UK Critical Minerals Intelligence Centre

CRITICAL MINERALS

Loan kit: mineral testing guide

British Geological Survey

Department for Business & Trade

Properties

Minerals can be identified by testing a number of properties. These properties can often give unique results depending on the mineral being tested and are best used in conjunction with each other to identify the mineral. Some of these properties are more useful than others in identifying a mineral.

In this guide you will find the list of properties along with how to test them, the equipment needed, any notable results, and the expected results for the minerals included within the kit.

- **Colour** – The colour of a mineral can be useful in identifying it as some minerals come in very distinctive colours
- **Lustre** – A description of the reflective qualities of the minerals
- **Streak** – By scratching a mineral on a streak plate, a powder can be left, sometimes a different colour to that of the mineral
- **Hardness** – Minerals can be scratched by increasingly strong items to test their own hardness
- **Density** – How heavy a mineral feels based on its size
- **Acid Test** – Some minerals can react with acid, often by fizzing
- **Magnetism –** Whether or not a mineral is magnetic
- **Crystal Habit** – Some minerals can form in very distinctive shapes, however this is not universal
- **Fluorescence** - temporarily absorption of a small amount of light which is released an instant later at different wavelength.
- **Additional Properties** – Minerals will sometimes have other unique properties that help to identify them

Colour

Colour is a visual test to determine whether the mineral has an odd or unique colour. Some minerals can be colourless/ clear whilst some minerals will have a more distinctive colour. In some cases minerals can be the same, whilst having a different colour, this is usually due to impurities or trace elements found within the mineral. For example, there are many different samples of quartz which have different colours.

Equipment Needed

- Clear Quartz
- Milky Quartz
- Amethyst
- Smokey Quartz
- Rose Quartz

Instructions

1. Select a mineral to observe
2. Take note of the colour of the mineral
3. Place the mineral on the square which best describes the colour of the selected mineral

Questions

- Are all the minerals the same?
- Are the minerals the same colour?
- Can you see through the minerals?
- Which of these minerals are transparent/ translucent/ opaque?

Lustre

Lustre describes how a mineral looks in light and the reflective qualities of a mineral. The lustre of a mineral can be described as being vitreous (glassy), metallic, pearly, or dull/earthy.

Equipment Needed

- Hand lens
- Minerals; Gypsum, Haematite, Bornite (Peacock ore), Clear Quartz, Feldspar, Mica

Instructions

1. Select a mineral
2. Shine the light from the hand lens onto the mineral
3. Examine how the mineral reflects the light
4. What does the surface of the mineral remind you of?
   - Does it remind you of glass, metal, pearls, silk, or even a wet surface?
   - Does the mineral reflect the light at all?
5. Repeat the process for each mineral
6. Match the minerals to the following descriptions:
   - Glassy, Metallic, Greasy, Pearly, Silky, and Dull

Descriptions of Lustre

Glassy:	Reminiscent of broken glass The most common lustre Commonly found in non-metallic minerals (for example, it is commonly seen in quartz) Occurs in translucent and transparent minerals
Metallic:	Reminiscent of polished metal Commonly occurs in opaque minerals
Greasy:	Reminiscent of a wet or oiled surface May also feel greasy to touch
Pearly:	Reminiscent of a pearl Minerals often have a perfect cleavage Often occurs in feldspars, carbonate minerals, and some micas
Silky:	Reminiscent of silk Minerals with a fibrous structure have this lustre
Dull:	Will have a non-reflective surface Often have a rough or granular surface

Answers:

Mineral	Lustre
Bornite (Peacock ore)	Metallic
Gypsum	Silky
Clear Quartz	Glassy
Haematite	Earthy/Dull
Feldspar	Pearly
Mica	Greasy

Streak

This test looks at the colour of the minerals residual powder when scratched across a streak plate. The colour of a mineral's streak can sometimes be different to the colour a mineral is observed to be. Geologists perform a streak test to identify the mineral present, as the streak of a mineral when compared with the observed colour can begin to give possible options of what the mineral could be.

Equipment Needed

Streak Plate

Minerals: Galena, Calcite, Apatite, Haematite, Chalcopyrite

Instructions

1. Select a mineral to scratch
2. Scratch the mineral gently onto the streak plate
3. Observe the colour of the powder left behind
4. Repeat for each mineral

Questions

- Is the colour of the streak what you expected it to be?
- Did it leave a colour behind at all?
- Did the minerals steak similar colours?

Answers

Mineral	Streak Colour
Galena	Grey
Chalcopyrite	Greenish-grey
Haematite	Brownish-red
Calcite	White
Apatite	White

Hardness

Hardness tests whether a mineral can be scratched by increasingly hard items. If a mineral can be visibly scratched by an item, then it is because that mineral has a lower hardness. Hardness is measured on Moh's Scale of Hardness, which assigns a numerical value (1-10) to certain minerals and items to determine a minerals hardness.

Moh's Scale of Hardness

Mineral	Hardness	Test
Talc	1	
Gypsum	2	← Fingernail
Calcite	3	← Copper Coin
Fluorite	4	
Apatite	5	← Steel pin
Feldspar	6	
Quartz	7	
Topaz	8	
Corundum	9	
Diamond (not included)	10	

Equipment Needed

- Minerals: Clear Quartz, Calcite, Gypsum, Talc, Fluorite
- Fingernail (Hardness 2.5)
- Copper Coin (Hardness 3.5)
- Steel Pin (Hardness 5.5)

Instructions

1. Select a mineral to test and scratch the mineral (relatively gently) with your fingernail
2. Observe if the mineral has been scratched. If not, scratch it with a stronger item (copper coin, then steel pin)
3. Finally, when you think you may know what the hardness of a mineral is, test with a higher and lower value mineral from the Moh's scale bags to confirm your answer
   - If the mineral can be scratched by another, then the mineral scratched must be of lower hardness
   - If the mineral can't be scratched by another, then the mineral scratched is of greater hardness

Answers

Mineral	Hardness
Talc	1
Gypsum	2
Calcite	3
Fluorite	4
Clear Quartz	7

Density

Density is the mass of an object in relation to its volume. For example, a mineral is considered to be dense if its mass is higher than its volume- if it feels heavier than it should for its size. Density is given in units of grams per cubic centimetre (g/cm^3) and is a useful diagnostic tool. Minerals can be described as “low”, “moderate”, or “high” density.

Equipment Needed

- Minerals: Apatite, Barite, Gypsum, Talc, Galena
- Digital scales
- Calculator

Instructions

1. Handle each mineral and order them in increasing weight based on how heavy they feel
2. Check your observations by weighing each mineral on the digital scales. You may want to record the mass for each mineral. Did you estimate the order correctly?
3. Density is calculated by dividing mass by volume. Using the volume data in the table below and the data you when you measured the mass calculate the density of each mineral

Volume data table

Mineral	Mass (g)	Volume (cm^3)	Density (g/cm^3)
Apatite		12	
Gypsum		15	
Talc		10	
Barite		10	
Galena		10	

Acid Test

An Acid Test simply tests whether or not a mineral will fizz when it comes into contact with (dilute) acid. Minerals will fizz with acid based on their chemical structure.

Equipment Needed

- Minerals: Apatite, Milky Quartz, Fluorite, Barite, Calcite
- Tray (Use the lid from the kit)
- Dropper Bottle of Cider Vinegar
- Hand lens

Instructions

1. Select a mineral from the box to test
2. Add a drop of cider vinegar to the mineral using the dropper bottle
3. Observe whether the mineral reacts with the vinegar, how have they reacted (bubbles, colour change etc)?
4. Repeat the steps above for each mineral
5. Do any of the minerals fizz when the vinegar (acid) was added?

Answers

The only mineral to fizz is Calcite because its chemical structure is calcium carbonate ($CaCO_3$)

Magnetism

Magnetite is one of the main iron ores. It is attracted to a magnet and is the most magnetic of all the naturally occurring minerals on Earth.

Equipment Needed

- Minerals: Magnetite, Chalcopyrite
- Bag of small compasses

Instructions

1. Lay out the mini compasses in a 3x3 grid over an even surface
2. Slowly move the chalcopyrite over them
3. Repeat the previous step for the magnetite
4. Did you see a reaction in the compasses?

Questions

- Which mineral affected the compasses?
- Why did the mineral affect the compass?
- Repeat the activity with more compasses, do you notice anything different?
- Test other minerals in the loan it, does it have the same results?

Answers

The only mineral to affect the compass needles is magnetite. This is because magnetite has a large iron content which allows it to generate a magnetic field which will in turn orient the compasses.

Fluorescence

All minerals can reflect light. That is what makes them visible to the human eye. Some minerals have an interesting physical property known as "fluorescence." This mineral can temporarily absorb a small amount of light and an instant later release a small amount of light of a different wavelength. This change in wavelength causes a temporary colour change of the mineral. The colour change of fluorescent minerals is most spectacular when they are illuminated in darkness by ultraviolet light (which is not visible to humans) and they release visible light.

Equipment Needed

- Calcite Rhombs
- UV torch
- Dark room/area

Instructions

1. In a darkened space, shine the UV torch over the mineral. What do you notice about the mineral under UV light?
2. Test other minerals in the loan kit, do they have the same results?

Crystal Habit (shape)

Crystal Habit (Shape) is the distinctive crystal shape that the mineral has formed into, if the mineral has formed slowly enough. Every mineral has one or more distinctive crystal habits, but it is not that common, in ordinary rocks, for the shapes to be obvious. Because of this, habit isn't as useful a diagnostic feature as you may think. Some of the words used to describe crystal habit (shape) are: (hexagonal) prism, reniform (kidney shaped – like bubbles), foliated (thin sheets), radiating, tabular.

Equipment Needed

- Mica
- Hand lens

Instructions

1. Using the hand lens, examine the mica
   - Hint: Examine the mica side-on
2. Gently feel the surface of the mica

Questions

- What do you notice about the shape of the mica?
- How would you describe the structure of the mica?
  - Do any of the words given in the introduction fit the mica?
- How would you describe how the mica feels to touch?

Did you know?

Many other minerals also have distinct crystal shapes.

Such as:

- Quartz Amethyst - (hexagonal) prism
- Haematite - reniform (kidney shaped – like bubbles)
- Barite - radiating
- Feldspar - tabular

Did you know?

Some minerals have additional properties that were not covered in this guide but can still be tested for. Often these properties are unique to the mineral and can as such be used to identify them.

These additional properties include:

- Halite tastes salty.
- Sphalerite has a pale-yellow streak that gives off a sulphurous (rotten egg-like) smell.
- Talc feels soapy to the touch.
- Plagioclase feldspar commonly has striations (scratches).
- Ulexite (sometimes known as **TV rock** or **Television stone)**, has natural fibres which conduct light along their long axes by internal reflection and, although it appears translucent will display an image of whatever surface is adjacent to its other side.

Rocks with Minerals

Rocks are made up of minerals. But there are also three different types of rock: Sedimentary, Igneous, and Metamorphic. These three types are different based on how they formed. Sedimentary rocks formed by accumulation or deposition of minerals at the surface. Igneous rocks are formed from the cooling of magma or lava. Metamorphic rocks are formed under intense heat and pressure within the Earth and often result in flowing patterns or bands.

There are 6 different rocks with minerals in this box. Use a hand lens and digital microscope to examine each rock and determine what characteristics they have as well as any minerals you might be able to identify.

Igneous Extrusive (Basalt) • Do you notice any holes in this rock? • Are any of the holes filled in? • Can you spot any different minerals?	**Metamorphic (Gneiss)** • What colours do you see in the rock? • Do you notice any patterns in the rock? • Does the rock have any reflective qualities?	**Sedimentary (Pudding Stone)** • Are there any large clasts in the rock? • What do they remind you of? • Are they round or sharp? • How are the clasts held together? • Are there any spaces where the clasts might have once been?
Igneous Intrusive (Granite) • What colours do you see in the rock? How many minerals do you think there are in the rock? • Can you identify any of the minerals in the rock? • Are any of these minerals larger than the others?	**Metamorphic (Garnet Mica schist)** • Are there any larger minerals in the rock? What colour are these minerals? • Are there any spaces where the minerals might have once been? • Does the rock have any reflective qualities? • What colours do you see in the rock?	**Ore rock (Galena ore)** • How would you describe the weight of the rock? • What colours do you see in the rock? • How many minerals do you see in the rock? Can you identify any of the minerals in the rock?