THE HIDDEN POWER BEHIND MODERN LIFE – MINING & MINERALS

An Interactive STEM Activity Book for KS3 (Years 7–9)

Name: ______________________

School Name: ______________________

School Year & Class: ______________________

INTRODUCTION

Welcome to your guide through the world of mining and minerals, a world that powers your phone, builds your schools and keeps the lights on. This book will help you explore where materials come from, how they're extracted, and how you can be part of this vital global industry.

The booklet is aimed at ages 11 to 14 and collates several separate activities that helps build awareness of the importance of mining and minerals in younger minds.

This educational resource has been produced by Sharon Strugnell, a Chartered Engineer based in the UK with support from many incredible industry partners (see the back page for further details).

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Designed by the Institute of Materials, Minerals & Mining (IOM3) | www.iom3.org

ACTIVITY 1

Why does mining matter?

Scan here to learn about Mining's Role in Energy Transition
Credit: Time for Geography

What is mining?

- Mining is the process of digging into the Earth to find valuable minerals and metals like gold, silver, copper, and iron.
- These minerals and metals are used to make many things we use every day, like electronics, jewellery, and buildings.
- There are many ways we mine materials from the ground, the two main types are surface (open pit) mining and underground mining.

Where mining is done?

- Mining happens all over the world, in places where there are rich deposits of minerals and metals.
- Some countries known for mining include Australia, Canada, China, and South Africa.

Who gets involved?

- Many people are involved in mining, including geologists who find the minerals, miners who dig them up and engineers who design the mines.
- To ensure minerals and metals are mined responsibly, roles such as Sustainability Managers, Ecologists and Environmental scientists are needed.
- There are also workers who process the minerals and metals, turning them into useful products.

Why does mining matter?

- Mining is important because it provides the raw materials needed to make many products we use every day.
- It also creates jobs and supports economies in many countries.
- Mining produces materials that are essential to the green energy transition, including batteries for electric vehicles and generators in wind turbines.

How long we have been mining and how?

- People have been mining for thousands of years, starting with simple tools and methods.
- Over time, mining techniques have become more advanced, using machines and technology to dig deeper, and mine more safely to extract more minerals and metals.

Did you know?

- A typical smartphone contains over 30 different minerals, including gold, lithium, and copper.
- Every person in the UK uses over 10 tonnes of minerals per year!
- Mining is not just digging holes, it's science, technology, engineering and sustainability.
- The United Kingdom has a rich history of mining, particularly of non-ferrous minerals like copper and tin, which has been ongoing since the Bronze Age!

	TRUE	FALSE
1. All gold in the UK comes from Scotland		
2. Electric vehicles don't need mined materials		
3. Your toothpaste contains minerals		
4. Mining is only done by machines		

ACTIVITY 2

From rock to reality

What is a mineral?
A mineral is a natural, non-living substance found in the Earth that has its own unique shape and makeup.

What is Chrysopase?
Chrysoprase is a bright green, gemstone-quality mineral made from a type of quartz coloured by small amounts of nickel.

Let's Learn about the key stages of mineral and material extraction... Read the descriptions and then put them in the correct order below.

Hint: we don't rush in and start digging up the ground!

Are you able to name at least one job associated which each phase:
We have helped you out a little!

Stage 1: → Typical job roles: Geologist

Stage 2: → Typical job roles:

Stage 3: → Typical job roles:

Stage 4: → Typical job roles:

Stage 5: → Typical job roles:

Stage 6: → Typical job roles:

Stage 7: → Typical job roles:

ACTIVITY 3

Word search

Find the hidden mining words in the grid below. Words can go in any direction... forward, down or diagonal!

W	A	K	V	O	Q	A	H	N	S	Y	U	X	Z	G
K	R	W	H	D	R	Z	F	G	C	Q	R	C	O	E
C	W	W	F	N	L	D	S	L	S	F	N	Q	B	L
J	L	Z	F	N	S	Q	A	X	I	Z	F	D	U	T
Z	B	S	V	J	H	T	F	W	L	M	M	I	N	E
K	V	E	E	I	A	V	E	W	V	N	F	G	P	C
O	M	W	U	Y	F	N	T	Z	E	Y	P	C	M	O
N	Q	X	A	H	T	Z	Y	F	R	U	W	B	I	P
T	U	N	N	E	L	M	E	U	A	T	H	J	N	P
H	T	U	P	Q	U	A	R	R	Y	K	R	F	E	E
E	D	Y	O	X	S	O	E	R	D	G	O	U	R	R
L	S	S	R	V	N	Z	R	G	R	R	Z	H	C	W
M	Z	M	E	I	G	S	X	O	O	G	I	V	J	K
E	T	Z	M	B	L	A	S	T	C	L	N	L	B	T
T	J	O	L	T	U	D	M	R	H	K	D	Y	L	W

MINE	DRILL	MINER	COPPER	ROCK
ORE	TRUCK	GOLD	SAFETY	QUARRY
SHAFT	HELMET	SILVER	TUNNEL	BLAST

ACTIVITY 4

Responsible mining

The aim of this activity is to learn about the positive and negative impacts of mining projects and understand sustainability challenges.

Read the short descriptions of 4 different potential mining projects below and get into groups and both discuss and document (using a separate piece of paper) which one you think would be best to start based on environmental and social (sustainability) differences.

Why not rank them in order of which would be more preferable?

1. BRAZIL (Underground)

An underground mine in a remote part of the Amazon rainforest. Think about:

- What are the potential effects on rainforest ecosystems and local tribes?
- What are the benefits of using electric trucks and underground mining?

2. SWEDEN (Open Pit)

A proposed open pit mine near a small town in northern Sweden. Think about:

- How might noise, dust, and protests from local people influence the project?
- What makes this project important for future green technologies?

3. MADAGASCAR (Open Pit)

A large open pit mine planned in a rainforest region with limited infrastructure. Think about:

- How might new roads and power plants affect the local environment?
- What could the project do to reduce greenhouse gas emissions?

4. CHINA (Underground)

A new underground mine near existing operations and renewable-energy power. Think about:

- How could mining increase pressure on already-polluted rivers?
- How might the local workforce and existing infrastructure be advantages?

ACTIVITY 5

What is geochemistry?

Geochemistry is the science that studies what the Earth is made of and how rocks and soil are formed from mixtures of different elements and minerals. In mining, Geochemists look for special clues in the ground that can help find minerals and metals hidden beneath the surface. They analyze the rocks to understand whether they might be harmful to the environment if they are mined. By studying samples from the Earth, they can tell where valuable resources might be and how they formed millions of years ago.

Use the clues to identify the primary element in each mineral from the periodic table.
(scan the QR code above or visit periodic-table.rsc.org)

5.1 BAUXITE
My atomic number is 13.

5.2 CHALCOPYRITE
I am in the same group in the periodic table as silver and gold, but my chemical symbol is NOT Rg.

5.3 GALENA
I am in group 14 of the periodic table, and my atomic weight is 207.2.

5.4 SPODUMENE
My chemical symbol is Li.

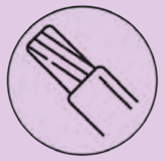
5.5 URANINITE
I am part of the actinide series, and my chemical symbol is just one letter.

Match the primary elements above to the following uses below...

5.6 Lead weight

5.7 Nuclear power

5.8 Batteries



5.9 Copper wire

5.10 Drinks cans

Pyrite is the most common example of a sulfide mineral. Its chemical formula is FeS_2.

5.11 Use the periodic table to identify which elements I am made of:

Mining exposes sulfide minerals to air and water, causing slufide oxidation.

5.12 What is the chemical formula for oxygen:

5.13 What is the chemical formula for water:

When objects like nails are exposed to air and water they can oxidize.

5.14 Do you know the common name for this?

Sometimes when sulfides oxidize near mines, they release acidity and metals, and can pollute nearby waters.

5.15 What problems might this pollution cause?

Mines today must manage the waste rock and treat the mine water to prevent pollution.

5.16 Can you think of ways they might do this?

TRUE OR FALSE?

5.17 Sulfide oxidation happens only when there is no air

5.18 Rust is an example of oxidation

5.19 Sulfide minerals can turn water acidic

5.20 Water helps sulfide oxidation happen

ACTIVITY 6

You're about to become a geology detective!

Across the UK, people have mined rocks, minerals and fuels for thousands of years.
Each riddle below gives you clues about one of these important resources.
Use what you know about geology and a little detective work to solve the puzzle!

TASK 1: Match the riddles to the minerals

1. Read each riddle carefully
2. Decide which mineral or resource it describes out of the following: Slate, Halite (Rock Salt), Copper, Crude Oil (Petroleum), Gypsum, Coal
3. Match the riddle to the mineral

TASK 2: Mark the locations on your map

1. Look at your UK geology map →
2. Think about where each resource might be found, for example: *Coal often comes from Carboniferous rocks (in parts of Yorkshire, Wales, and the Midlands)*
3. Mark or shade the regions where each resource occurs
4. Label them clearly using the mineral name

	RIDDLE	CLUE/REFERENCE	NAME THE MINERAL
1	*In forests of ferns, before people's day,* *I formed in mud where dead plants lay.* *Pressed for ages, I turned to black stone,* *I powered factories, trains, and homes.*	Carboniferous Period	
2	*From ocean mud long, long ago,* *I changed with heat and pressure's glow.* *Flat and grey, I split with grace,* *You'll see me on roofs in many a place.*	Pre-Cambrian	
3	*When molten rock cooled deep below,* *Veins of metal began to grow.* *Beneath the wilds of moorland floor,* *I help store green energy once more.*	Igneous Intrusions (Late Palaeozoic)	
4	*I formed when ancient seas ran dry,* *Before the dinosaurs roamed the sky.* *My crystals sparkle, like treasure* *I used on food and in cold weather.*	Permo-Triassic	
5	*Soft and white from seas long gone,* *I settled in rocks where red sands shone.* *Before great reptiles walked this place,* *I now build walls in every space.*	Permo-Triassic	
6	*Under the sea where plankton sleep,* *I changed to liquid, dark and deep.* *Trapped in rocks and sealed by clay,* *I fuel the world in many a way.*	Jurassic to Cretaceous	

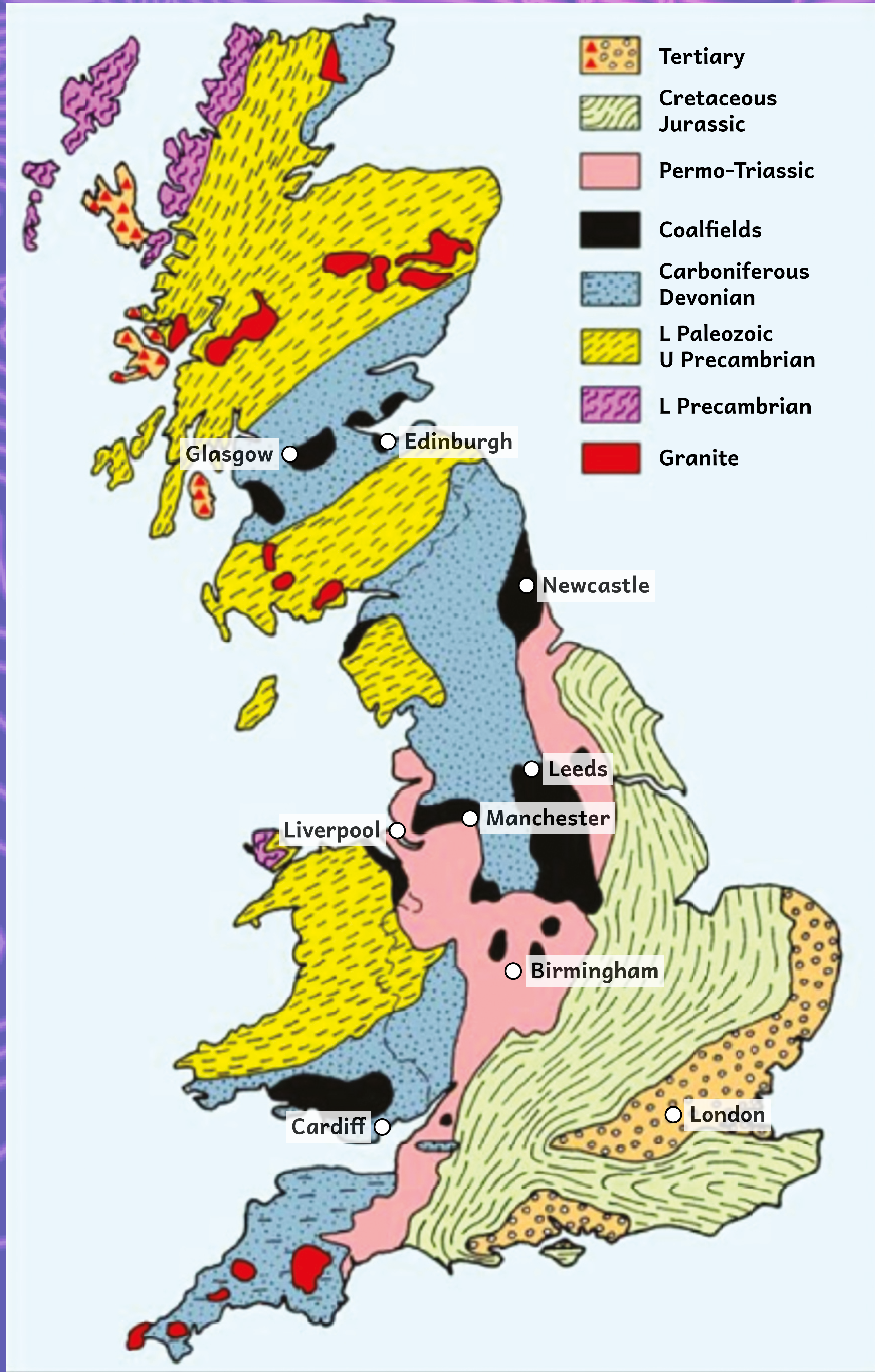


Figure 1: Image Reference: Foundations of engineering geology book by Tony Waltham.

ACTIVITY 7

Golden mountain mine – complete mining adventure!

You're managing a gold and silver mine that will operate for 15 years.
We'll start small (Years 1-3), run at full speed (Years 4-12), then slowly wind down (Years 13-15).

Some key facts and information on the project are shown in the following tables:

KEY ASSUMPTIONS TABLE

CATEGORY	PARAMETER	VALUE	REAL-WORLD COMPARISON
Materials	Ore Density	2.7 tons/m^3	Like compacted sand
	Waste Rock Density	2.5 tons/m^3	Like gravel
	Tailings Density	1.4 tons/m^3	Like wet cement
Metal Content	Gold Grade	1.5 g/ton	1 paperclip in 10 bathtubs of rock
	Silver Grade	6 g/ton	5 paperclips in 10 bathtubs of rock
Processing	Gold Recovery	90%	My process extracts nearly all the gold from the ore, but not every speck
	Silver Recovery	85%	My process for silver extraction from the ore is slightly less efficient than for gold
	Tailings Generated	99.5% of ore	Only 0.5% becomes metal
Economics	Gold Price	$60/gram	About $1,865 per ounce
	Silver Price	$0.75/gram	About $23 per ounce
Storage	Tailings Dam Capacity	6,000,000 m^3	2,400 Olympic swimming pools
	Waste Dump Capacity	12,000,000 m^3	4,800 Olympic swimming pools

15-YEAR MINING AND PROCESSING SCHEDULE TABLE

YEAR	PHASE	ORE (tons)	WASTE ROCK (tons)	GOLD (g)	SILVER (g)	TAILINGS (tons)
1	Ramp-Up	300,000	800,000	405,000	1,530,000	298,500
2	Ramp-Up	600,000	1,400,000	810,000	3,060,000	597,000
3	Ramp-Up	900,000	2,000,000	1,215,000	4,590,000	895,500
4	Steady	1,000,000	2,200,000	1,350,000	5,100,000	995,000
5	Steady	1,000,000	2,200,000	1,350,000	5,100,000	995,000
6	Steady	1,000,000	2,200,000	1,350,000	5,100,000	995,000
7	Steady	1,000,000	2,200,000	1,350,000	5,100,000	995,000
8	Steady	1,000,000	2,200,000	1,350,000	5,100,000	995,000
9	Steady	1,000,000	2,200,000	1,350,000	5,100,000	995,000
10	Steady	1,000,000	2,200,000	1,350,000	5,100,000	995,000
11	Steady	1,000,000	2,200,000	1,350,000	5,100,000	995,000
12	Steady	1,000,000	2,200,000	1,350,000	5,100,000	995,000
13	Slow Down	900,000	1,900,000	1,215,000	4,590,000	895,500
14	Slow Down	700,000	1,500,000	945,000	3,570,000	696,500
15	Slow Down	400,000	900,000	540,000	2,040,000	398,000

Are you ready to take on the Mining Maths Challenge?

1. WASTE VERSUS PRODUCT

In Year 7, what percentage of material hauled from the pit (ore + waste) actually becomes metal?

Hint: First calculate total material moved, then metal produced. Remember that only ore material goes to the processing plant for the metal to be extracted.

2. STORAGE CRISIS

2A (Waste): Using the density values, when will the waste rock dump reach capacity?

Hint: Convert tons to volume (m^3) each year and keep a running total.

2B (Tailings): Tailings are all of the sludgy ground up 'waste' left over from processing the ore. This 'tailings sludge' gets stored behind a dam in a Tailings Storage Facility (TSF). If we want the TSF to last 15 years, and there is no option to expand the TSF capacity, what's the maximum ore we could process annually?

Hint: Work backward from total capacity of the TSF (in the key assumptions table). You will need to think about converting volume (m^3) to tons.

3. MONEY MATHS

If gold prices jump to $70/gram in Year 10, how much more is that year's gold worth compared to normal prices?

Hint: Calculate difference between new and original price per gram.

4. ENVIRONMENTAL IMPACT

If each ton mined creates 0.05 tons of CO_2, what's the mine's total carbon footprint?

Hint: Multiply total tons mined by CO_2 rate.

5. METAL RECOVERY

In Year 4, how much gold and silver are lost because recovery isn't 100%?

Hint: Calculate what 100% recovery would be, then subtract actual recovery.

ACTIVITY 8

Abandoned mines assessments

The UK has a long history of mining and removing minerals from the ground, the minerals being extracted since Neolithic times (stone and flint). The impact of this historical mining cannot always be seen from the surface.

There are the old entrances to underground mines, such as shafts (vertical) and adits (horizontal), that were once used to access coal, metal ores, and other minerals. When mining operations stopped, many of these entries were simply left behind. Over time, they can become unstable, hidden by vegetation, or even built over.

Abandoned mine entries might look like harmless dips in the ground or overgrown patches of land but in not treated with care they can be extremely dangerous. Many of these old mine shafts and tunnels were never properly sealed or recorded, and over time they can become unstable or completely hidden. Here are some of the main risks:

PHYSICAL DANGERS

- **Collapse risk:** Old mine shafts can suddenly cave in, creating deep holes in the ground.
- **Unstable ground:** The land above old tunnels can sink or crack, especially after heavy rain.
- **Hidden entries:** Some mine openings are covered by thin layers of soil or vegetation, making them hard to spot.

ENVIRONMENTAL HAZARDS

- **Water pollution:** Mines can leak harmful chemicals like iron, lead, or arsenic into rivers and streams.
- **Acid mine drainage:** Rainwater reacts with minerals in the mine, creating acidic water that damages ecosystems.
- **Habitat disruption:** Wildlife and plants can be affected by changes in the landscape or water quality.

IMPACT ON PEOPLE AND PROPERTY

- **Building damage:** Homes or roads built over old mines can suffer from subsidence (sinking ground).
- **Public safety:** People and animals can fall into unmarked shafts or unstable ground.
- **Land use restrictions:** Some areas can't be developed or farmed because of the risk from old mines.

While abandoned mine entries can be hazardous if left unmanaged, many are made safe through proper care and monitoring. In the UK, organisations like the Mining Remediation Authority regularly inspect, seal, and monitor old mine sites, especially those near homes, schools, or roads. In fact, most people living near former mining areas are completely safe, thanks to modern surveying techniques and land management practices. As long as mine entries are properly recorded, maintained, or sealed, they pose little to no risk to the public.

The Mines and Quarries Act 1952 was one of the earliest comprehensive pieces of legislation requiring the keeping and submission of mine plans. This required mine owners to submit plans of or disused mines, seams, and veins to the district inspector within a prescribed period after abandonment or cessation of work. The aim was to ensure that accurate records of underground workings were preserved for safety, planning, and future mining operations.

For information on Coal Mining:
Open the Mining Remediation Authority Map Viewer using the attached QR code or enter the link below.
datamine-cauk.hub.arcgis.com
In Map Layers, tick the mine entry box.

For Non-Coal Mining:
Open up the Geo-Index website using the attached QR Code or enter the link below.
Mapapps2.bgs.ac.uk
Press the 'add data' button and find Mine Plan Extents, add these to the map. To view a map, click on the red box and in the pop up click 'see more details'.

TASK

Research your school or home and identify where are the nearest mine workings and mine entries:

What was the nearest mine or mine entry?

What was being worked? *i.e. what mineral or metal was being extracted.*

What year did they start mining?

How did this contribute to the local economy?

When did the workings end? *i.e. when did they stop mining.*

What happened to records of mine workings before 1952?

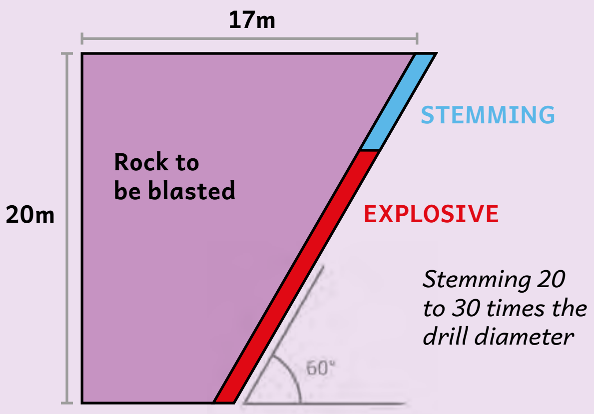
Why do you think some mine entries were never properly recorded or sealed?

What challenges might this cause for people living or working in those areas today?

ACTIVITY 9

Making big rocks into little rocks

Let's explore what 'plant' (machinery) we use in mining, and some things we need to think about when using explosive[s]. Look at this whole section to help you answer these questions.

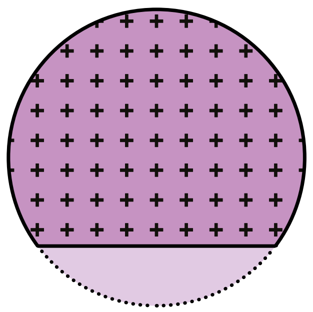


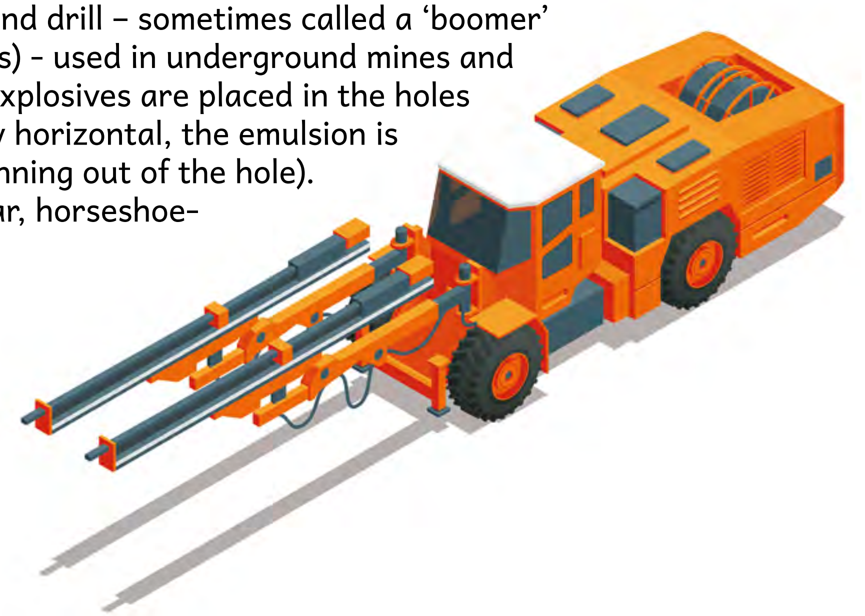
ACTIVITY A: The diagram on the right represents an area of solid rock that will be blasted. First the rock is drilledand explosives are pumped into the holes (see the red section). The part labelled 'stemming' is the plug above the explosive which stops the blast energy escaping. Look carefully at the dimensions. **If the rock section is 50m long, how much rock will be blasted?**

ACTIVITY B: The drill diameter is 0.125m (remember the stemming). **How many litres of explosive emulsion are needed?**

This is a surface, or above ground, drilling rig used to form blast holes. These are used in quarries for aggregates, and in open pits for mining for minerals. These circular blast holes are then filled with explosive. The explosive is a liquid emulsion (like paint). The blast is initiated with an electric signal.

The image on the right is an underground drill – sometimes called a 'boomer' (because it has so many booms, or arms) - used in underground mines and tunnels. As with surface blasting, the explosives are placed in the holes it has drilled, but as tunnels are usually horizontal, the emulsion is in packets (this is to avoid the liquid running out of the hole). Underground spaces are usually circular, horseshoe-shaped, or circles with flat bottoms.





ACTIVITY C: The diagram above represents an almost-circular tunnel, with a flat floor, 8m in diameter. If the blast section is 5m long, how much rock will be blasted?

Did you think about the flat bottom? We call this the tunnel invert.

ACTIVITY D: When blasting underground, where does the blast energy go?

Sketch your answer on a separate piece of paper.

ACTIVITY 10

Pitch the profession

Let's Learn about mining careers and build communication skills...

Pick one mining-related job from the following list:

- Geologist
- Safety officer
- Haul truck driver
- Environmental Scientists
- Drone Operators
- Data Analysts
- Civil Engineers
- Sustainability Officers
- Mining Lawyers
- Mining Engineer

Research what they do and present a 5-minute 'job pitch' to the class.

Don't forget to include:

- Day-to-day tasks
- Skills required
- How it helps the world
- Why you think the job would be fun and rewarding

ACTIVITY 11

Mining debate activity

You are going to engage in an exciting and thought provoking activity that will help you develop critical thinking and communication skills, which are essential in the mining industry.

In this activity, you will be divided into teams of approx. 4-6 people and each team will be assigned a topic to debate. The goal is to present well-reasoned arguments, listen to opposing viewpoints and communicate your ideas effectively. This will not only help you understand different perspectives but also enhance your ability to think critically and articulate your thoughts clearly.

INSTRUCTIONS

1. **Form Teams:** You will be divided into teams, with each team assigned one of the debate topics and whether the team are For or Against the topic (i.e. Team One: The UK Should Open More mines, Team Two: The UK should not open more mines)
2. **Research and Prepare:** Spend some time researching your topic. Gather facts, statistics, and examples to support your arguments. Think about both sides of the issue.
3. **Present Your Arguments:** Each team will have a chance to present their arguments. Make sure to speak clearly and confidently.
4. **Listen and Respond:** After each presentation, the opposing team will have the opportunity to respond with counterarguments. Listen carefully and be respectful.
5. **Open Discussion:** After the initial presentations and responses, have an open discussion where everyone can share their thoughts and ask questions.

Conclusion: Finally, summarize the key points from each debate and reflect on what you have learned.

TOPICS FOR DEBATE

Here are the topics you will be debating:

1. **Should the UK open more mines?**
   Consider the economic benefits, job creation and resource availability versus environmental impact, community disruption, and sustainability.
2. **Should deep sea mining be allowed?**
   Weigh the potential for discovering valuable minerals and metals against the possible harm to marine ecosystems and biodiversity.
3. **Should mining companies be forced to restore the land they use?**
   Debate the responsibility of mining companies to rehabilitate land and ecosystems versus the cost and feasibility of such restoration efforts.

This activity is designed to be both educational and fun. It will help you build important skills that are valuable not only in the mining industry but in many other areas of life. So, get ready to dive into the world of mining debates and let your voices be heard!

Good luck, and let's get started!

ACTIVITY 12

Mine remediation – making it a smooth journey

ACTIVITY A:

On a busy commuter rail line, some voids (holes) have appeared along the side of the railway. After investigation, an abandoned mine-working is found 10m below the track, so we need to work out the best course of action.

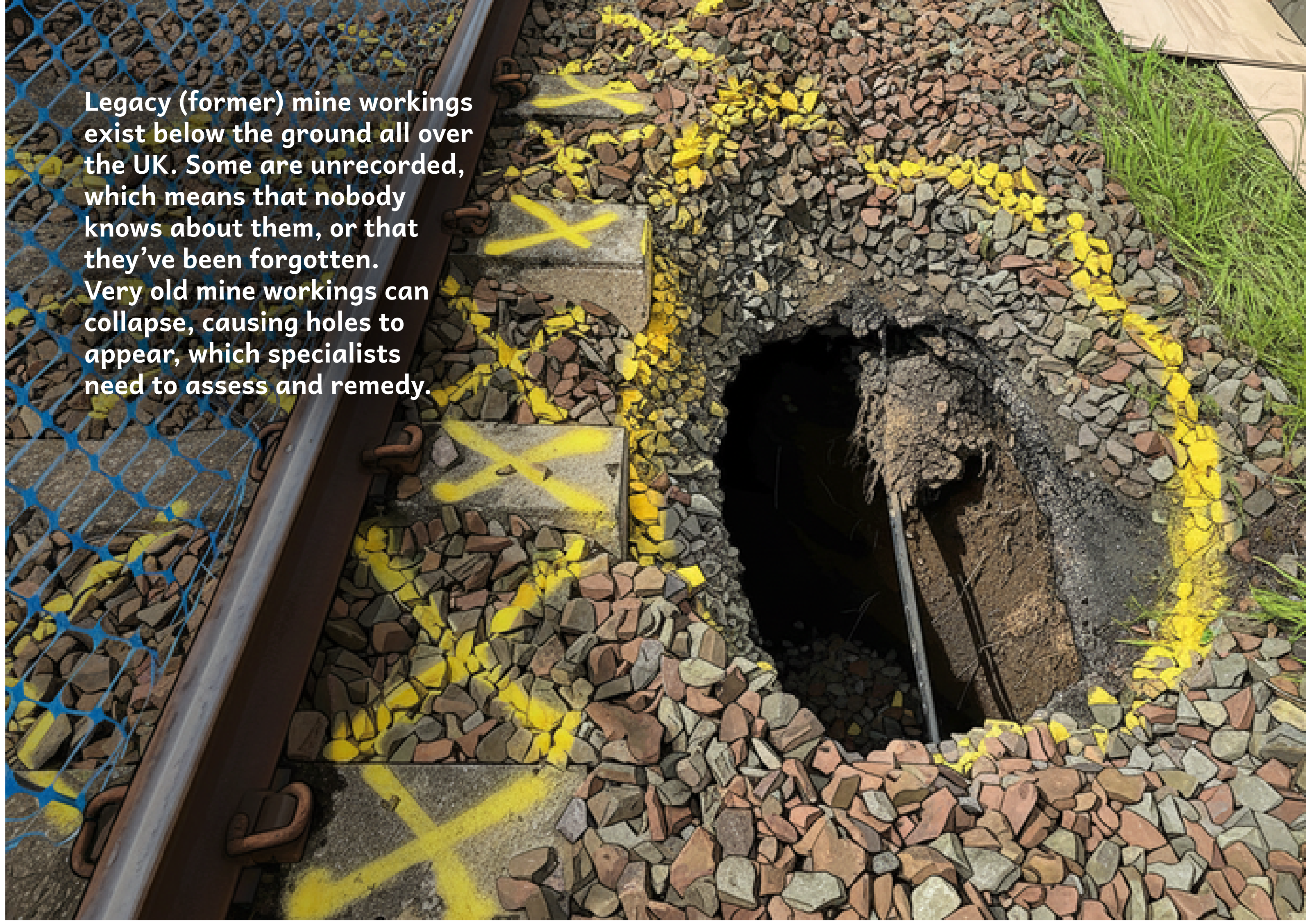
Look at the three options, list what impacts each may have on the railway, then suggest what we should do. Consider cost, timeframes and the people who rely on trains:

1. **Close the railway line entirely**

2. **Fill up the voids**

3. **Divert the railway by building new lines or move trains onto other existing lines**

Recommended option:

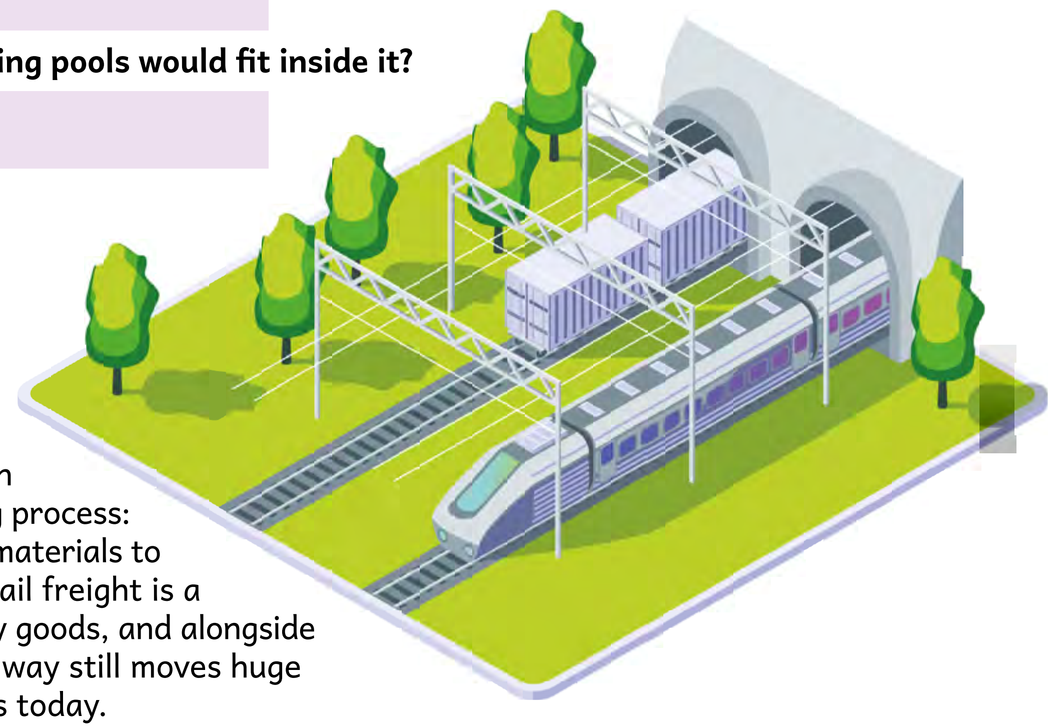


ACTIVITY B:

The void beneath the railway is 3m high, and the section of railway is 1km long. As it has 2 tracks, it is 12m wide.

How big is the void?

How many Olympic swimming pools would fit inside it?



Our railways have played an important role in the mining process: transporting 'won' (mined) materials to where they were needed. Rail freight is a good way to transport bulky goods, and alongside passenger services, the railway still moves huge amounts of mined materials today.

ACTIVITY 13

Land banking minerals

We need to ensure that, as a society, we have enough minerals for our everyday use. Minerals, such as sand and gravel, are used in the construction industry and provide vital products used to build homes, schools, hospitals, roads, and some are even used in the manufacture of food! Consequently, National planning policy indicates that all Councils in England need to have a set landbank of minerals to support its needs.

Jo works at the local Council and she needs to make sure that her County has enough minerals for the next 5 years. Minerals are measured in tonnes and are worked in quarries. Have a go at working out whether Jo has enough sand and gravel, and limestone as required by planning policy.

How many of the quarries below can you add.
Tick all the quarries that Jo will need to meet her Council's mineral needs.

SAND & GRAVEL **Jo requires 2,500 tonnes**	
Quarry 1: 2,200 tonnes	
Quarry 2: 1,250 tonnes	
Quarry 3: 760 tonnes	
Quarry 4: 500 tonnes	
Quarry 5: 750 tonnes	
Total tonnes:	

LIMESTONE **Jo requires 3,050 tonnes**	
Quarry 1: 1,525 tonnes	
Quarry 2: 2,010 tonnes	
Quarry 3: 915 tonnes	
Quarry 4: 2,700 tonnes	
Quarry 5: 610 tonnes	
Total tonnes:	

You have already chosen quarries according to the quantity of mineral they will produce, but what about their planning permissions and permits. Every quarry needs to have planning permission to extract minerals, and the working should be undertaken according to the permission. In addition to planning permission, certain quarries also require an environmental permit if they are abstracting or discharging water to a local river. An excellent health and safety record is also important.

Re-examine the quarries you have already chosen, and using the additional information below, decide which sites Jo should choose, and which ones she should no longer select.

The land banking of minerals requires an in-depth look at every quarry and an understanding of its planning, health and safety record, and whether it has the required environmental permits amongst other factors. It is vital to understand the tonnages at each quarry and which ones would be required to meet the requirements.

QUARRY 1: • Does not have planning permission • An excellent health and safety record • Does have an environmental permit	
QUARRY 2: • Does have planning permission • A poor health and safety record • Does not have an environmental permit	
QUARRY 3: • Does have planning permission • An excellent health and safety record • Does have an environmental permit	
QUARRY 4: • Does not have planning permission • An poor health and safety record • Does not have an environmental permit	
QUARRY 5: • Does have planning permission • An excellent health and safety record • Does have an environmental permit	

ACTIVITY 14

Minerals in my life, a visual journal

To help raise awareness of the role of mining in daily life, please help us by creating a "Without mining, I wouldn't have..." collage in the space below using magazine cutouts and drawings.

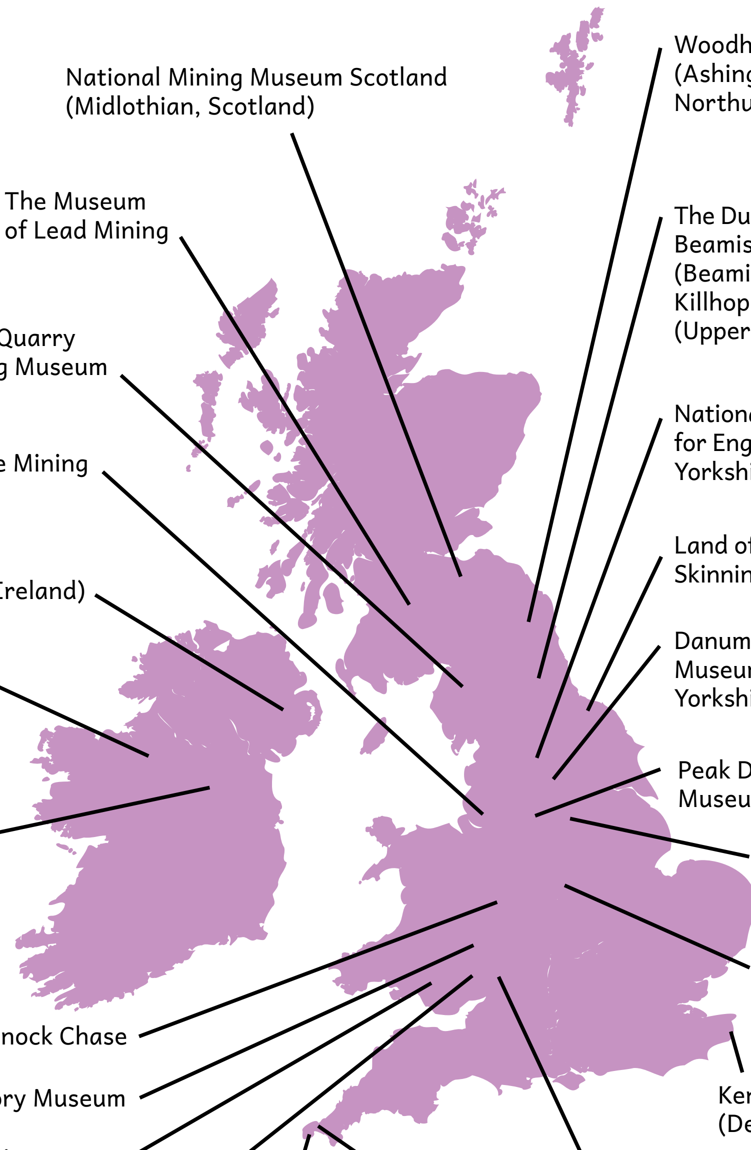
Choose one of the following themes and select several items from these areas that come from mined materials and minerals:

- **KITCHEN**
- **CLASSROOM**
- **BEDROOM**
- **BATHROOM**
- **MOTORWAY**
- **RAILWAY STATION**
- **SHOPPING CENTRE**

Where can I learn more about Mining in my area?

There are many museums and educational centres across the UK and Ireland where you can learn lots more about your local mining activities and history.

Check out the map below to see some of your nearby museums that exhibit local mining history and current practice!



ANSWERS

Lets see how you got on....

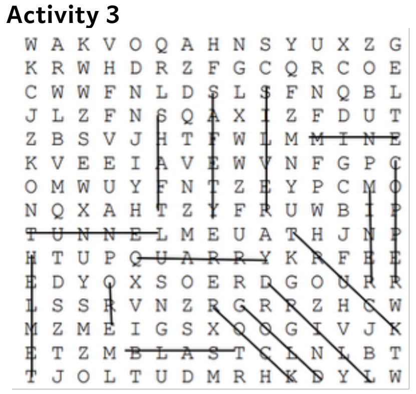
Activity 1

- False, While Scotland has some gold deposits (notably in the Highlands), gold has also been found in other parts of the UK, such as Wales and Northern Ireland.
- False, Electric vehicles rely on mined materials like lithium, cobalt, nickel, and copper for their batteries and components.
- True, Toothpaste typically contains minerals such as calcium carbonate, silica, and sometimes fluoride compounds, all of which come from mined sources.
- False, Mining involves both machines and human workers. People are needed for planning, supervision, safety, and some manual tasks, especially in smaller operations.

Activity 2

1. Exploration (Geologists)
2. Mining (Mining Engineer)
3. Processing (plant Operator)
4. Refining (Geochemist)
5. Manufacturing (Product Designer)
6. Shipping (Logistics Engineer)
7. Recycling (Site Operations Manager)

Activity 3



Activity 4

All have positives and negatives here are some to consider:

<u>Brazil (underground):</u>

- Positives: Would bring economic benefits to the local economy, helping to promote sustainable development (improving healthcare, infrastructure etc.) in a remote part of the Amazon rainforest. The company will use environmentally friendly methods of mining (such as electric trucks) and will mine underground (reducing noise and dust).
- Negatives: long distance to the UK. destruction of rainforest and habitats for endangered animals and reduce quality of drinking water. Remote nature of mine would be mean long distance to ship the material. Hot and humid environment makes working conditions difficult. There is a local indigenous tribe in the area that have lived there for 1000 years – they oppose the new mine opening.

<u>Sweden (open pit):</u>

- Positives: close to UK. Close to skilled workforce for easy access to workers. Close to electricity grid fuelled by renewable energy (hydroelectricity). The company will use environmentally friendly methods of mining (such as electric trucks). Habitats around mine are not sensitive (low biodiversity). The government says this is a strategic project because Sweden wants to build battery plants and this is a critical material.
- Negatives: open pit mining has high noise and dust impacts (close to existing town). Reindeer herders operate in area – access for reindeer across the mine site is challenging. There is a lot of opposition from local people to the mine as it is close to a town and may have many negative impacts – there have been protests.

<u>Madagascar (open pit):</u>

- Positives: would bring new jobs to a region with low employment in skilled industries. Would bring economic benefits to the local economy, helping to promote sustainable development (improving healthcare, infrastructure etc.).
- Negatives: long distance to the UK (bad for transporting materials and associated greenhouse gas emissions). Transport infrastructure is currently bad so would need to build a lot of new infrastructure to ship the materials. High level of biodiversity that may be impacted (clearing rainforest for the mine and infrastructure). Dust and noise related to mining and transport. Hot and humid environment makes working conditions difficult. No electricity grid, so plan to build oil power plant to power the mine (high greenhouse gas emissions).

<u>China (underground):</u>

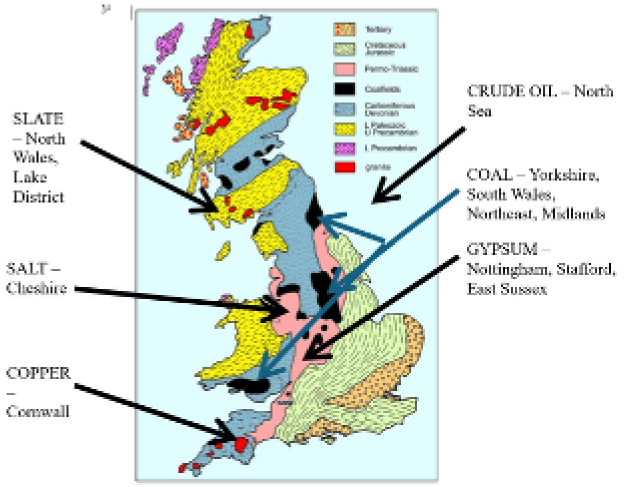
- Positives: close to existing mines with infrastructure (roads, railway). Close to skilled workforce for easy access to workers. Contribute to local economy. Close to electricity grid fuelled by renewable energy (wind and hydroelectricity). Underground mine reduces noise and dust.
- Negatives: long distance to the UK. Closed in winter due to heavy snowfall. Long working hours and difficult working conditions. Protected areas near by with endangered species. Water quality in the area is already bad and the mine will increase impacts.

Activity 5

5.1. Aluminium (Al)
5.2 Copper (Cu)
5.3 Lead (Pb)
5.4 Lithium (Li)
5.5 Uranium (U)
5.6 Lead (Pb)
5.7 Uranium (U)
5.8 Lithium (Li)
5.9 Copper (Cu)
5.10 Aluminium (Al)
5.11 Iron (Fe) and Sulfur (S)
5.12 O (chemical symbol) or O2 (molecular formula as it occurs in the atmosphere)
5.13 H2O
5.14 Rust
5.15 For example: Leaching of metals, harmful to aquatic environments, disrupts biodiversity, hazard to human health
5.16 For example: testing and monitoring waste to determine how it might cause pollution, covering and lining waste facilities to prevent water contact, segregating waste which is more harmful, putting waste back into the pit or underground, managing water with diversions to reduce contact with waste, capturing and treating polluted waters with water treatment plants or wetlands
5.17 False
5.18 True
5.19 True
5.20 True

Activity 6

1. Coal
2.Slate
3.Copper
4.Halite (Rock Salt)
5.Gypsum
6.Crude Oil



Activity 7

Answer 1: Waste vs. Product

Calculation:

1. Material moved = Ore + Waste = 1,000,000 + 2,200,000 = 3,200,000 tons
2. Gold produced (from table): 1,350,000g
3. Silver produced (from table): 5,100,000g
4. Total metal produced = 1,350,000 + 5,100,000 = 6,450,000g = 6.45 tons
5. Percentage = (6.45 ÷ 3,200,000) × 100 = 0.0002%

Answer: Only 0.0002% of what we dig up becomes metal!

Answer 2A: Waste Storage Crisis

Calculation:

1. Convert annual waste rock to m^3: 2,200,000 tons ÷ 2.5 = 880,000 m^3/year
2. Years until full = 12,000,000 ÷ 880,000 ≈ 13.6 years

Answer: The waste dump fills up in Year 14

Answer 2B: Tailings Storage Crisis

Calculation:

1. Total tailings dam capacity = 6,000,000 m^3
2. Annual allowance = 6,000,000 ÷ 15 = 400,000 m^3/year
3. Max ore = 400,000 × 1.4 ÷ 0.995 ≈ 563,000 tons/year

Answer: Could process max 563,000 tons ore annually

Answer 3: Money Maths

Calculation:

1. Gold produced in Year 10 = 1,350,000g
2. Original value = 1,350,000 × $60 = $81,000,000
3. New value = 1,350,000 × $70 = $94,500,000
4. Difference = $94,500,000 - $81,000,000 = $13,500,000

Answer: Year 10 gold is worth $13.5 million more

Answer 4: Environmental Impact

Calculation:

1. Total mined = 52,500,000 tons (adding all ore and waste over 15 years)
2. CO_2 = 52,500,000 × 0.05 = 2,625,000 tons

Answer: 2.625 million tons of CO_2 (equal to 570,000 cars for a year)

Answer 5: Metal Recovery

Calculation for Year 4:

1. Gold in ore = 1,000,000 × 1.5g = 1,500,000g
   Lost gold = 1,500,000g - 1,350,000g = 150,000g
2. Silver in ore = 1,000,000 × 6g = 6,000,000g
   Silver recovered = 6,000,000 × 0.85 = 5,100,000g
   Lost silver = 6,000,000g - 5,100,000g = 900,000g

Answer: We lose 150kg gold and 900kg silver in Year 4 alone

Activity 9

A. Split cross section into a rectangle 20 x (17 minus 'y') and a triangle ½ x 20 x 'y'
   'y' = 20m x tan 30 = 11.55m
   Area of rectangle plus triangle is
   (20 x 5.45) + (½ x 20 x 11.55)
   Area = 224.5m^2
   Volume of rock is Area x Length
   224.5 m^2 x 50m = 11,225m^3

B. Drill diameter is 125mm which is 0.125m
   Stemming is 20 to 30 times drill diameter
   So ;
   20 x 0.125 = 2.5m
   30 x 0.125 = 3.75m
   2.5m is minimum and 3.75m is maximum ; lets average so use 3.125m
   Drill hole length is 23m (20/cos30) : total explosives is 23m-3.125m = 19.875m
   So the volume of explosives is depth minus stemming times the area of the drill hole circle.
   Area of circle is πr^2 so (3.14 x (0.1252) = 0.012m^2
   19.875m x 0.012m^2 = 0.24m^3 or 240 litres

C. Tunnel is 8m diameter, Blast length is 5m
   Rock volume is area of 8m circle times length.
   Area of circle is πr^2 therefore Area is 50.3 m^2
   Volume is 50.3m^2 x 5m = 251.5m^3

D. Sketch what you think!
   Into a void in the centre of the tunnel created by an early (millisecond earlier blast) then out of the tunnel.

Activity 12

Making it a smooth journey

Activity A

Close the railway = no railway = no transport

Fill the voids = disruption to railway

Divert the railway = faster railway with straight lines & better passenger experience

Likely that the real-life solution will involve a blend of all three solutions.

Activity B

Void is 3m x 1000m x 12m

36,000m3 or 36,000,000litres

An Olympic swimming pool is around 2,500,000 litres so the answer is about 14.5

Activity 13

Sand & Gravel – 2500 tonnes required Quarries 2 , 4 and 5

Limestone – 3050 tonnes required Quarries 1 , 3 and 5

Environmental Permits at Quarries 3 and 5

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The Mining Association of the United Kingdom is the voice for the underground mining sector, representing 28 mines in all four nations across 12 different minerals.

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