

Be a mineral expert - 2

Identifying minerals using 'action' tests - streak, density, hardness, acid test

This activity is an extension of 'Be a mineral expert -1: Beginning to identify minerals - introducing colour, habit, lustre, cleavage'.

In that activity, under the heading of:

1. Spotting mineral differences, pupils were asked to suggest as many ways as they could in which a set of 'unknown' minerals differed from one another, and to begin to identify them using only those properties that they could **see**. They were introduced to the properties of colour, habit, lustre and cleavage, by means of a 'circus' of separate mineral specimens. The set of specimens is shown in the photograph below. This same set should also be supplied to small groups of pupils for this activity, 'Be a mineral expert - 2'.



A pupil set of five 'unknown' minerals

Having carried out the visual tests as outlined above, introduce pupils to the following 'action' tests, which involve actively handling the mineral specimens.

2. The circus: using 'action' tests on some known minerals

Lay out the tests in a 'circus' as before and ask pupils to visit each of the four sites in turn, to find out how to use the mineral properties of streak, density, hardness and their reaction to acid as a means of identification. Each circus site has a description card (see below), and a set of mineral specimens, as suggested in the resource list. Answers are given on the back of each card.

3. Identifying minerals: using 'action' tests on the unknown minerals

When pupils have carried out the tests in the 'circus', they should return to their places and apply the tests to the 'unknown' minerals as shown in the photograph. They should then look up the properties of some minerals given on the chart below, to see if they can identify them as a result of **all** their testing.

Cards for use with 'circus' of mineral tests

Streak - specimens are opaque i.e. you cannot see into them or through them making it difficult to tell their true colour. The streak test gives a powdered sample, which may show the colour better.

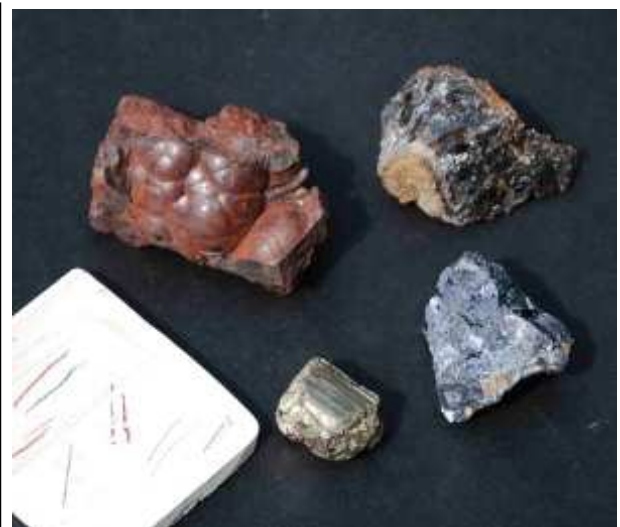
- make a short mark with the mineral on the unglazed side of the tile.
- note the colour of the streak and whether it is a thick or a thin line.

Answers on the back

Streak answers

galena	thick grey
sphalerite	pale brown or off-white
haematite	brownish-red
pyrite	thin greenish-grey

Is this what you found?



Streak: haematite, sphalerite, galena and pyrite with a streak plate





Density - weight of something in relation to its volume, e.g. a piece of lead weighs more than a piece of wood of the same size.

- pick up each specimen in turn
- order them in increasing density.

The minerals are: galena quartz
 gypsum barite

Answers on the back

Density answers

The order of relative density, RD (water has a density of 1)

- gypsum (RD = 2.0) - least dense
- quartz (RD = 2.5)
- barite (RD = 4.5)
- galena (RD = 7.5) - most dense



Density: galena, quartz, gypsum and barite



Hardness - using Mohs' Scale

Use the steel nail, the coin and your fingernails to try to make a short scratch on the specimens.

Answers on the back

Hardness answers

- gypsum 2
- calcite 3
- fluorite 4 *you have to press hard to mark it with the steel nail*
- quartz 7 *all you can say is that it is harder than 5*



Hardness: fluorite, calcite, gypsum, quartz with a steel nail and a 'copper' coin

Mohs' Scale of mineral hardness

Each mineral in the Scale will scratch all the minerals below it in the list but cannot be scratched by them.

- 10 diamond
- 9 corundum
- 8 topaz
- 7 quartz 7+will scratch glass
- 6 feldspar
- 5 apatite steel needle scratches 5 & below
- 4 fluorite
- 3 calcite 'copper' coin scratches 3 & below
- 2 gypsum fingernail scratches 2 & below
- 1 talc



Acid test - use very weak hydrochloric acid, wear eye protection and wash off any spills.
 Minerals which contain any carbonates will fizz when dilute acid is added.

- put one drop only of acid onto each specimen in turn, to find which one(s) contain a carbonate.
- dry off the acid with a paper towel.

Answers on the back

Acid test answers

There is only one carbonate mineral in this set.
 It is calcite - CaCO_3



Acid test: gypsum, fluorite, calcite, barite and a dropper bottle of dilute hydrochloric acid

All photos: Peter Kennett



Table of properties of some common minerals

Property	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	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
Streak	white	white	white	dark grey	pale brown or off-white
Relative Density	quite low 2.7	moderate 4.2	surprisingly dense for a pale mineral - 4.4	very dense 7.5	moderate 4.0
Hardness	3	4	3.5	2.5	3.5
Acid test	fizzes violently	nil	nil	DO NOT TEST gives off hydrogen sulphide	nil

The back up

Title: Be a mineral expert - 2

Subtitle: Identifying minerals using 'action' tests - streak, density, hardness, acid test

Topic: Using simple practical tests to enhance the identification of a set of 'unknown' minerals, which have previously only been observed visually.

Age range of pupils: 11 - 18 years

Time needed to complete activity: 30 minutes

Pupil learning outcomes: Pupils can:

- observe minerals carefully;
- carry out simple tests
- establish patterns in properties of minerals;
- apply the results of observations and tests on

known specimens to the identification of unknown ones.

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. The circus activity can be put together with the circus activity of the 'Be a mineral expert - 1' Earthlearningidea to make a circus of eight activities.

Following up the activity: '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 'streak', e.g. haematite, sphalerite, galena and pyrite, together with a streak plate (unglazed tile)
- one set of minerals for 'density', e.g. galena, quartz, gypsum, barite
- one set of minerals for 'hardness', e.g. fluorite, calcite, gypsum, quartz, together with a steel nail and a 'copper' coin
- one set of minerals for 'acid test': gypsum, fluorite, calcite, barite, together with a dropper bottle of dilute (0.5M) hydrochloric acid and a paper towel
- eye protection
- 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.

Useful links: www.earthlearningidea.com 'Found in the ground: sorted!' and 'Be a mineral expert - 1: Beginning to identify minerals - introducing colour, habit, lustre, cleavage'.

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/collecti on/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.

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 and acid	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 should 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.
Identifying minerals - use your sense(s)! Minerals in the dark: identifying minerals when the lights fail	A novel approach to the identification of minerals. Participants are blindfolded and are asked to identify minerals using their other senses, guided by a sighted pupil reading out from a key.

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