

Be a mineral expert - I

Beginning to identify minerals – introducing colour, habit, lustre, cleavage

1. Spotting mineral differences

Seat the pupils in groups of four or five. Give each group a set of about five different minerals (as suggested in the resource list and shown below). Try to use the same minerals for all the groups. Ask pupils to suggest as many ways as they can in which the minerals differ from one another, and to write down their findings. They may handle all the specimens carefully, as well as making visual observations.

When the pupils have reported their findings, tell them that we are going to begin to identify the minerals using only those properties that we can **see**. Another Earthlearningidea activity will use tests which involve **handling** the specimens.



1. A pupil set of five 'unknown' minerals

2. The circus: using properties you can see on some known minerals

Ask pupils to visit a 'circus' of four sites in turn, to find out how to use the mineral properties of colour; crystal habit; lustre and cleavage as a means of identification. Each circus site has a description card (see below), and mineral specimens, as suggested in the resource list. Answers are given on the back of each card. You may first wish to demonstrate mineral cleavage, if you have enough expendable samples to cleave one by hitting it.

3. Identifying minerals: using properties you can see on the unknown minerals

Pupils then return to their original sets of minerals. Issue the table of properties and ask them to identify their samples, solely on the basis of the tests they have just observed. How confident do they feel about their identifications without further testing?

Cards for use with 'circus' of mineral tests

Colour

These specimens are all the same mineral.

Write down the different colours of this mineral.
Write down which other properties of the minerals might tell you that they are all the same.

Some suggestions are on the back of this card.

Colour answers

The minerals are all the same, so they probably have the same:
hardness,
lustre ("shininess"),
crystal habit (shape),
density.



2. Colour: Quartz crystals, showing five different colours

Crystal habit (shape and proportions of the crystal).
Note: All these crystals have been formed naturally and have not been cut in any way. Please don't scratch them.

Draw one or more of the crystals.
 They include: quartz, pyrite, gypsum

Descriptions are on the back

Crystal habit descriptions

Quartz - well-formed prismatic crystal
 Pyrite - cubic, twinned
 Gypsum - tabular



3. Crystal Habit: well-formed crystals of pyrite, quartz and gypsum

Lustre - the way in which the minerals reflect the light.
 Match the descriptions to the minerals (jumbled here)

Lustre	Mineral
metallic	quartz
glassy (vitreous)	limonite
dull	gypsum
silky	galena

Answers on the back – don't cheat!

Lustre answers

metallic	galena
glassy	quartz
dull	limonite
silky	gypsum

Note: Diamond is especially valuable because of its very bright "adamantine" lustre, which makes it sparkle in the light. (You were not given a diamond in this set!)



4. Lustre: galena, gypsum, quartz and limonite

Cleavage – the regular way in which some minerals break

Your teacher will break a mineral with a hammer (Eye protection)

Draw one of the fragments.

Look at some tiny pieces through a hand lens. How does their shape compare with the bigger pieces? The regular surfaces you can see are called **cleavage planes**. We don't have to damage a specimen – you can see lines in it where it would cleave if it were to be hit.

Answers on the back

Cleavage answers

If your teacher was using calcite, the cleavage fragments form rhombohedra. (These look like squashed cubes).

The photo shows two really good "dog-tooth" crystals of calcite, with some cleavage rhombs lying in front of them.



5. Cleavage: well-formed 'dog-tooth' crystals of calcite (top) with cleaved fragments of calcite (bottom)
 (All photos: Peter Kennett)

Table of properties of some common minerals

Property	Mineral				
	Calcite	Fluorite	Barite	Galena	Sphalerite
Colour	white, pink, colourless	blue, yellow, green, colourless	white, pink	dark grey	black to brown
Habit	"dog-tooth": more often rhomb-shaped cleaved fragments	cubic	"layered" or "cockscomb"	cubic	good shapes are rare
Lustre	glassy	glassy	glassy to dull	metallic	metallic to glassy
Cleavage	rhombohedral	octahedral	two planes at right angles	cubic	several planes

The back up

Title: Be a mineral expert - I

Subtitle: Beginning to identify minerals – introducing colour, habit, lustre, cleavage

Topic: Using simple visual tests to identify a set of 'unknown' minerals.

Age range of pupils: 11 - 18 years

Time needed to complete activity: 30 minutes

Pupil learning outcomes: Pupils can:

- observe minerals carefully;
- establish patterns in properties of minerals;
- apply the results of observations on known specimens to the identification of unknown ones;
- appreciate that they need more evidence before they can be sure of an identification.

Context: This series of activities on minerals can be used in a variety of lessons, ranging from the nature of minerals as the 'building blocks' of rocks to the origins and recycling of useful elements in the Earth.

Following up the activity: The Earthlearningidea activity "Be a mineral expert 2 - Identifying minerals using 'action' tests – streak, density, hardness, acid test" should be used as an immediate sequel to this activity, either in the same lesson, or in the next one or both Earthlearningideas can be put together to form a circus of eight activities. "Be a mineral expert 3 – The mineral foundations of everyday life" and "Be a mineral expert 4 - recycle your mobile phone" will enlarge pupils' awareness of the sources of materials from minerals and will introduce them to the concept of recycling valuable components of a mobile phone, which originate from minerals.

Underlying principles:

- A mineral is a naturally occurring inorganic substance with a definite chemical composition, a definite atomic structure and physical properties which vary within known

limits. Minerals are mostly compounds, although native elements such as copper and silver do occur as minerals. This geologist's definition excludes 'minerals' as used in the 'mineral wealth' of a country, e.g. coal or oil; the ions in mineral water; the 'minerals' found in foods such as cereals, etc.

- Common minerals may be readily identified with the use of the senses, or by applying simple tests.
- Most minerals are crystalline and may exhibit good crystal faces, and/or good cleavage faces.

Thinking skill development:

Pupils build up a cognitive pattern as they work through their minerals. Some specimens may bring up a cognitive conflict. Applying their skills to other samples of unknown minerals is a bridging skill.

Resource list:

- enough pupil sets for the whole class of 'unknown' minerals, e.g. calcite, fluorite, barite, galena, sphalerite, as in Photograph 1, or any other common minerals which are available in good numbers
- one set of minerals for 'colour'. These should be samples of the **same** mineral, occurring in several different colours, e.g. quartz varieties – colourless; yellow = citrine; pink = rose quartz; purple = amethyst; green = prasiolite)
- one set of minerals for 'crystal habit'- one or more examples of any well-formed crystal with natural faces, e.g. quartz, gypsum, pyrite
- one set of minerals for 'lustre', e.g. galena = metallic; gypsum (satin spar variety) = silky; quartz = vitreous (glassy); limonite = dull
- one set of minerals for 'cleavage' - any minerals where cleavage planes can be seen within the crystal. Pupils will not be allowed to break the samples, but merely to observe them.
- trays to hold the minerals
- description cards for each point in the 'circus', folded and glued, to bring 'answers' to the back of the card

- a copy of the Table of properties of minerals per small group
- (Optional) expendable sample of a mineral with good cleavage, e.g. calcite; a small hammer and eye protection, if you intend to demonstrate cleavage
- For those who wish to examine more examples, a data sheet of the properties of some common minerals is given in the Appendix, page 4.

See the E-library of the National Science Learning Centre for a full version of “Groundwork”, including these activities - <http://www.nationalstemcentre.org.uk/elibrary/collection/236/science-of-the-earth-11-14>

Source: Originally devised by Peter Kennett and published by the Earth Science Teachers’ Association in a teaching pack titled “Groundwork – Introducing Earth Science”, Geo Supplies Ltd. Sheffield, 1990.

Useful links: www.earthlearningidea.com “Found in the ground: sorted!”

The progression of thinking skills shown by the Earthlearningidea Mineral Expert activities

Earthlearningidea	Strategies and skills developed
Be a mineral expert – 1: Beginning to identify minerals – introducing colour, habit, lustre, cleavage	Observational skills are used to begin to identify minerals.
Be a mineral expert – 2: Identifying minerals using ‘action’ tests – streak, density, hardness, acid test	Tests involving motor skills are added to purely visual ones, leading to an understanding of the need for more data to be sure of an identification.
Be a mineral expert – 3: The mineral foundations of everyday life	A much wider range of minerals is introduced, together with their chemical compositions, involving higher level thinking skills to match them to their uses in the real world.
Be a mineral expert 4 – Recycle your mobile phone: Why <u>should</u> I recycle my mobile (cell) phone?	An introduction to responsible citizenship, widening the scope from the purely scientific to a mature understanding of the need for recycling scarce materials.

Appendix

Common Mineral Data Sheet for ELI activities

Name	Cleavage/Fracture	Hardness	Relative Density	Streak	Lustre	Colour	Other diagnostic properties
Quartz	RF *none/conchoidal	7	2.65	scratches streak plate	vitreous	colourless, milky but variable	hexagonal prisms terminated by pyramids
Orthoclase Feldspar	RF *2 good, 90	*6	2.6	scratches streak plate	vitreous	pink, white	
Plagioclase Feldspar	RF *2 good, 90	*6	2.7	scratches streak plate	vitreous	creamy-white, grey, colourless	
Muscovite Mica	RF *1 perfect (basal)	*2.5	2.7-3.1	white	pearly	colourless or pale yellow, green or brown	*flaky
Biotite Mica	RF *1 perfect (basal)	*2.5-3	2.7-3.1	white	pearly	brown/black	*flaky
Hornblende	RF *2 good, 60/120	*5-6	3.0-3.5	scratches streak plate	vitreous	black, dark green	prismatic crystals
Augite	RF *2 good, 90	*5-6	3.2-3.5	scratches streak plate	vitreous	greenish-black	prismatic crystals
Olivine	RF none/conchoidal	*6-7	3.2-4.3	scratches streak plate	vitreous	*olive green	
Chialstolite/ Andalusite	poor 1/ uneven fracture	7.5	3.1-3.3	scratches streak plate	vitreous	pearly grey/pink	needle crystals with square x-sections, black centre
Garnet	none	*6.5-7.5	3.5-4.3	scratches streak plate	vitreous	red/brown	*12-sided crystals - each face rhomb shaped
Calcite	RF *3 good, not at 90, perfect rhombs	*3	2.71	white	vitreous	colourless, white, tints	*effervesces with 0.5M HCl, rhombic shape
Fluorite	*4 good, parallel to octahedron	*4	3.0-3.2	white	vitreous	colourless purple/green/yellow	fluoresces in uv light, cubic or octahedral crystals
Halite	3 good, 90 cubic	*2.5	2.2	white	vitreous	colourless, white, often stained	*salty taste cubic crystals, often stained
Gypsum	1 good (basal)	*1.5-2	2.3	white	silky, pearly	colourless, white, often stained	fibrous
Barite	2 good, 90	*3-3.5	*4.5	white	vitreous, pearly	white, pink	bladed crystals
Chalcopyrite	poor/conchoidal	4	4.2	*black	metallic	bronze yellow	*tarnished to peacock colours
Pyrite	none/conchoidal	*6	5.0	*greenish-black	metallic	brass yellow	crystals often striated cubes
Galena	*3 good, 90 cubic	*2.5	*7.5	*lead grey	metallic	lead grey	cubic crystals
Haematite	poor/subconchoidal	*5.5-6.5	4.9-5.3	*cherry red	metallic-dull	red/black/steel grey	kidney shaped masses, fibrous

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* – Useful property for diagnosis RF – Common rock-forming mineral

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