

Be a mineral expert - 3 The mineral foundations of everyday life

Minerals are essential for making most of the things we use every day.

If pupils have followed the Earthlearningidea activities *Be a Mineral Expert 1 and 2* they will be familiar with several minerals. Teachers will have pointed out that minerals are composed of elements, and have a defined chemical composition and atomic structure.

In this activity, pupils are asked to match pictures of familiar objects with the mineral (s) from which the items are made.

Provide pupils with the sets of photographs on page 4 (cut into separate photos) and a copy of the Table on which to lay out the photographs. (Note that they will need more than one copy of

three of the photographs in the “Source mineral” columns).

Ask pupils to carry out their own research to enable them to do the matching exercise, as a general knowledge activity, a class discussion, a websearch activity, or as a homework. With the metal objects, they can be asked to name the main metal(s) used, and then the mineral ores from which the metals are obtained. When they have sufficient information, ask them to lay down their cards in the correct places on the Table and then tell you when they are ready to have their work checked. All the objects in the Table come from the house and garage shown in this photograph.



Table – the mineral origins of some everyday items

Item shown in picture	Component(s)	Source mineral 1	Source mineral 2
 <p data-bbox="264 477 399 506">water pipe</p>	<p data-bbox="539 190 847 248">The metal making up this water pipe is:</p> <p data-bbox="539 293 826 309">.....</p>		<p data-bbox="1209 309 1350 338">Not needed</p>
 <p data-bbox="264 766 399 795">kitchen foil</p>	<p data-bbox="539 530 879 589">The (light) metal from which this kitchen foil is made is:</p> <p data-bbox="539 633 826 649">.....</p>		<p data-bbox="1209 649 1350 678">Not needed</p>
 <p data-bbox="264 1064 399 1093">car battery</p>	<p data-bbox="539 828 879 945">The two metals forming the different plates that act as electrodes inside the battery are made of:</p> <p data-bbox="539 978 871 994">.....and</p> <p data-bbox="539 1050 826 1066">.....</p>		
 <p data-bbox="150 1382 507 1411">bronze sledge dog statuette</p>	<p data-bbox="539 1117 871 1207">Two metals make the alloy from which this dog is cast. They are:</p> <p data-bbox="539 1240 871 1256">.....and</p> <p data-bbox="539 1312 826 1328">.....</p>		
 <p data-bbox="264 1702 399 1731">brass lock</p>	<p data-bbox="539 1438 871 1554">Two metals make the alloy from which this lock is manufactured. They are:</p> <p data-bbox="539 1588 871 1603">.....and</p> <p data-bbox="539 1659 826 1675">.....</p>		
 <p data-bbox="204 2045 459 2074">high speed drill bits</p>	<p data-bbox="539 1758 831 1787">The main metal used is:</p> <p data-bbox="539 1832 842 1848">.....</p> <p data-bbox="539 1881 812 1971">and the metal which is alloyed to it for extra hardness:</p> <p data-bbox="539 2016 847 2031">.....</p>		

Item shown in picture	Component(s)	Source mineral 1	Source mineral 2
 <p style="text-align: center;">watch</p>	<p>The chip which controls the accuracy of the electronics in this watch is made from:</p> <p>.....</p>		<p>Not needed</p>
 <p style="text-align: center;">pencil</p>	<p>The material which makes up the "lead" in the pencil (It is NOT lead!) is:</p> <p>.....</p>		<p>Not needed</p>
 <p style="text-align: center;">toothpaste</p>	<p>The common name of the chemical which is added to reduce tooth decay is:</p> <p>.....</p>		<p>Not needed</p>
 <p style="text-align: center;">bag of plaster</p>	<p>The chemical composition of plaster is:</p> <p>.....</p>		<p>Not needed</p>
 <p style="text-align: center;">table salt</p>	<p>The main constituent of this product is:</p> <p>.....</p>		<p>Not needed</p>
 <p style="text-align: center;">stainless steel knife</p>	<p>Three metals make the alloy from which this knife is manufactured. They are:</p> <p>.....and</p> <p>..... and</p> <p>.....</p>		<p>Source minerals 2 and 3</p>

Mineral photographs



bauxite



cassiterite



chalcopyrite



chromite



fluorite



galena



graphite



gypsum



haematite



halite



pentlandite



quartz



sphalerite



wolfram

The back up

Title: Be a mineral expert - 3

Subtitle: The mineral foundations of everyday life

Topic: A matching exercise, where pupils are asked to match photographs of everyday objects with photographs of the minerals from which they are manufactured.

Age range of pupils: 11 – 16 years

Time needed to complete activity: 10 to 30 minutes, depending on the amount of background research which pupils might need to do.

Pupil learning outcomes: Pupils can:

- work together in small teams to carry out research on the composition of a range of minerals;
- appreciate that many minerals have important economic uses;
- understand that metals are obtained from ores, (or, rarely, from the native metal);
- (extension) identify the chemical content of minerals from their formulae.

Context: This activity can be used in a variety of circumstances, e.g. in revision of a minerals topic by relating photographs to some minerals which pupils have already encountered. It could feature in a geology lesson, or in discussion of the mineral wealth of a country.

Possible answers are shown below:

Item shown in picture	Components	Mineral
water pipe	copper	chalcopyrite
kitchen foil	aluminium	bauxite
car battery	lead; zinc	galena; sphalerite
sledge dog statuette	bronze = alloy of copper and tin	chalcopyrite; cassiterite
lock	brass = alloy of copper and zinc	chalcopyrite; sphalerite
drill bits	steel (from iron); tungsten;	haematite; wolfram
The chip controlling the accuracy of the electronics in a watch	quartz	slice of quartz crystal especially grown in factory
“lead” pencil	graphite + clay	graphite
toothpaste (active ingredient to reduce tooth decay)	a fluoride compound	fluorite
bag of plaster	plaster, $\text{CaSO}_4 \cdot \frac{1}{2} \text{H}_2\text{O}$	gypsum
table salt	salt	mainly halite
stainless steel knife	steel (from iron); chromium; nickel	haematite; chromite; pentlandite

Following up the activity:

Mineral	Formula	Mineral	Formula	Mineral	Formula
bauxite	$\text{Al}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$	galena	PbS	pentlandite	$2\text{FeS} \cdot \text{NiS}$
cassiterite	SnO_2	graphite	C	quartz	SiO_2
chalcopyrite	CuFeS_2	gypsum	$\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$	sphalerite	ZnS
chromite	FeCr_2O_4	haematite	Fe_2O_3	wolfram	$(\text{Fe}, \text{Mn})\text{WO}_4$
fluorite	CaF_2	halite	NaCl		

- Pupils could be given a set of cards with the chemical formulae of the minerals (above) and asked to match them with the photographs of the minerals.
- Possible extension work at home would be for the class to photograph other objects around the house or school and find out what minerals were needed for their manufacture.
- All pupils could be asked to find out what components are needed for a mobile phone, and where the minerals come from to make them, in readiness for “Be a mineral expert – 4: Recycle your mobile phone”.

Underlying principles:

- Minerals provide the raw material for a vast range of manufactured products.
- A mineral is referred to as an **ore** if it contains one or more elements, usually metal, in sufficient concentration to be economically viable.
- Metals extracted from minerals are frequently **alloyed** (mixed) with other metals to improve their physical properties, e.g. hardness or strength.

Thinking skill development:

Pupils build up a cognitive pattern as they work through the photographs of the minerals. Some examples may bring up a cognitive conflict. Applying their skills to the economic value of minerals is a bridging skill.

Resource list: per small group:

- a copy of the Table
 - copies of the photographs of minerals, to lay down in the appropriate spaces on the Table.
- Note: One photograph of each mineral is needed, except for chalcopyrite (3), sphalerite (2) and haematite (2), where more than one photograph is required.

Useful links: www.earthlearningidea.com "Be a mineral expert – 1, 2 and 4"

Source: This activity was devised and written by Peter Kennett of the Earthlearningidea team.

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.

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