonnes
4. What two major industries does the mining of coal support in the Illawarra?
   Steel production and Manufacturing
5. What two exports does Port Kembla support? Coal and Steel
6. What was discovered in 1851, and where? Gold, Orange
7. What is Cadia Hill known to have started? Gold and Copper Mining
8. Name the NSW regional centres that are known to be supported by the mining industry?
   Newcastle Broken Hill Wollongong
   Cessnock Muswellbrook Lithgow
   Orange Gunnedah Cobar
9. What town is the biggest service town for mining in NSW? Singleton
10. List the different ways that mining supports important industry in NSW.
    Thousands of jobs and generating economic activity to support the development of government infrastructure and essential services like schools, hospitals and police.

What & why do we mine?

So many things in our modern world are either made from minerals or are produced with the help of minerals.

NSW has an abundance of vital minerals. In addition to coal, NSW has deposits of metallic minerals such as gold, copper, silver, lead and zinc, cobalt and lithium for batteries, and industrial minerals like mineral sands, clay, and limestone. These minerals are owned by the NSW Government on behalf of the people of NSW.

Minerals are essential to produce materials required for construction and manufacturing. Like iron ore, which is used to make steel with the help of coking coal. Coal is also used to make cement.

Electricity generated from thermal coal is part of the world's energy mix. In NSW, electricity generated from coal helps to heat and cool homes, keep the lights on, prepare and preserve food, as well as supplying fresh drinking water. Thermal coal also provides a stable energy supply to keep NSW businesses thriving each day.

The extraction of minerals provides the essential elements required for generating energy, manufacturing, and products. It also provides employment and a significant economic return to the state.

Taxes and royalties from mined coal and minerals are paid to the NSW Government to help provide the infrastructure we rely on like roads, new train lines and bridges. And they help our nurses, teachers and police do their jobs.

Plus, the money spent by our miners and their families in mining communities, as well as the businesses that supply our mines, flows through towns across NSW and the state economy.

QUICK QUIZ

1. Why are minerals essential?

Minerals are essential to produce materials required for construction and manufacturing.

2. What are the chemical symbols for…..

Gold	Au
Copper	Cu
Zinc	Zn
Silver	Ag
Lead	Pb
Cobalt	Co
Lithium	Li

3. What generates electricity? Thermal coal

4. Name four things electricity generated from coal helps to do:

   a. Heat and cool homes

   b. Keeps the lights on

   c. Prepare and preserve food

   d. Supply fresh drinking water

BRAINSTORM

In groups of 2-4, complete the bubble below. Consider items that you find in your house. In order to be manufactured, which items do you think require products from mining?

VR ACTIVITY – MINERAL AWARENESS

Use the VR headset to virtually visit the mine sites in Australia where the minerals are mined to make the smart phone. Explore the Sites!

Exploring the Smartphone

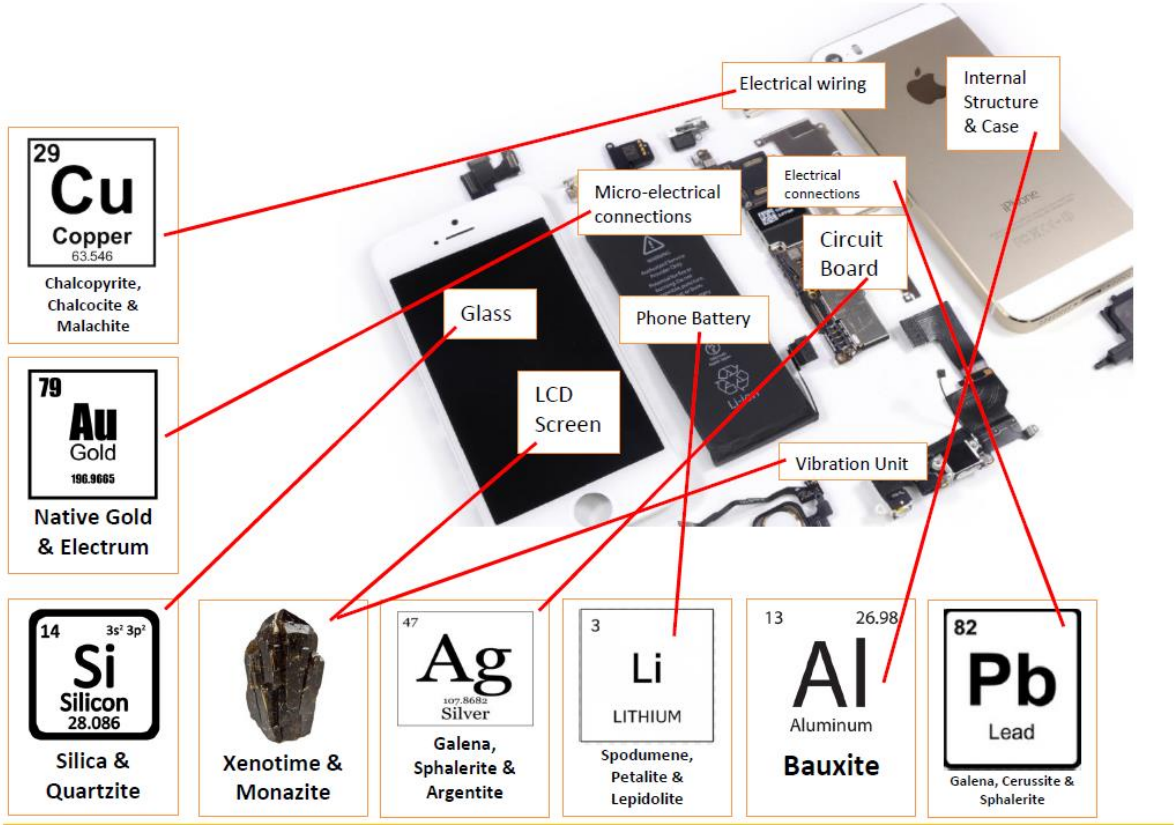
Engage with the VR Headset to launch the **'MEA VR'** App – Students will complete challenges to construct their very own virtual smartphone.

Accessing the VR App: https://www.youtube.com/watch?v=3mtWTETr3L8

It is a real collaboration to mine and process all the minerals required to build a smartphone.

You have visited some sites across Australia to collect the minerals and learnt about their operations. Record the names of the mines and the minerals collected from each.

Without the mining of minerals, the modern smartphone would not exist. Match the components of the phone to the minerals required for its production.



RESEARCH

Everyday things mining makes possible

MY EVERY DAY ITEM IS

Food / Drink Packaging

CHEMICAL SYMBOL AND ELEMENTS USED IN YOUR ITEM

Al	Aluminium		
Cr	Chromium		
Cu	Copper		
Sn	Tin		
Ni	Nickel		
Mn	Manganese		
Mo	Molybdenum		
C	Carbon		
Fe	Iron		

WRITE ONE INTERESTING FACT ABOUT YOUR ITEM

Coca cola uses 300000 tonnes of Aluminium every year in the US which equates to 17.4% of total US Aluminium production.

WHAT IS YOUR MAIN ELEMENT? LIST FOUR EVERYDAY ITEMS IT IS USED IN

Al

Aluminium

Kitchen Utensils, Window Frames, Power Lines, Refrigerators

CLASS PRESENTATION

Listen to everyone present their items from the above research activity. List the main chemical symbols used and one everyday item they are used in.

CHEMICAL SYMBOL	ITEM
Cu	Electrical equipment
Al	Soft drink can
Au	Jewellery
Li	Batteries
Mo	Light bulb (filament)
C	Auto care products
Fe	Stove
Ni	Cutlery
Cr	Hubcap
Sn	Tin cans
Ag	Jewellery
Si	Computer chips

Coal Awareness

Coal is a hard rock which can be burned as a solid fossil fuel. It contains mostly carbon but also contains hydrogen, sulphur, oxygen, and nitrogen.

It is a sedimentary rock formed from peat, by the pressure of rocks laid down later on top. Peat and therefore coal, is formed from the remains of plants which lived millions of years ago. Coal can be burned for energy or heat, like in power stations or in the manufacturing processes for making steel and cement.

Black Coal used to generate electricity is called thermal coal, energy coal or steaming coal, and there is an abundance of this high-quality black coal in NSW. In fact, NSW coal is considered some of the highest quality coal in the world.

There are several regions in NSW with large thermal coal deposits and mining operations extracting coal for local and export markets. There are operating mines in Newcastle and Lake Macquarie, further north in the Hunter Valley and Gunnedah regions and in Lithgow and Mudgee to the West of Sydney.

Some NSW coal mines provide coal to nearby **NSW Power Stations** such as Bayswater, Eraring and Liddell in the Hunter region and Mt Piper Power Station near Lithgow to the West of Sydney. NSW coal plays a fundamental role in supporting the community and the economy, with up to 80 percent of NSW electricity being generated by coal-fired power stations. That helps to keep the lights on at home and power businesses across Sydney and regional NSW.

Much of the NSW **thermal coal** is exported, mainly to Asian countries, providing a stable and reliable source of energy for major economies and trading partners including Japan, Korea, China, Taiwan and India, as well as export revenue for the national economy. Black coal is also used to make steel and cement. Known as coking coal or metallurgical coal, this high-quality coal is primarily mined in the Southern Coalfields of NSW, a region South and South-West of Sydney and is used to create coke, one of the key inputs to produce steel, alongside iron ore and limestone.

Coking coal is used in NSW at the Port Kembla Steel Works where BlueScope makes steel products for local and export markets. It is also used by our trading partners in Asia to make steel and cement for many different building, transport, and infrastructure applications here and overseas. Brown coal is not mined in NSW.

The future role of coal – Demand for energy continues to grow as the world's population grows and we will need a mix of energy sources to power homes and businesses into the future.

Renewable energy is an important and growing part of the global energy mix. Coal also has a continuing and important role, as outlined by the independent International Energy Agency which forecasts coal consumption in Southeast Asia will more than double by 2040. This has primarily been driven by an increase in demand for reliable and affordable electricity, and the deployment of a growing number of advanced technology High-Efficiency Low Emissions (HELE) coal-fired power stations.

NSW is well-positioned to capitalise on this growing demand as these new technology coal-fired power plants being developed in Southeast Asia work best using Australia's high-quality coal. You can learn about the industry's investment in the research and development of low emissions technologies, like **HELE coal-fired** power stations and carbon capture and storage on the LET website https://www.letaustralia.com.au/

KAHOOT ACTIVITY

Once you have read and understood the above information on COAL AWARENESS, create a KAHOOT quiz that you will share with the class.

CREATE AN ACCOUNT INSTRUCTIONS

- https://create.kahoot.it/register
- Register with Kahoot as a student
- Sign up using your school email account
- Complete your account details
- Write these details into your workbook below for future reference
- Write down 10 possible questions for your Kahoot Quiz based
- On the information on COAL AWARENESS.

My account number is: _____

My Password is: _____

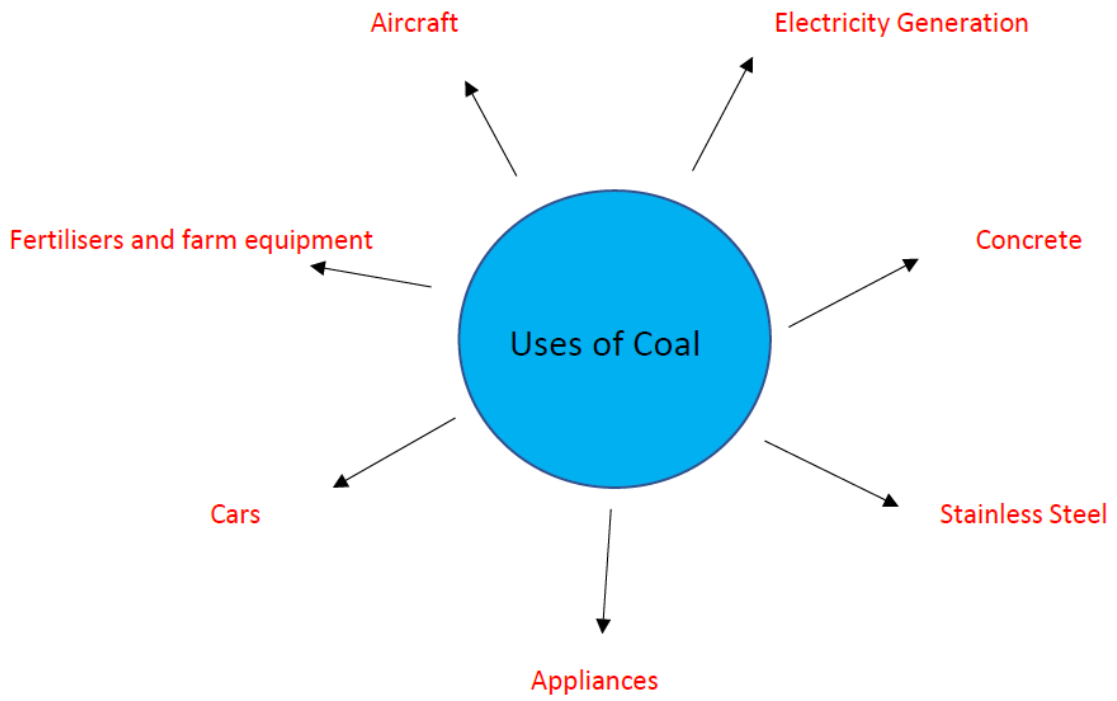
My KAHOOT Quiz number is: _____

Sample Question Ideas

1. Is coal a fossil fuel? Yes
2. What element does coal mostly contain? Carbon
3. What type of coal often referred to as thermal or energy coal is used to generate electricity? Black coal
4. What type of power station generates up to 80% of NSW electricity? Coal-fired
5. Where is much of NSW coal exported to? Asian Countries
6. What are the 3 key inputs to create steel? Coke, Iron Ore, Limestone
7. Where does BlueScope make steel products? Port Kembla Steel Works
8. Does NSW mine Brown coal? No
9. What does HELE stand for? High Efficiency Low Emissions
10. Is the demand for coal increasing or decreasing? Increasing

MIND MAP

Create a mind map of beneficial uses of Coal in our everyday lives.



This activity can be introduced as either a whole class or small group activity. Students will either collaboratively produce a large mind map on a whiteboard or develop posters that can be displayed in the classroom. Physical mind maps could be photographed and shared on a digital class platform such as Google Classroom or LMS. Students could create digital mind maps, using an appropriate app or website. The mind map activity could be extended to include a mind map of potential issues mine sites face, to strengthen content links to Final Project tasks.

Lifecycle of a Mine

VR ACTIVITY – LIFECYCLE OF A MINE

You will be taken on a journey through the lifecycle of a mine.

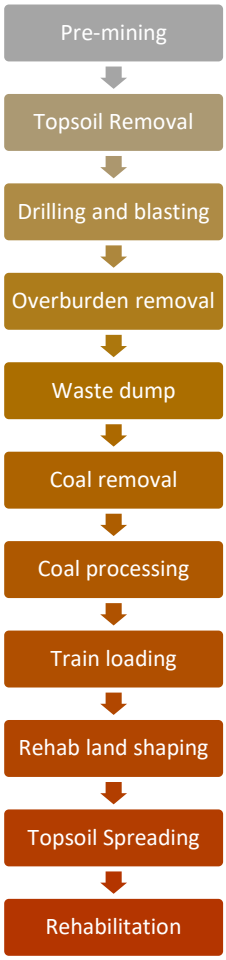
Lifecycle of a Mine

Engage with the VR Headset to launch the **'Lifecycle of a Mine'** Experience.

Accessing the VR App: https://www.youtube.com/watch?v=3mtWTETr3L8

Alternatively, you can view via YouTube:
https://www.youtube.com/watch?v=rWtao5rfFXw&feature=youtu.be

Create a flowchart of the lifecycle of the mine.



Answer the following questions about the mine lifecycle:

1. **Trees must be cleared from a mine site before mining begins; how do mines offset the impact of clearing land of trees?**

To offset the impact of land clearing, native vegetation is assessed, and seeds are collected to be used in rehabilitation so the land can be returned to as natural a state as possible. Mines may also be required to preserve significant tracts of land as offset areas to preserve native flora and fauna.

2. **What is rehabilitation and when does it occur?**

Rehabilitation means returning mined land to a safe and stable landform and is done progressively as the mine operates. Rehabilitation is an integral component of mine site operations from the very start of exploration through to mine closure. Mining companies have a commitment to rehabilitate the land and leave the site in the best condition possible and they will progressively rehabilitate the land disturbed during operations to a specified state suited to its agreed end use.

3. **What happens to the topsoil removed to make way for mining?**

Topsoil is removed, mixed with the mulched trees, and stored to be used in the rehabilitation process.

4. **When blasting, why are the holes for explosives drilled in a pattern?**

The drill hole patterns, depth and number of explosives are designed to ensure the most efficient method of accessing the coal as well as minimising dust, fume, noise and vibration resulting from the blast.

5. **How much does each scoop of material weigh of the overburden shovel?**

Each scoop of material weighs between 50 and 60 tonnes.

6. What is the material removed after blasting called and what happens to it?

It is called overburden and it is stockpiled and used to shape the landform allowing rehabilitation to be completed progressively.

7. What are the impacts of coal mining? What are the benefits?

Coal mining has impacts including disturbance of large tracts of land, dust and noise, however, coal also plays a large, beneficial, role in our day to day lives. Coal is used in the production of many things we use every day including concrete, steel, electricity, household appliances, fertilisers and farm equipment, cars, carbon fibre and more.

8. Why is the coal excavator smaller than the one used to remove overburden?

The excavator used for coal is smaller than the one used to remove overburden as the loading operation is more precise because the operator does not want to mix dirt in with the coal.

9. Other than machinery operators, name five career opportunities offered by mines.

As well as truck, excavator and other machinery operators, mines offer a diverse range of employment opportunities including jobs for tradesmen, geologists, environmental scientists, engineers, marketers, communication officers, administration and management, human resources, health and safety, and much more.

10. What is progressive rehabilitation?

Progressive rehabilitation means rehabilitation occurs as the mine disturbs new areas and replaces the newly disturbed land with freshly rehabilitated land; as the mine moves along the coal seam, the resulting pit is typically filled behind it with the overburden.

11. What are two possible uses for rehabilitated mining land?

Native bushland and grazing.

12. Once overburden is put back into the mine pit – what happens next?

Once placed back in the pit, the overburden is covered with fertile topsoil which was collected earlier in the mining process and grasses and trees – seeds from which may have also been collected in the land clearing process – are planted to suit the intended final use of the land.

13. Who monitors and inspects the growth of rehabilitation areas?

Rehabilitation is a long-term commitment; after grasses and trees are planted the land is closely monitored by the mining companies' rehabilitation experts and inspected by Government regulatory bodies.

14. What is done to ensure successful rehabilitation?

The growth of the vegetation continues to be closely monitored to ensure successful rehabilitation and is subject to independent auditing. Mature rehabilitation can be indistinguishable from land that has never been mined; in fact, in some cases, it is in better shape than neighbouring unmined land due to the scientific decisions made by rehabilitation experts in terms of land shape, addition of fertile topsoils, minerals, fertilisers, plant species and ongoing monitoring.

15. What are two different types of coal and what are they used for?

Different specifications and types of coal are used for different processes, thermal coal is used to generate electricity and coking coal is used to produce steel.

16. Give two examples of how mines work to minimise dust.

Water carts wetting haul roads, careful blasting, weather forecasting, adjusting the speed of trucks, coal stockpiles can be wetted, and the coal can also be sprayed with water as it is being loaded onto trains. Progressive rehabilitation also plays a large role in minimising dust.

Exploration

Exploration is the process of searching areas where mineral resources may be present to work out the volume and the quality of those resources, and to investigate the viability of extracting the resource.

Exploration is not mining and doesn't mean that mining will occur in the area being explored. In fact, very few exploration programs find economically recoverable minerals and go on to be developed into mines. It's like a process of elimination to zero in on the best location for a mine that will generate the most economic benefits with the least environmental impacts.

Exploration is needed to generate a continued pipeline of future mining projects to both replace existing mines as they exhaust their resources and expand the volume of mineral production as global demand for mineral resources continues to increase. Exploration is critical to the development of mining in NSW and the economic benefit it generates.

Exploration is the process of searching for mineral deposits in the ground. Exploration can be as simple as mapping or collecting and analysing rocks and soil from the ground surface, while more detailed investigations may involve various forms of drilling to get a detailed understanding of what types of rocks and minerals lie beneath the surface.

Exploration is generally a very low impact activity that occupies a small area of land, and its impacts can be fully rehabilitated once exploration is complete. Most exploration equipment is of a similar size to farming equipment and many forms of exploration drilling are like water bore drilling commonly undertaken for agricultural purposes.

Before any exploration begins, an explorer must first be granted an exploration licence by the NSW Government and then enter into a land access arrangement with any landholders whose land they want to explore on. An access arrangement sets out things like where on the property the exploration activities will take place, at what times, for how long and under what conditions, and what compensation may be paid to the landholder.

While there are some very limited exploration activities that can then be undertaken (such as rock chip sampling), most forms of exploration require additional environmental approvals by the NSW Government. The licence holder also must lodge a substantial security deposit with the government that is only returned once rehabilitation is complete.

VIDEO ACTIVITY – MINING EXPLORATION

Watch the video on Mining Exploration and answer the questions.

Land Use Facts: Exploration
https://youtu.be/SvckV-RlTz8

1. Before any drilling can go ahead on anyone's land, what do the mining companies require?

A signed land access agreement between the mining company and the land holder.

2. Exploration involves two main assessment areas. They are:

a) What is below the ground and the ground water
b) The impacts around the surface

3. After exploration of a site has been completed, they need to submit assessments on the environment, ground water and agriculture as well as presenting the case to Government. How many years can this process take before approval may be granted for a mining lease?

A long process – from 5 years to 20 years.

4. What are the steps undertaken to rehabilitate the site after the exploration process has been completed?

Step 1	Remove the drilling cuttings from the sumps
Step 2	Take offsite and dispose of them
Step 3	The subsoil and topsoil are replaced
Step 4	Seed is planted to re-establish the soil
Step 5	The bore hole is converted into a water monitoring bore

Preparing to Mine

After exploring the land and discovering a possible place to mine, steps need to be undertaken in order to gain approval for the mine to start. This could take many, many years!

The Mine Planning Process takes into consideration many facets including the Ecological sustainable development, proper consideration must be given to potential environmental, social and economic impacts during the mine planning process.

- the full lifecycle of the mine from construction and operation to rehabilitation and lease relinquishment
- consideration of project options and alternatives to avoid or minimise negative impacts
- reducing the potential for environmental and community impacts which exceed relevant approval criteria
- lessening levels of public concern
- avoiding potential delays in the approval process
- optimising sustainability of post-closure land use outcomes

The project needs to be outlined in its entirety so that interactions between various components of a mine plan and the reasoning behind design decisions are clearly articulated in the development application. This will ensure that decision makers understand what choices or trade-offs have been made and why.

It is common for mine plans to be significantly altered from the initial proposal before they are approved, in order to respond to community concerns and to satisfy the NSW Government that mining impacts are minimised to an acceptable level.

Public exhibition during the assessment process and pro-active consultation programs undertaken by mining companies ensure that members of the community have the opportunity to make comment and raise any concerns they might have in relation to the project. Every activity in the mining process, from exploration to mining and eventually to mine site rehabilitation is carefully managed to mitigate potential impacts on surrounding communities and neighbouring industries.

Mining Methods

Mining techniques have dramatically transformed over many years, with technological advances improving efficiency and the safety and health of the workers while minimising the environmental impact of our operations. NSW has both surface and underground mines.

There are 2 types of mining:

1. Open-Cut
2. Underground

Open-Cut mining is used when the minerals are found over a large area and relatively close to the surface.

It involves blasting and removing surface layers of soil and rock to reach the mineral deposit. When the mineral seam becomes exposed, it is broken down and the coal or minerals are recovered for processing.

Open-Cut mining can be more effective than underground methods, generally recovering 90% of a mineral deposit and is the main mining method for extracting coal in NSW.

Open-Cut mining is also used for some gold and copper production in NSW.

How do we mine coal – Open-Cut processes
https://www.youtube.com/watch?v=DE-LoOZCCW4

Underground mining is primarily conducted for extracting deeper ore bodies.

ROOM AND PILLAR is the oldest underground mining technique and was common in NSW before longwall mining began in the 1960s.

This method uses a grid of tunnels and involves progressively cutting panels into the coal seam whilst leaving behind pillars of coal to support the mine. It is no longer commonly used in NSW to extract coal.

Longwall mining is more efficient than room-and-pillar as it does not leave behind pillars of coal, so more of the mineral resource can be extracted.

LONGWALLING revolutionised underground coal mining with its capacity for safe, cost-effective, and efficient large-scale extraction. It is the most widely used method of underground coal mining in NSW.

In this form of underground operations, mechanical shearers cut coal away from the coal seam in long sections, while hydraulic powered supports hold up the roof of the mine. As coal is removed on a conveyor, the supports are moved forward as the mine advances in a horizontal direction.

This can result is some subsidence on the surface, however this is planned for, monitored and managed very closely in consultation with the regulator and any nearby neighbours to minimise any impacts on the land.

BLOCK CAVING is a modern mining technique where mineral ores such as gold and copper are extracted by collapsing the mineral deposits under their own weight.

This is achieved by tunnelling underground and digging underneath a block of ore and letting it cave in. Once 'caved' the broken ore is collected and hauled to the surface for processing.

ALPHABOXES

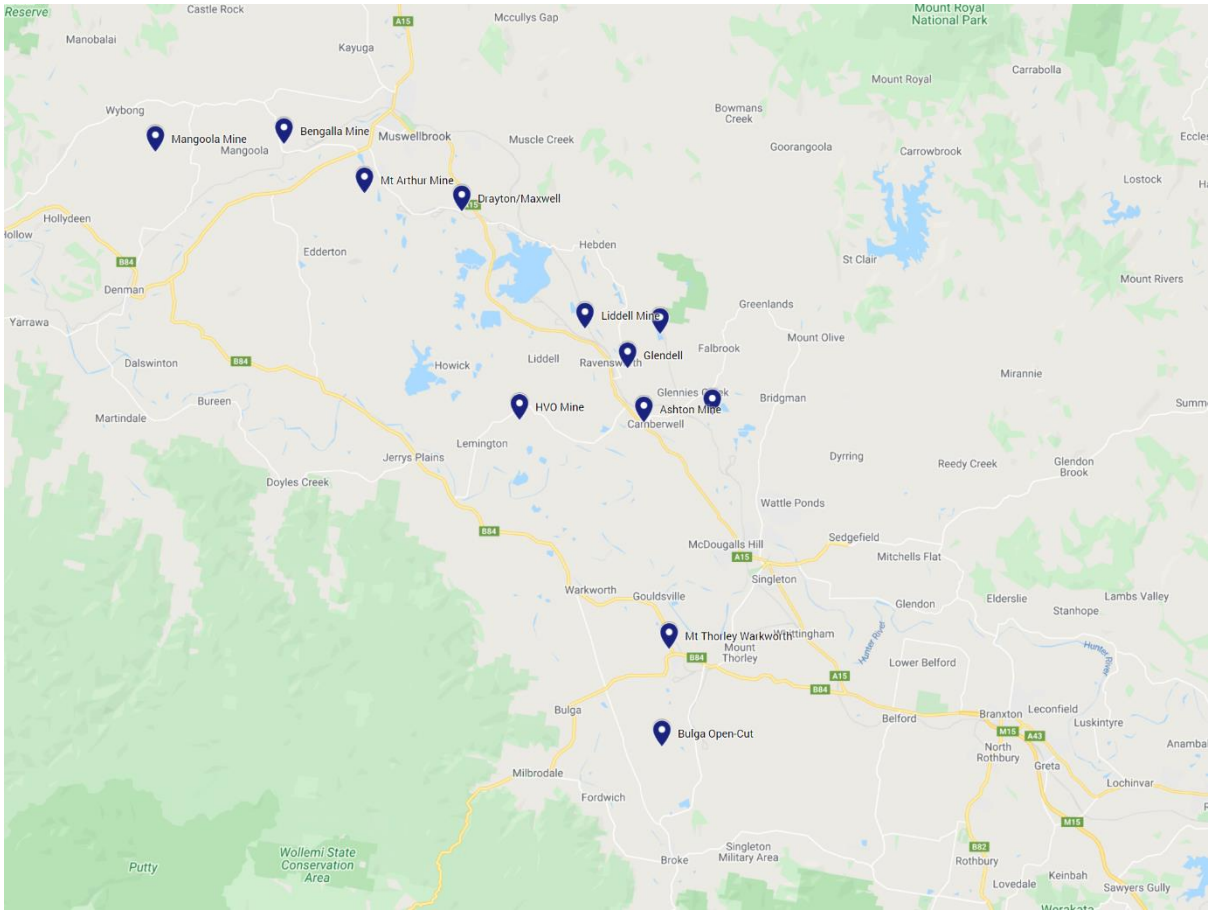
In pairs, read the information above and watch the video on the methods of mining in NSW. Complete the Alphaboxes sheet listing mining related words that you have read, seen, and heard about.

A Advances	B Blasting Block caving	C Coal Copper Cutting Cost-effective	D Deposit Digging
E Efficiency Environmental Extracting	F	G Gold Grid	H Hydraulic Horizontal Hauled
I Impact	J	K	L Longwall Large-scale Land
M Minerals Mechanical Monitor Minimise	N	O Open-Cut Ore Operations	P Processing Production
Q	R Recovering Room & Pillar Resource Regulator	S Surface Soil Seam Safe	T Technique Tunnels
U Underground	V	W Weight	XYZ

Hunter Mines

MAP & RESEARCH ACTIVITY

In pairs, discover where our local mines are located. Plot and label them on the map below. Complete the table on the next page with their full details.
https://www.google.com.au/maps



1. Name the mine that is closest to where you live? _____

2. What do they mine there? _____

NAME OF MINE	LOCATION OF MINE	WHAT TYPE OF MINE IS IT? Open-Cut/Underground - Coal/Gold etc
Mangoola	Wybong	Open-Cut Coal
Mt Owen	Ravensworth	Open-Cut Coal
Mt Arthur	Muswellbrook	Open-Cut Coal
Hunter Valley Operations	Lemington	Open-Cut Coal
Liddell	Liddell	Open-Cut Coal
Bulga	Broke / Bulga	Open-Cut Coal Underground mine ceased operation in May 2018 Approvals are being retained to support future options
Ashton	Camberwell	Open-Cut & Underground Coal
Mt Thorley Warkworth	Mt Thorley	Open-Cut Coal
Integra	Glennies Creek	Underground Coal
Glendell	Ravensworth	Open-Cut Coal
Drayton/Maxwell	Muswellbrook	Open-Cut & Underground Coal
Bengalla	Bengalla	Open-Cut Coal

Processing Coal

After removing coal from the ground, the miners may send it to a Coal Handling Preparation Plant (CHPP) near the mining site. The plant cleans and processes coal to remove rocks, dirt, ash, sulfur, and other unwanted materials. This process increases the heating value of the coal.

Bulga Coal in the Hunter Valley operates a CHPP 24 hours per day, 7 days per week with a capacity of 20Mtpa Run of Mine (ROM) coal. It currently processes approximately 16Mtpa ROM coal from both Bulga Open-Cut and Bulga Underground Mines.

Once mined, the Bulga coal is transported to their CHPP where the minor waste component, usually clay or sandstone is washed away. The waste is either disposed into tailings dams or thickened and co-disposed in the overburden dumps. The coal is broken down to particles of less than 125 millimetres in a crusher and then washed, screened, rinsed and dewatered.

In 2010, the Bulga CHPP successfully installed a paste thickener, the first of its kind in coal processing. The aim of the paste thickener is to thicken tailings which saves on water, power and reduces space required for tailings storage. Bulga Coal was awarded Minerals Processing Plant of the Year in the 2010 Australian Mining Prospect Awards largely due to the commissioning of the Paste Thickener.

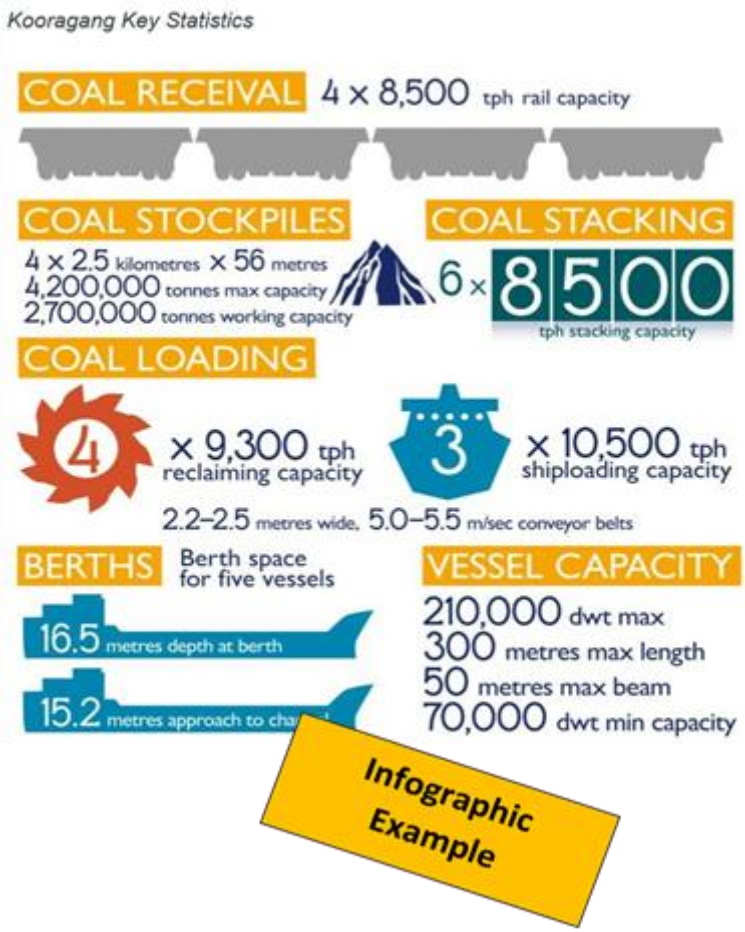
The product coal handling facilities include dual product conveying systems from the plant out to the stockpiles. They also include separate stockpiling and reclaiming facilities for coking coal and for thermal coal. The combined capacity of the product stockpiles at Bulga is 1000000 tonnes. Clean coal is reclaimed from the product coal stockpiles and loaded into a 1500 tonne train loading bin. Trains are loaded from this bin at a rate of up to 3500 tonnes per hour. The Bulga Complex loads on average 90 trains per month with each train carrying 8500 tonnes. The coal is then transported from site to the Port of Newcastle via rail for export.

INFOGRAPHIC TASK

In pairs, read the information above on Processing Coal at Bulga. Create an Infographic using the information you have read about.

What is an Infographic?

- An **Infographic** is a visual representation of information and data
- By combining elements of text, images, charts, diagrams, and more recently videos, an **Infographic** is an effective tool to present data and explain complex issues in a way that can quickly lead to insight and better understanding



RESEARCH AND NOTE TAKING

- Read through the Processing Coal information with your partner. Do not take notes.
- Read again, this time highlight the important information that you would like to use in your infographic.
- Order your information from the most important facts to the least important.

THINK ABOUT

- What will your reader want to know?

CREATE AN INFOGRAPHIC

- Using the information you have selected, create an infographic below. Consider relevant information, fonts, data and colours.

PRESENTATION

- Present your infographic to the class and explain why you selected that information.

This activity could be expanded to provide students with a choice to create either a digital or physical infographic.

The task follows a number of steps of the design process, and could be extended to include draft design, feedback on design, revision of design, then final production.

Transportation Chain

There are about 35 mines involved in the Hunter Valley Coal Chain, owned and managed by 11 Coal Producers.

Thermal Coal (used in power generation) and Semi Soft Coal (used in steel manufacturing) is delivered to the Coal Terminals at the Port of Newcastle by trains which typically transport 9,000 tonnes of coal per unit. The coal is stockpiled at the Port facilities prior to been loaded onto a vessel.

Port Waratah Coal Services (PWCS) operates the Kooragang Coal Terminal (KCT) and the Carrington Coal Terminal (CCT) whilst the Newcastle Coal Infrastructure Group (NCIG) operates the third Coal Terminal in the Port of Newcastle.

KCT and NCIG service Panamax and Capesize vessels whilst CCT load Panamax and Handysize vessels due to harbour and berth restrictions.

To find out more about different Hunter Valley Coal Producers you can visit the NSW Minerals Council - NSW Mining website.

Rail Services

There are four main rail haulage providers: **Pacific National**, **Aurizon**, **One Rail Australia** and **Southern Shorthaul Railroad**.

Collectively the rail haulage providers transport coal from over 30 different load points from afar as Ulan in the west and Boggabri in the north-west of NSW to the three terminals at the Port of Newcastle. This equates to more than 20,000 train trips a year.

The track is owned and maintained by the Australian Rail Track Corporation (ARTC), a Australian Government-owned statutory corporation.

Train movements are scheduled by the **Hunter Valley Coal Chain Coordinator** (HVCCC) so that rail arrivals are aligned with stockyard capacity at the Port as well as vessel arrivals. The Hunter Valley coal chain is the world's largest coal export operation.

Hunter Valley Coal Chain Coordinator
https://vimeo.com/584781359

Portside Services

While Port Waratah Coal Services and Newcastle Coal Infrastructure Group (NCIG) are different companies, they are both responsible for the receival, stockpiling and loading of coal onto vessels for export. It is at the Port that cargos are assembled from various trains and mines, specific to the end users' needs.

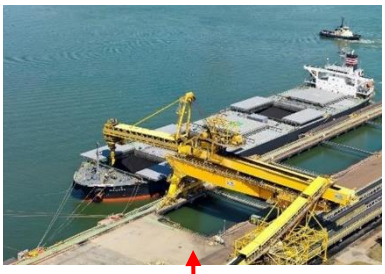
The **Port of Newcastle** welcomes over 1400 coal vessels each year. Independent tug operator **Svitzer** is responsible for working with the pilots and the Harbour Master to safely guide the vessels in and out of the harbour.

As a working international harbour there are a range of rules and regulations which need to be followed. They work with Government agencies such as **NSW Port Authority, Australian Maritime Safety Authority (AMSA)** and the **Australian Customs and Border Protection Service** to keep Newcastle a safe and secure international port.

While at berth, vessels and their crews have the opportunity to restock on supplies such as food and water, visit the local community or touch base with crew support services such as the **Mission to Seafarers**.

MACHINERY MATCH

Draw a line from the definition to the machine that transports the coal at the Kooragang Coal Terminal.



SHIP
Arrive from all over the world to be loaded with coal.

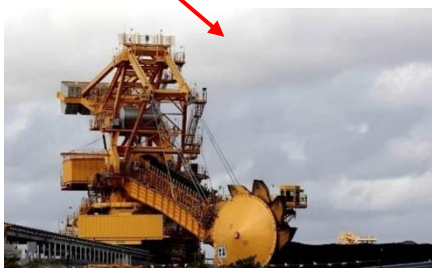
SHIPLOADER
Loads coal onto ships in the port. It has a long arm and conveyor belt to elevate and transfer the coal.

DUMP STATION
Trains arrive at Port Waratah from mines in the Hunter Valley Coal Chain. They move slowly through the dump station where they release the coal onto conveyor belts.

RECLAIMER
Blends and picks up coal from stacked piles using the large bucket wheel. The reclaimers at Port Waratah travel back and forth along rails.

STACKER
Stacks coal into huge piles. The stackers at Port Waratah travel back and forth along rails.

CONVEYOR
Belts which move coal around Port Waratah.



RESEARCH – COAL SHIPS

Research the three different sizes of ship used in the transportation of Coal out of the Port of Newcastle. Explain why they are called these names.

NAME OF SHIP	WHY IS IT NAMED THIS?
Capesize	Capesize are large-sized bulk carriers and tankers typically above 150,000 deadweight tonnage. Capesize vessels are too large in size (especially their draught) to pass through the Panama Canal. As a result, they must transit via Cape Horn to travel between the Atlantic and Pacific oceans.
Panamax	Panamax are the mid-sized cargo ships that are capable of passing through the lock chambers of the Panama Canal which are 1,050 ft (320.04 m) in length, 110 ft (33.53 m) in width, and 41.2 ft (12.56 m) in depth. These limits have influenced the ship building companies to build Panamax vessels strictly in accordance with the dimensions (width, length, and depth) of the lock chambers and the height of the Bridge of the Americas.
Handysize	Handysize refers to a dry bulk carrier or an oil tanker with a capacity between 15,000 and 35,000 DWT. Due to their small dimensions, Handysize ships can serve ports and terminals of all sizes, even ports with length and draught restrictions.

Health and Safety

Mining techniques have dramatically transformed over many years, with technological advances improving efficiency and the safety and health of the workers while minimising the environmental impact of operations.

Safety is an essential component of any healthy workplace. **Mine** safety is an ever-present concern. NSW miners have a **world class health and safety record**, but there is still room for improvement. We're working towards a NSW minerals industry free of fatalities, injuries and disease.

To avoid repeat accidents NSW mines:

- Make safety a top priority
- Set a goal to eliminate repeat accidents
- Train as if their lives depended on it
- Reinforce safe behaviours
- Discipline whilst offering help
- Emphasise hazard detection and reporting
- Investigate every incident

Safety is paramount to NSW miners and Australia is an international leader in safety research and technologies. We lead the way with our **virtual reality training facilities, mining software** and **innovation.**

Our world-leading safety standards and skills are being adopted by other industries in Australia. We're also exporting our expertise to help lift health and safety standards in mines overseas, with our **mine safety training** implemented around the world.

All fatalities, injuries and diseases are preventable. Every task, however urgent or important, can be done safely. All hazards can be identified, and their risks managed. Everyone has a personal responsibility for the safety and health of themselves and others. Safety and health performance can always be improved.

As in any industry, working in mining does pose health and safety challenges. But we believe that:

It's not just about safety. The health of NSW miners is important, so we help ensure individual health and fitness for work by positively addressing issues such as **fatigue, mental health**, and innovations to reduce or eliminate injuries. Health and safety are interrelated, and both require effective management to ensure the wellbeing of people in the industry.

We also work together with unions and regulators on the **NSW Mine Safety Advisory Council**, to manage safety and risk in the workplace to the best of our abilities. Through the Mine Safety Advisory Council, we've helped to create and implement practical resources for miners in NSW, including mine site **fatigue management plans**, a guide to prevent musculoskeletal disorders and a campaign to encourage a culture of **"looking out for each other"** at work.

RISKS & PPE

Many employees across the mining industry (and in other sectors) utilise Personal Protective Equipment (PPE). The requirements for PPE vary based on the potential risks associated with different tasks. Listed below are 7 common mining health and safety risks and an image with some examples of PPE. Write which items of PPE (from the image and your own research) would be most useful to help protect a Miner from each risk.

1. Dust Inhalation – Dust Mask, Respirator
2. Noise – Ear Plugs, Earmuffs
3. Whole Body Vibration – Shock Absorbent Boots, Anti-Vibration Gloves
4. UV Exposure – Safety Sunglasses, Protective Clothing, Safety Helmet with neck flaps attached
5. Musculoskeletal Disorders – Safety Helmet, Steel-cap Boots
6. Thermal Stress – Cooling Vest, Heat Resistant Gloves
7. Chemical Hazards – Safety Gloves, Safety Glasses, Protective Clothing, Respirator

Environmental Monitoring

Environmental monitoring is crucial to mining operation and ensures the safety of people, our environment and compliance with regulatory requirements.

AIR

Read about AIR in the mines and watch the video on drones and dust. Check out this link on current air quality updates [Upper Hunter map | NSW Dept of Planning, Industry and Environment]

Glencore Ravensworth: Gas Monitoring Drones
https://www.youtube.com/watch?v=JUVZ4vA_yYA

Like other types of primary industries, mine sites generate dust through activities such as bulldozing and excavating rock and soil, blasting activities and through haul trucks and other vehicles travelling on unsealed roads. Windy conditions can also stir up dust from exposed areas of rock or soil.

The mining industry continues to improve the way it is managing these work processes to minimise the dust that is generated by mining operations.

Mines are one of many sources of dust and other particulates in the air that we breathe. Other sources include agriculture, bushfires, wood fired heaters, power stations, cars and other vehicles and sea spray from the ocean.

Because of their potential health impacts, governments set air quality standards and establish regulatory frameworks to help minimise the level of dust and other particulates in the air. Mines have been required to comply with a range of new regulatory requirements in recent years, including reducing dust emissions from haul roads inside mines by at least 80 per cent.

Mines have air quality management plans in place to reduce the levels of dust they generate. Mining operations are planned and conducted to minimise disturbed areas and progressively rehabilitate mined areas; stockpiles are sprayed with water; and water carts keep unpaved roads damp so that dust generation is kept to a minimum.

And mines now have improved modern technology to forecast when weather conditions are going to contribute to dust generation so they can modify their operations accordingly. For example, if mining operations can forecast that it is going to be a windy day, they will move operations into deeper areas of an open-cut mine pit to avoid producing dust at height that can be blown off site and impact nearby neighbours.

Other modern technology solutions like drones are being used to minimise dust and other impacts from blasting operations.

Local mining communities in NSW have access to some of the most comprehensive air quality information in Australia. For example, the mining and power generation industries have funded the installation and ongoing operation of the Upper Hunter Air Quality Monitoring Network which has fourteen air quality monitoring stations established across the Upper Hunter region.

The monitoring sites are operated independently by the NSW Environment Protection Authority (EPA), and real time data is available to the public.

Potential dust generation from coal trains transporting coal from mines to ports, such as the Port of Newcastle, has also been a topic of discussion with local communities. While the available evidence indicates that coal trains are not a significant source of dust, the NSW EPA has undertaken a range of research initiatives and actions to minimise pollution from coal train dust. The Hunter Valley coal industry has also done a range of work to manage coal train dust.

WATER

Read about WATER in the mines.

Water is a vital and valued resource for communities, the environment and for homes and businesses across NSW. While water is essential for mining operations, NSW mines only use around 1.5% of the State's water (ABS Water Account) and it is used as efficiently as possible.

Mines need water for ore and coal processing, dust suppression, staff amenities and in some cases irrigation to help establish new vegetation or support agricultural activities on surrounding land owned by a mine. For some of these activities, such as dust suppression, poorer quality water can be used, which helps conserve higher quality water for other uses.

Mines can source water from rivers, groundwater aquifers, rainfall, water recycled on site, recycled town effluent, potable town water supply or water supplied by a third party, such as another mine. Preference is always given to poorer quality water where it is available and can be used, or water captured on site so that the need to extract water from rivers or groundwater aquifers that may be used by other residents or industries is minimised.

Mines must be licensed for any water they take from rivers or groundwater aquifers, just like other water users. Extensive monitoring is undertaken within and around each mine to continually assess water quality, stream flows and groundwater levels to ensure any impacts of the mine are within predicted and approved levels. Where mines have excess water that cannot be stored or used onsite, there are strict rules around the volume and quality of water that can be released into nearby streams. Several mines have water treatment plants in place to ensure water is a high quality before it is discharged.

In the Hunter Valley, the Hunter River Salinity Trading Scheme is an innovative market-based scheme that controls the discharges of saline water into the Hunter River by mines and power stations. The scheme has been successful in reducing salinity levels in the Hunter River for many years and ensures water quality is suitable for all water users.

NOISE

Read about NOISE in the mines.

Mines generate noise from processing plants, blasting activities, and mobile equipment and machinery operations like trucks and dozers.

Mines in NSW have comprehensive noise management plans to keep any disruptions to neighbours and the community to a minimum. There are more stringent noise requirements at night-time and some activities, such as blasting, can only be undertaken during certain times of the day and week.

Mines in NSW are tightly regulated for noise against standards adopted by the NSW Environment Protection Authority and outlined in its Noise Policy for Industry.

Where a mine has taken all steps to reduce noise, but noise levels still exceed certain criteria, NSW Government policies require mines to install noise mitigation at affected households, or in some cases, if requested by the landowner, the mine must purchase the affected property. This would usually occur as part of the planning and independent assessment process for a new mine or an extension to an existing mine.

Blast Management Plans, based on EPA guidelines, outline management and monitoring methods to minimise blasting impacts.

Rehabilitation

Rehabilitation is an integral component in the lifecycle of a mine. The mining industry in NSW takes its environmental responsibilities very seriously and works diligently to ensure the land we use is rehabilitated to provide beneficial outcomes or uses after mining is complete.

VR ACTIVITY

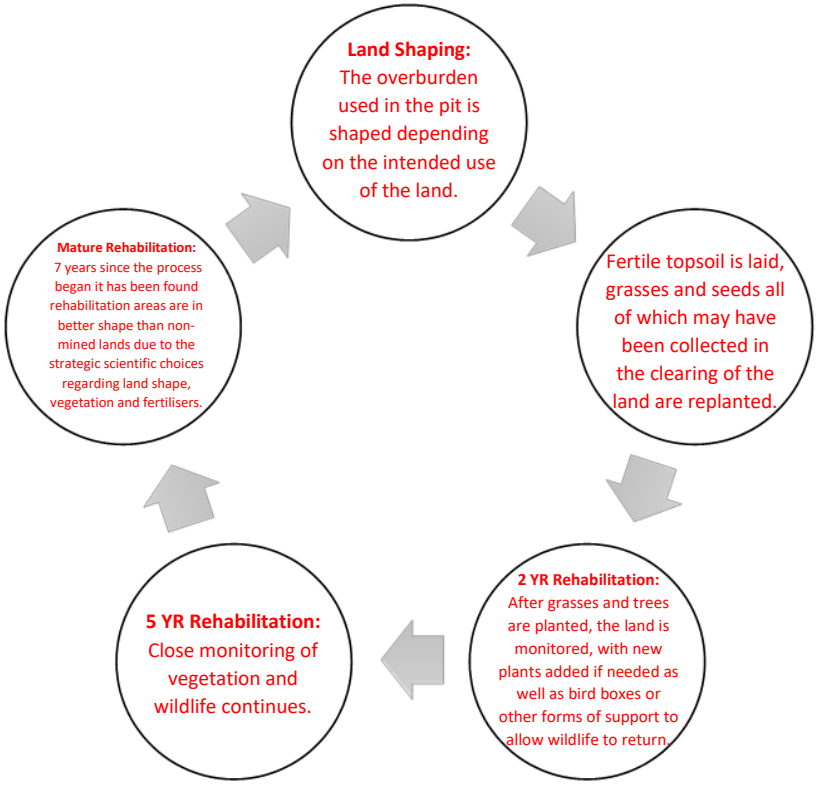
Revisit your journey through the lifecycle of a mine. In the schematic below, outline the processes involved in the rehabilitation of a mine.

Lifecycle of a Mine

Engage with the VR Headset to launch the **'Lifecycle of a Mine'** Experience.

Accessing the VR App: https://www.youtube.com/watch?v=3mtWTETr3L8

Alternatively, you can view via YouTube:
https://www.youtube.com/watch?v=rWtao5rfFXw&feature=youtu.be



There is opportunity for inclusion of a hands-on model mining activity, to enhance student insight into the difficulties involved in mining an area of land and returning it to its former state.

For example:

• Students could use toothpicks and other implements to "mine" the choc-chips out from a choc-chip cookie. Prior to mining, students would need to follow the processes they have learned about in PRIME (mining exploration, selection of mine site, preparation for mining, documenting original landscape, planning mining methods, plan collection of waste material / overburden, and plan rehabilitation / reuse of the landscape).

To request additional delivery support for this activity, please contact prime@rdahunter.org.au

READING

Read the information below as a class and then complete the creative activity.

Rehabilitation is the closure and reclamation of a mine. Once a mining site has been exhausted of reserves, the process of decommissioning the site occurs, dismantling all facilities on the property. The reclamation stage is then implemented, returning the land to its original state.

Rehabilitation is an integral component in the lifecycle of a mine. Before commencement of any mining operations, mining companies work with government authorities to develop comprehensive rehabilitation plans. These plans determine the post-mining use of the land, and include objectives developed in consultation with the community and endorsed by the Government.

Land disturbed by mining activity is progressively rehabilitated throughout operations with the objective of returning the resulting landform to a safe and stable condition and in a manner consistent with the surrounding landscape.

For example, rehabilitation at Glencore's Mount Owen in the Hunter Valley has been underway for many years while mining continues nearby. This is to minimise the land disturbed at the site and to ensure the land is returned to another productive use after mining is finished.

Areas of land known as biodiversity offset areas are also established by the industry to counterbalance any impacts to land (often at a significantly higher rate than the land disturbed). Industry also partners with community groups on conservation and biodiversity initiatives.

Mining companies are responsible for the full cost and implementation of rehabilitation across NSW. So, while there is a lot of public focus on mining operations, there is also much effort and investment quietly undertaken by companies to restore the land alongside mining as operations continue for many years.

Each mine is required to lodge a rehabilitation security deposit with the NSW Government to cover estimated rehabilitation costs in the unlikely event that the company cannot fulfil its financial obligations, and to ensure the costs are not borne by the NSW Government or taxpayers. Deposits are only returned to industry when the NSW Government is satisfied that those conditions have been met. Over 42.3 billion is currently held in security deposits for this purpose.

Closure and Relinquishment

Closure and relinquishment occur after mining is finished and involves the decommissioning of mining equipment and the relinquishment of the mining lease back to the government once the operation has completed rehabilitation and satisfied all legal obligations.

These legal obligations would include returning the land to the approved land use in line with the rehabilitation plan or development consent which had been set out before mining began.

Mines may be temporarily placed in care and maintenance, where economic conditions make the mine unviable to continue operations at the time with the potential to recommence mining later when economic conditions improve. Mining companies remain responsible for the site, managing and monitoring the mine throughout this phase, even though production has stopped.

Mining Voids

A mine void is a mined area, typically a pit, that remains as a residual depressed landform feature after rehabilitation of a mine is complete. A void may take various forms ranging from a shallow depression in the rehabilitated landscape to a landform feature that is more reflective of the mine pit at the end of mining.

All matters regarding rehabilitation (including the need for a residual mine void) are carefully considered early in the design and planning process, prior to commencing operations, as part of a rigorous and comprehensive assessment process managed by the Department of Planning, Industry and Environment.

The current regulatory and approval process requires that any voids are minimised and incorporated into the local landscape and rehabilitated to a safe and stable condition.

The industry is investigating the beneficial use of voids to provide ongoing assets to the community after mining. Various opportunities including recreational lakes, wildlife conservation, irrigation, water storage, aquaculture, and hydro-electric power generation could be explored as potential options for residual mine voids in the future.

CREATIVE ACTIVITY

There is always discussion on rehabilitation within mining communities. Look at the picture below and brainstorm ideas the land could be used for after the mine closure. As a class, hold a mock community consultation meeting where everyone can share their ideas and work together to agree on a use for the land.

Dam

Entertainment Hub

Bike Track

Solar Farm

Wind Turbine Farm

Hotel

Wildlife Habitat

Crops

Our class agreed the land will be rehabilitated for use as:

_____

_____

_____

Renewable Energy

RESEARCH

Research and answer the following questions on renewable energy.

What are the differences between fossil fuels and renewable energy resources?

FOSSIL FUELS

Fossil fuels are formed by natural processes, such as anaerobic decomposition of buried dead organisms, containing energy originating in ancient photosynthesis. Examples include coal, oil, and natural gas. They are nonrenewable resources meaning once they are used up, they will be gone forever.

RENEWABLE ENERGY

Renewable energy is collected from renewable resources, which are naturally replenished on a human timescale, such as sunlight, wind, rain, tides, waves, and geothermal heat.

How much are we using renewable resources compared with fossil fuels?

Most of Australia's energy relies on traditional sources—non-renewable fossil fuels. Coal and gas account for about 79% of electricity generation. Most of our electricity is produced from burning black and brown coal at large power stations. Renewable energy from sources like wind, solar and hydro provide about 21% of Australia's electricity supply. This includes both large generators and small systems owned by Australian families and businesses. (www.energy.gov.au)

What are the pros and cons of renewable energy resources?

PROS

- Renewable energy won't run out
- Maintenance requirements are lower
- Renewables save money
- Renewable energy has numerous health and environmental benefits
- Renewables lower reliance on foreign energy sources
- Higher upfront cost
- Intermittency
- Storage capabilities

CONS

- Most renewable energy generators are expensive to set up
- Sources such as wind turbines and solar cells rely heavily on the weather. If it is not a windy day, wind turbines will not turn. And if it is not sunny, solar cells will not produce much electricity.
- To capture large amounts of renewable energy, a great deal of land is required to install solar panels, wind turbines, etc

There are 6 types of renewable energy resources. Complete the table below:

TYPE OF RENEWABLE ENERGY	DEFINITION
WIND	Power obtained by harnessing the energy of the wind.
SOLAR	Power obtained by harnessing the energy of the sun's rays.
HYDRO	Hydroelectric power (HEP), or hydroelectricity is electrical power generated through the energy of flowing water.
GEOTHERMAL	Geothermal power is generated from the thermal energy in the earth's crust. Technologies in use include dry steam power stations, flash steam power stations and binary cycle power stations.
TIDAL	Tidal energy is the form of hydropower that converts energy obtained from tides into useful forms of power, mainly electricity.
BIOMASS	Biomass power is a carbon neutral electricity generated from renewable organic waste that would otherwise be dumped in landfills, openly burned, or left as fodder for forest fires.

Some things City of Newcastle are doing to limit carbon emissions in 2022

Solar farm

Operating a 5MW solar farm at Summerhill, the largest landfill solar farm in Australia. The solar farm provides over 50% of the City of Newcastle's electricity and reduces our carbon dioxide (CO_2) emissions by 6000 tonnes annually. Covering an area of around five football fields on a capped landfill, which was once part of the Wallsend Borehole Colliery, the solar farm's 14500 photovoltaic solar arrays help dramatically reduce the city's annual electricity bill.

Bin sensors

Instead of waste crews pointlessly doing full rounds only to service many empty bins, new smart bins in public spaces contain sensors which detect when they need emptying, thereby saving driving time and emissions, and helping to reduce the number of overflowing bins.

Street lighting

New smart street poles save energy thanks to light-emitting diodes (LEDs) and boast controls that allow lights to be dimmed when not needed, further reducing energy use. Changing over existing street lighting to LEDs allows City of Newcastle to save energy, money and reduce carbon emissions.

Environmental monitoring

Running an environmental monitoring network to help understand air quality (smell, dust, pollution), temperature, humidity, and a range of other features. This data is shared to help identify areas of improvement.

CLOZE PASSAGE

Complete the cloze passage below about the Summerhill Solar Farm, Wallsend.

The solar farm produces enough electricity to run the equivalent of 1300 households, which provides significant environmental returns for ratepayers and millions of dollars in savings on energy costs.

About 14500 solar panels are installed across an area the size of five football fields between Summerhill's main entry road and the construction waste area.

It is built on a capped landfill site that was once part of the Wallsend Borehole colliery. Electricity flows to a nearby substation to "offset" electricity used at City of Newcastle facilities across the local government area.

This includes the working of streetlights, community centres, libraries, sport and recreation facilities and other public access buildings.

The project cost $8 million, with the council directly funding $1.5 million.

solar	waste	streetlights	energy
substation	electricity	council	built

Mining Economy

Mining in NSW makes a major contribution to the State's economy through jobs, expenditure with local businesses, taxes, levies and royalties paid to Local, State and Federal Governments, and export revenue to the State.

RESEARCH

Using the website https://www.dictionary.com/browse/australia find definitions for the words relating to economy below.

WORD	DEFINITION
Economy	The state of a country or region in terms of the production and consumption of goods and services and the supply of money.
Commodities	Raw materials or primary agricultural products that can be bought and sold, such as copper or coffee.
Support	Economic Support means financial mechanisms offered by a Contracting Authority and/or Ministry of Economy and Finances to ensure the financial viability, possibility, and/or sustainability.
Community	Organisation/group that aims to bring about economic integration among its members.
Export	Send (goods or services) to another country for sale.
Royalties	A royalty is an amount paid by a third party to an owner of a product or patent for the use of that product or patent. ... The royalty rate or the amount of the royalty is typically a percentage based on factors such as exclusivity of rights, technology, and the available alternatives.
Infrastructure	The basic physical and organisational structures and facilities (e.g. buildings, roads, power supplies) needed for the operation of a society or enterprise.
Revenue	Revenue is defined as the income generated through a business' primary operations. It is often referred to as "top line" and is shown at the top of an income statement.
Trading Partners	A country or company that another country or company does business with regularly.
Low Emissions	Producing little emission of atmospheric pollutants; as a low-emission vehicle.
Overheads	Business expenses, such as rent, that are not directly attributable to any department or product and can therefore be assigned only arbitrarily.
Logistics	The planning, implementation, and coordination of the details of a business or other operation.

READING ACTIVITY

In pairs, read the information below and discuss your understanding of mining economy with your partner. Highlight the main points. Discuss your findings as a class.

The New South Wales Minerals Council (NSWMC) latest Jobs and Expenditure Report found that the 28 mining companies surveyed directly injected an estimated $14.9 billion in the NSW economy in 2019/20, supporting thousands of jobs and businesses across NSW, particularly in many regional communities.

$2.7 billion in wages and salaries was paid to approximately 20,117 full-time equivalent residing direct employees (not including contractors).

$10.3 billion was spent in purchases of goods and services from approximately 7,862 local businesses, community contributions and payments to local government (including rates, developer contributions and other payments).

$1.9 billion was paid in state government payments (including royalties, stamp duty, payroll tax and land tax).

The Hunter region recorded the highest direct expenditure in 2019/20, with $6.1 billion (or 41.1% of the total direct spend across NSW), followed by the Sydney ($3.5 billion, or 23.3%) and Central West ($1.0 billion, or 6.9%) regions.

With long-term projects and global demand for commodities remaining strong, mining will continue to help build and support economies and communities in regional NSW.

Mining is the state's most valuable export commodity. And mining companies operating in NSW pay billions of dollars in mining royalties to the NSW Government that contribute to the funding of essential infrastructure and services, like roads, hospitals, schools, and police stations.

It takes a lot of different people in a lot of different jobs to keep mines working. There are major supply chains with more than 7,000 businesses big and small in NSW supporting mining operations, providing a range of goods and services. Supplying businesses employ thousands of people across the state, keeping local economies growing and local communities flourishing.

Export Revenue

Coal continues to be NSW's most valuable export commodity, with export earnings of $16 billion in 2021.

Analysis from NSWMC shows the demand for NSW coal has remained strong despite the global pandemic, with top three traditional markets being Japan, Korea, and Taiwan, as well as important emerging markets including India, Vietnam, and the Philippines. This demand is expected to remain strong for at least the next two decades.

The higher coal price is supporting profitability of NSW current operations and driving developments, with a range of coal projects under assessment.

DEBATING ACTIVITY

In pairs, read the Reuters article about Coal Exports in Australia. Discuss your understanding and write some questions that could be used to head a debate about the future of coal. Share answers as a class. Divide into small groups. Pick one question for your group to debate.

Analysis: India, Indonesia benefit as China's ban on Australian coal reshapes trade flows

By Muyu Xu, Sudarshan Varadhan, Melanie Burton
5 MIN READ

BEIJING/CHENNAI (Reuters) - India and Indonesia have emerged as key beneficiaries of a Chinese ban on Australia's coal exports which is expected to further shift global trade in the fuel used for power generation and steelmaking this year.

Australia, the world's biggest coal exporter, will continue to benefit from growing Indian demand for its coal, made cheaper after it was shunned by China, analysts said. Coal traders and buyers expect India's buying spree of Australian coal to last into next year due to its price and quality.

Full article can be viewed online:
Analysis: India, Indonesia benefit as China's ban on Australian coal reshapes trade flows | Reuters

DEBATING PROCESS

1. Designate a team leader
2. Brainstorm individually (10 minutes)
3. Share your cases (10 minutes)
4. Create your team's case (20 minutes)
5. Write your speeches (10 minutes)
6. Add finishing touches (10 minutes)

NEXT LESSON – DEBATE

Sample debate topics:

China should not ban Australian Coal

China's ban on Australian Coal benefits other countries

Chinese manufacturers can't operate without quality Australian Coal

Coal is essential to Australian Economy

Careers

There are many different rewarding and interesting careers available in the mining industry.

VIDEOS

Mining Engineer
Careers in Resources Sector - Bodie Sherrington, Mine Engineer, New Hope Group - YouTube

Chemical Engineer
Careers in Resources Sector - Alicia Hurkmans, Chemical Engineer, Santos - YouTube

Metallurgist
Metallurgical Academic: WA School of Mines - YouTube

Geotechnical Engineer
Careers in Resources Sector - Kathryn Young, Geotechnical Engineer, BHP - YouTube

Health and Safety Officer
Careers in Resources Sector - Beck Weaver, HSE Field Advisor, Arrow Energy - YouTube

Civil Engineer
Careers in Resources Sector - Michael Hoppe, Civil Engineer, Peabody - YouTube

Electrician
Careers in Resources sector - Iain Parcell, Apprentice Electrician, B&R Enclosures - YouTube

SPOTLIGHT – MINING ELECTRICIAN

Do you enjoy mathematical and technical activity, have good hand-eye coordination and are physically fit? Maybe a career as an electrician would suit you!

Electricians install and maintain electrical systems. In the resources sector, they are responsible for establishing and ensuring ongoing supplies of power from generators to plant and accommodation units. Their role is varied and includes working at various locations including both on site, at camps and in support roles. An aptitude for mathematics is a must, as electricians need to complete electrical calculations to ensure projects are completed on time and correctly first time.

Throughout an apprenticeship, electricians learn through both theory and hands on practical experience. With experience, and possibly some business training, they may specialise as electrical contractors who order materials, organise staff to meet customer needs and carry out further tasks associated with running a business.

Electricians can work both in teams or individually, and as they are a client-focused role, good verbal and written communication skills are important. They should have good eyesight and normal colour vision, have an aptitude for mechanics and electronics, and be able to use logical and diagnostic thinking to solve problems.

Electricians are vital in many industries and can be employed in the manufacturing, resources, construction, energy and water supply, storage and transport, domestic and commercial electronics service, and retail industries. Some electricians also work for government organisations, while others work as contractors.

To become an electrician, you must complete an apprenticeship that includes both study and on-the- job training. There are many pathways into this apprenticeship across Australia, so keep an eye on your local apprentice pathway organisations.

For more information about this career, including skills and knowledge, job prospects and pathways, please visit the website Home | JobOutlook.

Queensland Resources Council acknowledges the assistance provided by many organisations in coordinating this career resource including BEtR Enclosures and the Department of State Development, Manufacturing, Infrastructure and Planning.

SPOTLIGHT – MINING ENGINEER

Are you a good communicator, good at problem solving, have an aptitude for mathematics and are practical and creative? Perhaps a career as a mining engineer is for you!

Mining engineers plan and direct the engineering aspect of extracting mineral resources from earth. These roles can be located in a variety of places, such as remote and rural areas, or in cities around Australia and across the globe!

Working alongside other professionals, such as geologists and geotechnical engineers, and surveyors, mining engineers determine the most suitable and safest method of extracting minerals from the earth, taking into account factors such as the depth and characteristics of the mineral deposit and its surroundings.

Mining engineers use multiple technologies to design and prepare plans for mines, including tunnels and shafts for underground operations, and pits and haulage roads for open-cut operations. This includes using geospatial, satellite and drone/UAV data to assist in the development of plans and using simulations to optimise and visualise extraction plans.

As this is a role with specific technical requirements, there are specialist tertiary pathways available at both the bachelor and Post Graduate level at select universities across Australia. Mining engineers are not only employed by the resources sector, but there are also other opportunities available as consultants and within government departments.

People interested in this career should enjoy working with people within teams, but also working independently, and be able to think and act decisively. They should enjoy and have a passion for engineering, technology, design and mathematics, and have the ability to understand and work within legal frameworks and regulations.

For more information about this career, including skills and knowledge, job prospects and pathways, please visit the website Home | JobOutlook.

Queensland Resources Council acknowledges the assistance provided by many organisations in coordinating this career resource including the Minerals Council of Australia and Downer MEI.

ACTIVITY

Using the videos and information above, as well as the website Careers - Oresome Resources summarise each job in the table below and note what areas you would need to study at school to follow each career path.

MINING CAREER	DESCRIPTION
Mining Engineer	Mining engineers plan and direct the engineering aspect of extracting mineral resources from the earth. These roles can be in a variety of places, such as remote and rural areas, or in cities around Australia and across the globe! Working alongside other professionals, such as geologists and geotechnical engineers, and surveyors, mining engineers determine the most suitable and safest method of extracting minerals from the earth, considering factors such as the depth and characteristics of the mineral deposit and its surroundings.
Geotechnical Engineer	Geotechnical engineers use a wide range of skills, including problem solving, mathematical aptitude, communication, and digital literacy to identify, analyse and create practical and creative solutions related to engineering projects. They work in teams of professionals, and often independently to ensure geotechnical activities are conducted safely to provide a safe working environment for employees and contractors while maintaining company standards and complying with government legislation. Computer modelling, predictive and photographic analysis are used by geotechnical engineers to advise and report to multi-disciplinary teams for safe and efficient operations within the resources sector.
Mechanical Engineer	Mechanical engineers plan, design and oversee the development, installation, operation, and maintenance of machinery. Everything that moves has been designed and refined by a mechanical engineer! They conduct research to solve practical engineering problems and improve efficiency. Using their mathematical ability and digital technology skills, they enjoy working on technical and engineering activities while adhering to safety requirements. The skills gained by studying to become a mechanical engineer are used across numerous industries, including aviation, power generation, manufacturing, refrigeration and air conditioning, transportation, and mechanical handling. Mechanical engineers may specialise in areas such as research and development, engineering design, production, plant, and maintenance. They frequently work closely with other professionals, at times pooling expertise on particular projects.
Surveyor and Spatial Scientist	Surveyors and spatial scientists assemble and assess land and geographic information which is used for planning and regulation of the land, the sea and related structures. These professionals require good mathematical ability and organisational skills as well as the ability to work in a team or independently in a wide range of work environments. Advances in technology have changed the way that surveyors and spatial scientists work. Drone and UAV technologies are used in data collection and sophisticated computers assist in processing large amounts of data for the creation of maps, plans, charts, files and reports.
Diesel Mechanic	Diesel fitting mechanics carry out diagnostic procedures, servicing, repairs and engine overhauls as well as, repairing and servicing diesel fuel systems. In carrying out routine servicing, they ensure correct lubricants/fluids are used, do a safety inspection, read and interpret engineering drawings and complete minor repairs to electrical circuits/systems. As a customer-focussed role, they possess a commitment to safe working practices and have the ability to work within company and legislated safety

	guidelines. They should be able to work within a team, take accountability for their actions and output and have the ability to work shift work. Diagnosis and logical thinking are a key part of this role, so diesel fitting mechanics should be comfortable with using digital technologies in their day-to-day work to diagnose faults and follow procedures as set out by companies and equipment manufacturers.
Laboratory Technician	Laboratory technicians and scientists use their knowledge of chemistry, biology and/or physics, along with the skills gained through on-the-job training and formal qualifications, to collect, prepare and test samples and analyse results. The role of these employees is to perform efficient and accurate preparation and testing of samples within agreed test methods (e.g. Australian Standard test methods, Original Equipment Manufacturer requirements, etc.) to ensure consistency of results across a range of similar samples for comparison. Often service laboratories can be fast-paced environments and laboratory technicians and scientists can be a customer-focussed role, with the need to have good written and oral communication skills to interpret, analyse and report on findings.
Metallurgist	Their role can include studying and applying physical methods for separating minerals from their ores using various techniques, working with operators of the plant to ensure efficiencies within the processes, develop and control methods of storing and treating waste material and preparing technical reports. Metallurgy typically suits people who like chemistry, mathematics and physics, as well as an interest in engineering. Metallurgists need to be able to communicate effectively both orally and in written form to meet the objectives of their day-to-day or project work.
Civil Engineer	Civil engineers plan, design, construct, operate and maintain roads, bridges, dams, water supply schemes, sewerage systems, transportation, harbours, canals, dockyards, airports, railways, factories and large buildings. Working independently and as part of a team, they need to assess the risks associated with natural disasters, use geotechnical and geophysical investigations to assist in the design and implementation of projects and work with other professionals including other engineers, architects, landscape architects and environmental scientists for the success of the project. Civil engineers can specialise in areas such as geotechnics, hydraulic/water, irrigation/drainage, materials and testing, pipelines, railways and structural engineering.
Electrician	Electricians install and maintain electrical systems. In the resources sector, they are responsible for establishing and ensuring ongoing supplies of power from generators to plant and accommodation units. Their role is varied and includes working at various locations including both on site, at camps and in support roles. An aptitude for mathematics is a must, as electricians need to complete electrical calculations to ensure projects are completed on time and correctly first time. Throughout an apprenticeship, electricians learn through both theory and hands on practical experience. With experience, and possibly some business training, they may specialise as electrical contractors who order materials, organise staff to meet customer needs and carry out further tasks associated with running a business. Electricians can work both in teams or individually, and as they are a client-focussed role, good verbal and written communication skills are important. They should have good eyesight and normal colour vision, have an aptitude for mechanics and electronics, and be able to use logical and diagnostic thinking to solve problems.
Haul Truck Driver	Haul truck drivers work on mine sites, transporting rock, soil, ore and minerals to different locations around the mine. Haul truck drivers should enjoy practical work, be able to understand and follow directions and instructions, have an ability to work safely and have a good driving record. Exceptional defensive driving skills are a must to handle these machines in varying road conditions across the mine site. While haul truck drivers may need to work for long amounts of time on shift-work, there's a good amount of work-life balance with time off to spend time with friends and family. Imagine the sunrises and sunsets you would see, while carting around 200 tonnes of material to its destination! Crews are very tight-knit groups and haul truck drivers can make friendships that last a lifetime.

Auto Electrician	Automotive electricians install, maintain and repair electrical wiring and electronic components in motor vehicles and machinery. They dismantle and remove electrical and electronic assemblies and repair, replace or retrofit new electronic and electrical systems. Working independently and as part of a team, they work in a customer-focussed role and need to ensure they work safely around hazardous and dangerous equipment. Being able to notice differences between colours and be able to notice details that are up close are a must when working on complex electrical systems. With the gradual introduction of digital technologies, sensor technology and automation within the resources sector, automotive electricians will continue to see stable employment over the next 5 years. Their role will be to install, maintain and diagnose faults on these new or retrofitted electrical systems on vehicles, and provide advice regarding the installation of the items.
Health and Safety Officer	Health and Safety professionals develop and coordinate safety and health systems and strategies within organisations. They identify workplace hazards, assess risks to employee health and safety, and recommend solutions. Part of this role also includes managing environmental considerations both in the field and within office settings. Traditionally, health and safety professionals have been employed in the manufacturing, construction, health and resources industries. There has been an increase in opportunities outside of these sectors for health and safety professionals, including in consultative roles and within other sectors including finance and insurance, health, government and service-based organisations. Communication is a key skill requirement in this role, including both verbals, written and interpersonal communication skills. Health and safety professionals are required to understand the relevant legislation and regulations related to their industry and workplace and can be asked to conduct or assist with training of new and existing employees.

1. After learning about the mining industry, do any of the careers interest you?
   YES/ NO

2. If Yes - which one and why?

3. What subjects in Year 11 and 12 do you need to take for this career pathway?

4. Where in NSW can you study to attain this qualification?

5. Using the website Make Your Career In Mining - Careers Guide | Minerals Council of Australia, name 5 emerging mining industry careers which have not been listed in the table above?

Complete the online survey - your teacher will give you the link.

Final Projects

Expectations

In small groups you will choose one of the 4 Project Topics and work together to design a solution to the problem specified.

It's important to get a good understanding of your Project Brief and to identify the specific problem your group is looking to solve.

You should conduct some research into what has already been done in the area. When you come up with your innovative solutions, it is a good idea to consider:

- both the positives and negatives of your proposed ideas
- how they compare with what is already in use
- cost effectiveness
- scalability
- energy and water usage
- waste reduction
- safety
- community consultation and social impacts

Collaboration and communication are important skills for any career, and we encourage you to work together as team, utilising individual strengths, sharing the workload evenly and coming up with a solution you all agree on.

At the completion of the PRIME program your group will be required to present your solution, **either at a showcase event or via video** (depending on current Covid restrictions). Tips for an effective presentation include:

- Explaining your aim, methodology and solution
- All members contributing
- Consistent messaging
- Using visual aids (diagrams, images)
- Engaging the audience
- Speaking clearly and not too fast or too quietly

NSW Minerals Council industry members will review and provide feedback to your solutions (either electronically or at a Showcase event. The PRIME management team to provide advice to your teachers.

1.0 ECONOMIES OF SCALE

CONTEXT:

Mining companies are continuously looking at ways of improving operational efficiencies and reducing overheads. The smallest improvements, such as a slightly shorter haul route or improved road surface conditions, can have significant cost savings over the mine life because of the business term, "economies of scale".

PROBLEM:

The CSIRO Futures released a Mining, Equipment, Technology and Services (METS) roadmap in 2017 and identified several opportunities to the mining industry for the future which includes ways to create efficiencies across the mine's life cycle. Some of these opportunities and challenges include:

DATA DRIVEN MINING DECISIONS – Rapidly evolving digital technologies are providing opportunities to enable both better and faster decisions by making relevant data available anywhere and just-in-time.

ADVANCED EXTRACTION – Deeper, more complex, and lower grade orebodies combined with the need for a lower environmental footprint will drive the development of advanced methods of extraction.

MINING AUTOMATION & ROBOTICS – Recent technology cost and performance breakthroughs in robotics, automation, Artificial Intelligence, data communications and vision systems are enabling safer and more efficient operations.

TASK:

Your PRIME teams' task is to use the information supplied above, the lessons learnt during the PRIME program, and your own investigation to define a problem faced by a mine/ company and design a solution to:

"Identify ways that mines may increase operational efficiencies or lower overhead costs?" (Brainstorm, Define, Design, Communicate)

In your solution, we'd also like you to consider the effectiveness of various community consultation methodologies (Public meetings, small group and one on one meetings, newspaper interviews and articles, newsletters, websites etc). Create an example of something you would use to communicate your solution to the local community.

2.0 WATER AS A FINITE RESOURCE

CONTEXT:

Mining is a balance between maintaining production targets and satisfying community standards. With more frequent and intense periods of drought, water is becoming a finite resource for mining companies.

Approximately 97% of the world's water is salt water and 2% is in glaciers at the north and south pole. This leaves approximately 1% as fresh and usable. This small percentage is used for human consumption, households, agriculture, transportation, mining and energy production. Across Australia, consumers on average use 100,000L of freshwater per person per year.

Water taken out of the system for domestic, agricultural, mining and/ or energy production is water that is not available for the environment.

PROBLEM:

Some of the flow on effects from deteriorating water storages include lower water reserves for processing of coal or ore, and a drier mining landscape with less water for dust suppression.

What are some other potential risks of water shortages posed to mining companies?

What are some ways mining companies can mitigate against the effects of water shortages?

How can mining companies maintain a higher community standard by managing dusty conditions (which also reduces production downtime) in a dry environment?

TASK:

Your PRIME teams' task is to use the information supplied above, the lessons learnt during the PRIME program, and your own investigation to define a problem faced by a mine/ company and design a solution to:

"Water as a Finite Resource" (Brainstorm, Define, Design, Communicate)

In your solution, we'd also like you to consider the effectiveness of various community consultation methodologies (Public meetings, small group and one on one meetings, newspaper interviews and articles, newsletters, websites etc). Create an example of something you would use to communicate your solution to the local community.

3.0 TRANSPORT & LOGISTICS

CONTEXT:

The Hunter Valley Coal Chain is the largest coal export operation in the world and consists of:

- Approximately 35 coal mines owned by 11 coal producers
- Coal haulage distances of up to 380 kilometres
- More than 31 points for loading coal onto trains
- 4 Rail Haulage Providers delivering to three Coal Terminals
- The movement and loading of more than 1400 coal vessels/year from the Coal terminals through the Port of Newcastle

Up until 2003 there was no central planning and coordination process for the movement of coal through the Hunter Valley Coal Chain. All planning was done at the individual Service Provider level, often resulting in:

- The inefficient planning and scheduling of coal through the Coal Chain
- Lack of coordinated planned maintenance activities
- Excessive levels of cancellations
- Excessive rework

In 2003, the Hunter Valley Coal Chain Planning Group was established to provide efficiencies across the Hunter Valley Coal Chain. This later became the Hunter Valley Coal Chain Coordinator (HVCCC) which exists today to provide a central agency in the “day to day planning and scheduling” and “long term capacity planning” for the Hunter’s coal industry and supply chain.

PROBLEM:

Mining companies and associated transport and logistics partners face ongoing logistics challenges while aiming to run an efficient organisation. Factors that are considered include efficient removal of waste, loading of coal onto ships, fuel costs for trucks and trains, infrastructure required, layout and design of the mine site and time taken to move coal from the pit to port.

TASK:

Your PRIME teams’ task is to use the information supplied above, the lessons learnt during the PRIME program, and your own investigation to define a problem faced by a mine/ company and design a solution to:

“Increase efficiencies across the transport and logistics in the mining sector” (Brainstorm, Define, Design, Communicate)

In your solution, we’d also like you to consider the effectiveness of various community consultation methodologies (Public meetings, small group and one on one meetings, newspaper interviews and articles, newsletters, websites etc). Create an example of something you would use to communicate your solution to the local community.

4.0 SUSTAINABILITY & RECYCLING

CONTEXT:

Open Cut mining produces waste products. Rock and soil need to be moved to gain access to coal, metal ores and/ or other resources. Wastewater, consumable products, packaging, hazardous chemicals, and contaminated earth. This waste may be discarded inefficiently and un-environmentally.

This may create hazards, provide environmental impacts, organisational inefficiencies, product contamination, customer and community dissatisfaction and hygiene issues.

PROBLEM:

With the international price of commodities fluctuating, what may be waste today may have economic value tomorrow. Recycling for the Circular Economy is affecting many sectors across Australia and encourages industries to maximise the use of valuable resources to contribute to innovation, growth, and job creation.

Mining companies are taking to this new economic trend and are researching ways to safely capture discarded product, assess it for recycling capability and to recycle/ re-use it where practical.

TASK:

Your PRIME teams' task is to use the information supplied above, the lessons learnt during the PRIME program, and your own investigation to define a problem faced by a mine/ company and design a solution to:

"Identify a recycling or re-use of materials initiative that can be adopted by mining companies to provide an environmental or financial benefit" (Brainstorm, Define, Design, Communicate)

In your solution, we'd also like you to consider the effectiveness of various community consultation methodologies (Public meetings, small group and one on one meetings, newspaper interviews and articles, newsletters, websites etc). Create an example of something you would use to communicate your solution to the local community.

RDA HUNTER VIDEO, PHOTOGRAPHY, VIRTUAL PLATFORM RELEASE FORM

STUDENT

I _____(Student's Name) of _____ (School)

hereby authorise **RDA Hunter** and the **NSW Minerals Council** to use Publication Material (photographs, images or video recordings) of myself and in which I am included participating in PRIME for use in external and internal, promotional material (including social media) and other publications electronically or by any other means of communication.

Signature: .....

Dated: .....

PARENT/GUARDIAN

I _____ (Parent/Guardian Name) am the parent/legal guardian of the individual named; I have read this release and approve of its terms.

Parent/Guardian Signature: .....

Dated: .....

Please return to prime@rdahunter.org.au and your teacher.