



UK Critical Minerals
Intelligence Centre

CRITICAL MINERALS

KS2 teacher's notes: what are rocks, minerals and metals?



British
Geological
Survey



Department for
Business & Trade

What are rocks, minerals and metals?

Curriculum Links:

Wales	England
Science & Technology • Being curious and searching for answers is essential to understanding and predicting phenomena • Matter and the way it behaves defines our universe and shapes our lives Humanities • Our natural world is diverse and dynamic, influenced by processes and human actions • Human societies are complex and diverse, and shaped by human actions and beliefs	Science • Working scientifically • Rocks • Properties and changes of materials Geography • Locational knowledge • Place knowledge • Human and physical geography • Geographical skills and fieldwork

Learning objectives

By the end of this lesson, students should:

- know the difference between a rock, a mineral and a metal
- be able to identify where minerals are in a rock
- understand that many different household objects (and their constituent parts) are reliant on minerals
- know what critical minerals are and where they can be found

What are minerals?

Introduction

Today we are going to be looking at rocks, minerals and metals. We will be going over what they are, the differences between the three and what they can be used for in everyday objects.

To start with, we are going to watch a video [available here: <https://www.bgs.ac.uk/discovering-geology/maps-and-resources/critical-raw-materials-resources/critical-raw-materials-classroom-activities/>], which will introduce what rocks, minerals and metals are.

[Play video 'What are rocks, minerals and metals?' from start to 2:05, which can be used as an introduction and introduces Activity 1. 2:05 to 2:27 can be used as an introduction to Activity 2.]

Note: the rocks held up are granite (hard) and sandstone (soft). Filming took place at Minera Quarry, Wrexham, and Xplore Science Discovery Centre, Wrexham.

What is a rock?

A rock is a solid, naturally occurring object. Rocks are generally thought of as being hard and a big part of the Earth (which is true — the Earth is a terrestrial or rocky planet). However, many rocks have different properties: some are harder than others, some might crumble more than others, some let water through (permeable) and have spaces in them (porous) and they might have different colours and textures. For example, sandstone is generally a soft(er) rock that is both porous and permeable and is more likely to crumble than, for example, granite, which is a hard rock.

A rock is also a collection of minerals and will contain one or more different minerals within it. These minerals can be either abundant (lots) or sparse (little) within any given rock.

What is a mineral?

A mineral is a naturally forming substance that is found within rocks. Minerals are solid, inorganic and will often have a crystal structure. Minerals will be made of either a single element such as diamond (which is purely carbon (C)) or a compound of elements such as halite (sodium chloride (NaCl) or salt) or quartz (silicon dioxide (SiO₂)).

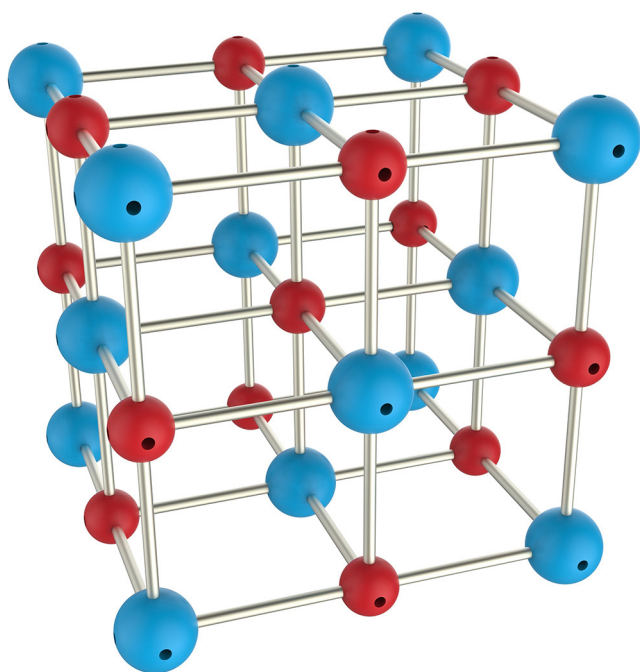


Figure 1 The crystalline structure of halite (sodium chloride (NaCl) or salt).

Minerals have their own set of properties that can be tested, such as:

- **hardness**: Moh's scale of hardness is a scale that measures a mineral's relative resistance to scratching, ranging from 1 (talc) to 10 (diamond); this can be tested to see whether they can be scratched by a variety of objects such as a fingernail (hardness 2.5), a copper coin (3) or a steel pin (5.5)
- lustre: how the mineral appears in light (metallic; vitreous (like glass); silky; dull)
- **colour**
- **streak**: the colour the mineral leaves when it is scratched on a 'streak plate' (not always the same as the mineral's colour!)
- cleavage: how the mineral splits along its planes; for example, mica has one cleavage resulting in it forming sheets
- specific gravity: the density of the mineral compared with water

Note: **bold** indicates which properties will be the most important to look at for KS2 level (can be found in lesson plan).

Minerals found within rocks can often contain metals, such as gold, copper or iron, and can be refined to extract them.

What is a metal?

A metal is a naturally forming, inorganic solid that is often found within certain minerals. Metals are often the form in which many different chemical elements naturally occur, such as gold (Au), iron (Fe) or copper (Cu).

Metals have many different properties:

- conduct heat and electricity
- often shiny
- often malleable (they can be hammered or bent into shape without breaking)
- generally have a high melting point (melts into a liquid at higher temperatures — the exception to this rule is mercury, which is liquid at room temperature)

Metals are often found in minerals and rocks as metal ores and must be mined or quarried, extracted and refined before they can be used.

Alloys are mixtures where at least one part is a metal; for example, brass is an alloy of copper and zinc.

What is the difference between a rock, a mineral and a metal?

A rock contains minerals that may contain metals. Not all rocks will contain valuable minerals or metals, while some may contain them in only non-economic quantities (amounts so small that it isn't worthwhile to mine and refine them based on how much it would cost).

What minerals do the students know?

Likely answers to the question 'Can anybody name a mineral?' or similar variations:

- copper: a metal that can often be found in different minerals such as chalcopyrite, chalcocite and malachite
- diamond: a mineral made up of pure carbon, the hardest known naturally occurring substance and a very popular gemstone
- gold: primarily found as a pure native metal, usually embedded within quartz veins or as placer stream deposits (deposited along with sand by slow-moving parts of a river) and in the minerals sylvanite and calaverite
- iron: a metal often found as an ore in the minerals haematite (also spelled as hematite) and magnetite
- quartz: an extremely common mineral found in many different types of rocks such as the igneous rock granite and the sedimentary rock sandstone
- calcite: another extremely common mineral that is found in sedimentary, igneous and metamorphic rocks

More information on these minerals.

Most of these minerals will likely be known from the game Minecraft. A full list of the minerals from Minecraft, including fictional ones created for the game, is available in Extra information (page 8).

Activity 1: chocolate minerals

[Play video 'What are rocks, minerals and metals?' from 0:47 to 1:06 as an introduction, if needed.]

Now we are going to be using what we know about rocks and minerals to try and identify the different parts of rock samples we might find. To do this, we will use chocolate bars as rocks and have a look at what is inside them. Look for features such as caramel, nougat, nuts, biscuit and marshmallow.

Suggested/optional demo

Use this as an introduction activity for what they will be looking for in the cross-sections in KS2 Worksheet 1. The aim of this is to show that a chocolate bar is made up of many ingredients, just like rocks.

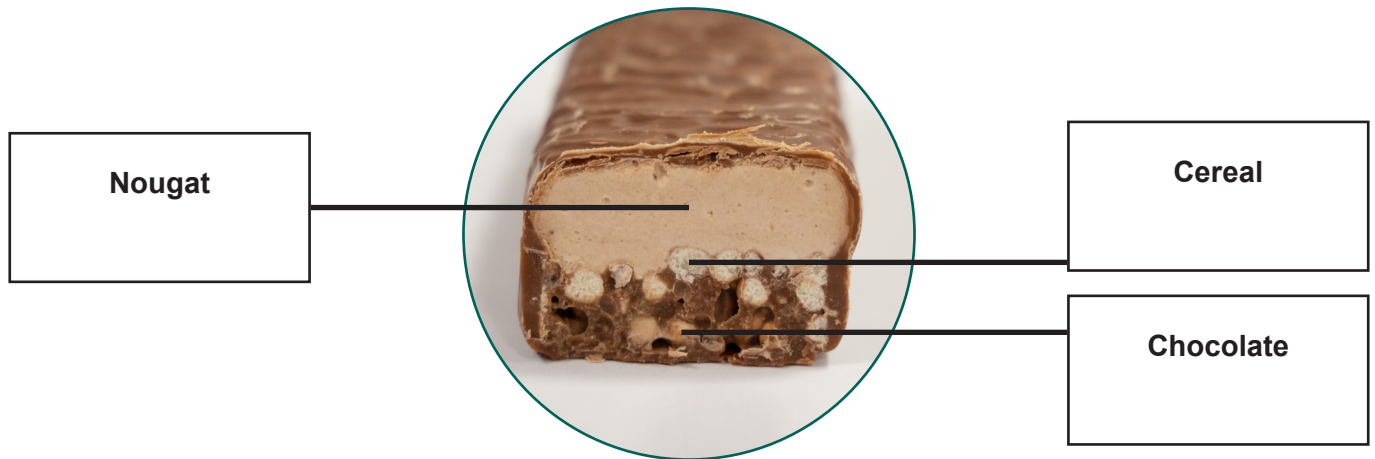
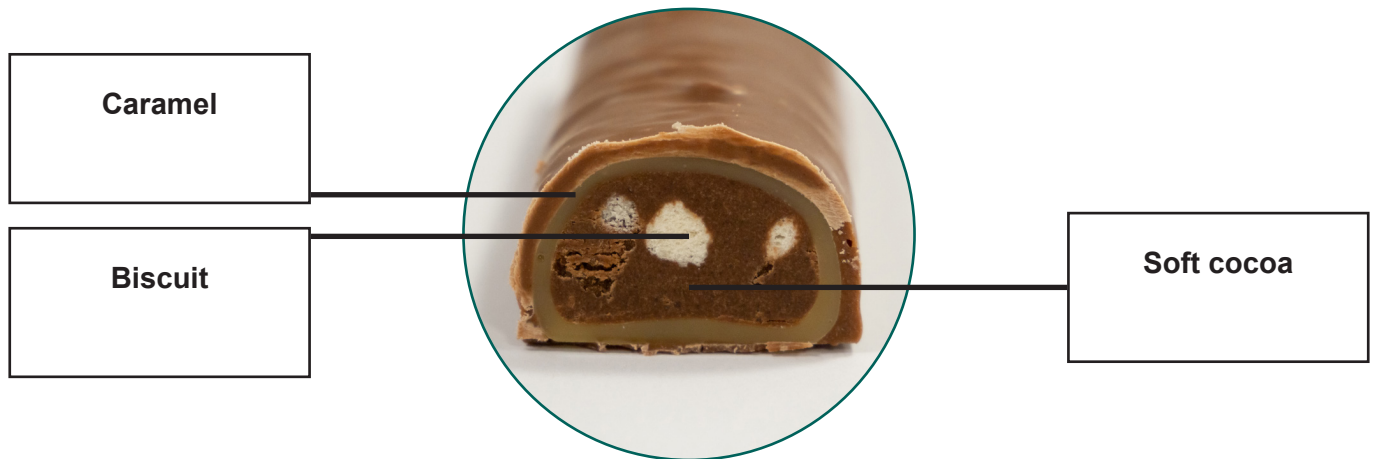
Cut into a chocolate bar to show the class a cross-section and point out the key parts inside (for example, chocolate coating; caramel; nougat; nuts; biscuit; marshmallow, etc.). This could also be done by the students in pairs or small groups.

Equipment required

- A cutting device
- Selection of chocolate Bars (Mars, Double Decker, Boost and Picnic are used in Worksheet 1)

We are going to be looking at three different chocolate bars and picking out the key parts.

Activity 1 part 1



Once completed, we will move onto doing the same with three different rocks, except we are looking for minerals within the rock itself. In this case, we are looking for the differences between the parent/ base rock and the minerals we can see within, to identify them. The minerals should be identifiable as they will have a different colour, be shinier or duller and have a distinctive shape compared to the rock around them. The rock surrounding the larger minerals is known as the matrix, which holds the minerals together, similar to cement. The matrix itself is made of smaller minerals.

To introduce the activity, show them a rock sample. Pick any full-sized rock sample from the BGS Loan Kit (if you have it) and pass it around the class, or use a sample of rock that has been found by the teacher.

Activity 1 part 2

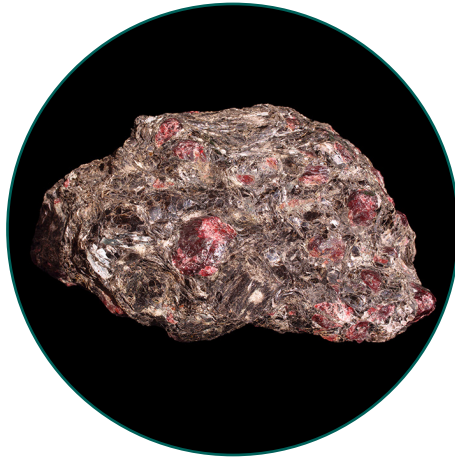
Circle where you think minerals could be in these rocks.

Students can circle any part of the rock that appears different to the base rock.

Amygdaloidal Basalt



Garnet Mica Schist

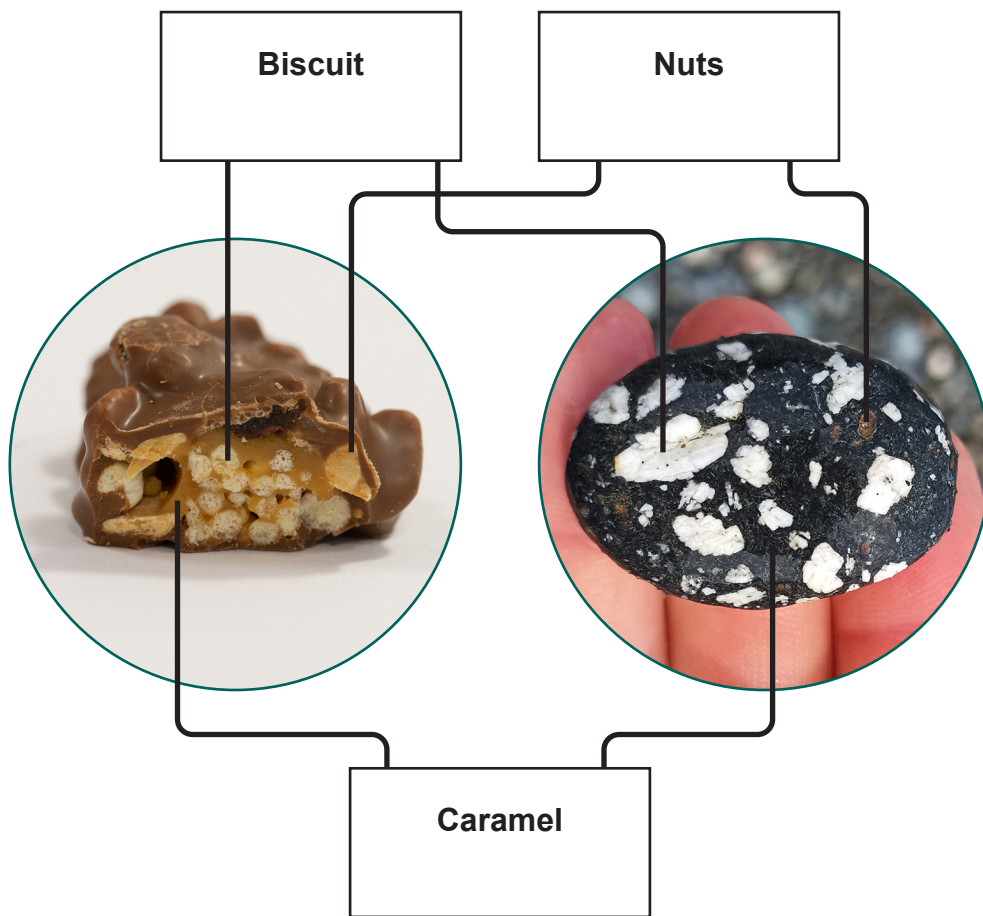


Granite



Activity 1 part 3

Once completed, bring it all together by comparing a chocolate bar (Picnic bar) to a porphyritic basalt. Students will label the diagram so they can see which parts of a chocolate bar are similar to the constituent parts of the rock.



Note: the chocolate bar pictured is a Picnic and the rock pictured is porphyritic basalt.

Activity 2: minerals treasure hunt

[Play video 'What are rocks, minerals and metals?' from 2:01 to 2:27 as an introduction if needed.]

Many of the minerals from the rocks we've analysed and the metals within them are processed and refined in order to be used in various items. These items will often have several different minerals making up different parts.

For example, in a lamp:

- copper will be used for the wiring
- quartz as part of the bulb
- tungsten as the lamp filament
- brass (copper and zinc) generally on the outside

Items such as computers rely heavily on the minerals silver and quartz, which are used in the electronics. Even towels need both sphalerite (zinc) and chromite (chromium), which are used in dyes.

[More examples of mineral use in the home.](#)

Students will have five minutes to look around the classroom and find common items that they think may have been made from minerals. Students will pick one item each; the teacher will go around the class asking what item they have picked and confirming whether it has been made from minerals.

Class discussion

Go over items that are not made from minerals and clarify whether they originate from plants or animals.

Equipment list

General classroom items, for example computers, calculators, clocks, pencils, etc. (more items in table).

Item	Origin	Additional information
Backpack	Plant	The majority of a backpack is often made from cotton; some may have zips made out metal but the primary material is the cotton
Books	Plant	Primarily made from paper, which is made from wood (trees)
Calculator	Mineral	Electronics often use silver and quartz; wiring is generally copper
Chairs (metal legs)	Mineral	Most chairs in schools will generally have a plastic seat with a metal frame and legs
Clock	Mineral	Quartz is often used for the glass as well as the timekeeping mechanism
Compasses	Mineral	A form of iron (likely steel) will be used for the edge of the compass, which keeps it in place in the paper
Computer/ laptop	Mineral	Electronics often use silver and quartz; wiring is generally copper
Glue	Animal	Bones and animal tissue are main ingredients of glue
Paper	Plant	Made from wood (trees)
Pen	Mineral	Different types of pen will include different metals but, in general, the springs and nibs are often made from galvanised iron or stainless steel, whilst the rollerball can be made from tungsten
Pencil	Mineral	Graphite is a key component of the pencil lead
Projector	Mineral	Electronics often use silver and quartz; wiring is generally copper
Ruler (metal)	Mineral	Generally made from high-carbon steel (iron) with chrome (chromium) plating. Plastic rulers are made from crude oil, which whilst sometimes classed as an economic mineral, is not a mineral like those this lesson focuses on. Oil originates from plants which have been buried over millions of years
Scissors	Mineral	The blade of the scissors is often a form of iron (likely steel)
Sharpener	Mineral	The blade of the sharpener is often a form of iron (likely steel)
Stapler	Mineral	The staples and often the body of the stapler are made from iron (likely steel)
Whiteboard	Mineral	Are generally either painted steel or have a form of steel backing or frame

Note: anything made primarily of wood, plastic, fabric, etc. count as coming from a plant or animal source, whilst anything with glass, metals or electronics can be counted as coming from a mineral source.

Extra information

In the game Minecraft, there are many real minerals and metals such iron, gold, diamond, emerald, copper and calcite as well as fictional ones like glowstone, netherite, redstone and prismarine. These can all be used when building and crafting different things in the game. For example, gold can be used to make clocks, bells and powered rails; iron can be used for compasses and copper is used for lightning rods and spyglasses. Redstone is also a popular mineral for its use in creating electrical-type mechanisms, such as the powered rail and builds that require sending a signal of some sort.

Activity 3: minerals in a lamp

A lamp has many minerals used within it: copper wiring, quartz bulb, brass (copper and nickel) casing and a tungsten filament. Different makes of lamps may include different minerals but, for our lamp, we will look at these minerals.

What is a critical mineral?

A critical mineral is either a metallic or non-metallic mineral that is essential for the production of advanced technologies like computers, mobile phones, fibre-optic cables, etc., the functioning of the economy, or national security. The supply chain of these minerals is susceptible to disruption and could potentially rely on as little as one single country or company. Each country has its own list of critical minerals, taking into account which minerals it can currently mine within its own borders and which are required for global technology leads .

Even everyday household items can contain critical minerals. For example, a lamp will contain tungsten (otherwise known as wolfram, from the mineral wolframite), which is on the UK's critical minerals list.

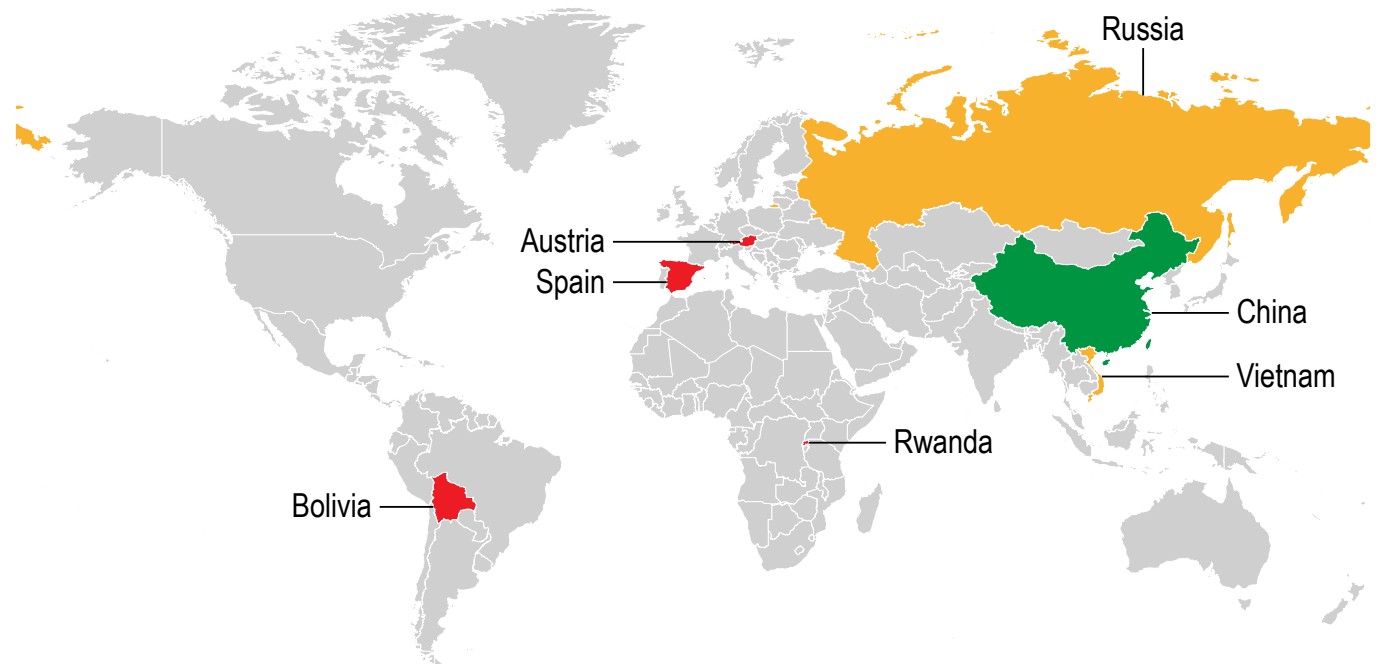
Tungsten can be sourced from a lot of countries, including the UK. However, the biggest suppliers of tungsten are China (accounting for 80 per cent of the world's tungsten), Vietnam and Russia: combined, these three countries produce 90 per cent of the world's tungsten. Bolivia, Rwanda, Austria and Spain are also large producers of tungsten, all producing more than [900 MT of tungsten in 2021](#).

Activity 4

Notes

- KS2 Worksheet 2 will include which countries should be coloured in
- KS2 Worksheet 2 will include what colour each country should be coloured (based on their production of tungsten)

Completed worksheet



Plenary

Students should now be familiar with these points.

- The differences between rocks, minerals, and metals: a rock contains minerals that may contain metals. The rock is the main solid body, made up of one of multiple minerals and sometimes containing metals. Rocks have various properties, which will determine their uses. Minerals are found and form within rocks and can be extracted for use in various items. Minerals also have their own set of testable properties such as hardness, colour and streak. Metals can be found both within rocks and minerals as metal ore and must then be extracted for use. Metals are often conductive (of heat or electricity), shiny and malleable (able to have their shape changed).
- How to identify minerals within a rock: minerals can be identified within rocks because they have characteristics that are noticeably different from the surrounding/parent rock, such as shininess, shape and colour. These characteristics often make them visually distinguishable.
- Many household and everyday items are reliant on minerals: items that are reliant on electricity will need wiring, which is often made from copper (a metal found in the mineral chalcopyrite). Items that incorporate glass will require quartz, a very common mineral. Sometimes the minerals needed do not have a high or reliable supply.
- What are critical minerals and where do we get them from: critical minerals are minerals that are key for use in emerging and advanced technologies (for example, computers, mobile phones, etc.) but also have a limited supply. For example, 80 per cent of the world's tungsten is mined in China, but tungsten is in high demand for many products. Often, the supply of a critical mineral will be limited to only a few countries. Each country will come up with its own list of what it considers critical minerals, based on what they need and what they can currently produce.

Homework

Students will be asked to find and record five items at home that contain minerals.

Items they should look for:

- use electricity or have wiring (these items will likely contain minerals such as copper and silver)
- made from metal
- have a glass component (glass is produced from quartz)
- contain minerals such as graphite in pencils
- similar items to the ones they found during the mineral treasure hunt