# Found in the ground: sorted!
## An introduction to classification using things 'found in the ground'

Provide small teams of pupils with a box of assorted items, most of which come straight from the ground, but also including one or two manufactured objects. A typical list is given under "Resources".

- Ask the pupils to sort the items into groups, using their own criteria, and without any prior briefing regarding the usual names for materials of geological origin. They may set up as many groups as they like, so long as they can justify why they have placed items in each group. Tell them that, when they have finished, you will want them to justify their reasons for their groupings. Listen to the pupils' discussion as you move about the room whilst they are working.
- When the pupils have finished their groupings, ask them to look at a neighbouring team's efforts and compare with their own. Then run a class discussion on the variation between the teams. Hopefully, this will lead pupils to realise that scientists need to agree on a commonly accepted system of classifying natural materials.
- Explain that geologists divide most Earth materials into three groupings, namely minerals, rocks and fossils. Give the teams a brief definition of the meanings of these terms (see "Underlying Principles"), and ask them to regroup their items according to the geologist's method. There may be some debate about whether a fossil embedded in a rock counts as a fossil or as a rock.
- Ask pupils to examine a rock specimen that you have previously marked with a spot. How do they know that it is a rock and not a mineral?
- Ask them to examine a mineral which is an ore of a metal (e.g. galena – lead ore: haematite – iron ore). Ask them to compare the properties of the ore with a sample of the metal derived from it, also provided in their boxes. How might they extract the metal from the ore and what other element might the ore contain?

"Found in the ground" – the complete set

"Found in the ground" – fossils.
Photos: *Peter Kennett*

"Found in the ground" - rocks

"Found in the ground" – minerals, + steel nail and sheet lead

## The back up

**Title:** Found in the ground: sorted!

**Subtitle**: An introduction to classification using things 'found in the ground'

**Topic**: An introduction to the classification of materials derived from the Earth

**Age range of pupils:** 7 -14 years

**Time needed to complete activity**: 20 minutes

**Pupil learning outcomes:** Pupils can:

- develop observational skills;
- discuss amicably a range of different views;
- appreciate the need for a uniform 'scientific' system;
- learn the standard geological classification of materials from the Earth.

**Context:** This activity may be used in any lesson where the principles of classification are required. It forms a useful basis for further activities in Earth science.
Unless pupils already know some geology, they usually arrange their groups on the basis of colour, 'shininess', 'crystals' and size of crystals, roughness, obvious fossils. It is important to tell

them that they are not 'wrong', since they were asked to devise their own criteria and not to have any preconceived method.

Less able pupils may need additional guidance, such as:

- try for at least three groups;
- try to have at least three things in each group;
- try not to have a group of 'things which didn't fit into any other group'.

*How do they know that the marked rock (e.g. granite) is indeed a rock and not a mineral?*
A granite is coarse enough for pupils to see that it contains different 'bits', or 'minerals' and is therefore a mixture and not a compound. The separate minerals may be distinguished by the hardness of each mineral when scratched with a steel nail, its colour, its lustre ('shininess') and the way it splits (cleaves).
Note 1: Note that most minerals are crystalline, even if they do not possess good crystal shapes.
Note 2: The term 'hardness' as applied to minerals refers to relative hardness, using Mohs' scale; although scientists also often refer to 'soft' and 'hard' rocks, there is no formal hardness scale for rocks.

*Compare the properties of an ore with a sample of the metal which it contains.* Properties might include hardness, mineral properties such as cleavage and malleability ('ease of bending').

*How might they extract the metal from the ore and what other element might the ore contain?*
Answers will vary with pupils' experience, but most ores require smelting with heat, in the presence of carbon, to reduce the ore to the metal (i.e. to remove oxygen). The associated elements in the ore commonly include oxygen, sulfur and carbon (in the form of a carbonate).

**Following up the activity:**

- Carry out a simple smelting activity over a gas burner, to show how a metal may be derived from its ore (See Earthlearningidea "Smelter on a stick")
- Show a diagram of the components of any common manufactured object. Ask pupils to plot the sources of the materials on an outline map of the world.
- Set a homework where pupils attempt a similar activity based on an object found in their own home.

**Underlying principles:**
Definitions are as follows, although the wording may need simplifying for younger pupils:

- 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.
- A rock is a naturally occurring material composed of minerals or fragments of older rocks or fossils. A rock is thus a mixture. Some rocks, e.g. granites, consist of three or more different minerals, i.e. quartz, feldspars and micas: most limestones are composed of one predominant mineral, i.e. calcite.
- A fossil is the trace of a once-living organism preserved in a rock, generally taken to be at least 10,000 years old. This includes 'body' fossils such as an actual shell or its impression in the rock matrix, and 'trace' fossils such as tracks and trails.

**Thinking skill development:**
Pupils use their own criteria for constructing a pattern. Cognitive conflict (but hopefully nothing more serious!) arises between the different teams of pupils. Relating the activity to the real world involves bridging skills.

**Resource list:** per small team of pupils:

- a set of assorted specimens, to include *minerals, rocks* and *fossils*. It does not matter about the exact components, but the box photographed above contains: *Minerals* – calcite, fluorite, galena, haematite. *Fossils* – brachiopod, ammonite fragment, trilobite fragment. *Rocks* – chalk, flint, red sandstone, buff sandstone, shale, limestone, slate, quartzite, granite, "Blue Pearl granite", marble. It is helpful if the granite has a cut polished surface, as obtained from a worktop manufacturer's scrap heap. This should be marked with a spot of colour or similar.
- a small piece of metal to match one or more of the metallic ore minerals, e.g. iron or steel nail (from haematite) lead sheet (from galena, if school policy does not object to handling lead).
- optional – hand lenses

**Useful links:** www.Earthlearningidea.com
"Smelter on a stick".
See the E-library of the National Science Learning Centre for a full version of "Groundwork" - 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", 1990