MINERAL IDENTIFICATION

INTRODUCTION

Minerals can be identified through their physical properties. The physical properties can be tested through readily available testing methods. Scientists use the identification of the minerals to draw conclusions about the origins and properties of the rocks formed by the minerals, as well as for information about possible ore deposits.

Notice: This activity combines a general mineral identification activity and an advanced mineral identification activity. The advanced activity adds on crystal forms, so if the general mineral identification activity is preferred, merely do not include references to the crystal forms.

PURPOSE:

Students will learn the basic steps in mineral identification using the physical properties of each mineral. This is accomplished through observation and testing of the minerals involved.

MATERIALS

- Glass plate
- Penny
- Magnet
- Steel blade or steel knife, or nail
- Streak plate (white unglazed porcelain)
- Bottle of vinegar or 10% solution of HCl (hydrochloric acid). If HCl is used, only adults should handle it.
- Mineral worksheet (included in activity)
- Mineral background pages (included in activity)

PROCEDURE

1) Set out on each table two to three mineral samples for the students to identify.
2) Each table should be equipped with the following items:
    a) Glass plate
    b) Penny

   c) Magnet
   d) Steel blade or steel knife
   e) Streak plate (white unglazed porcelain)
   f) Bottle of vinegar or 10% solution of HCl (hydrochloric acid). If HCl is used, only adults should handle it.
3) Divide students into groups with no more than 4 per table.
4) Distribute to each student a Mineral Worksheet and the Mineral Background pages on which to record their test results.
   a) Give students 5 minutes per 3 samples.
5) Instruct the students to perform the physical property tests listed on the background sheet and record the test results on the worksheet.
6) Have Mineral Sheets ready to hand out with names of each mineral with its specific features.
7) After the completion of their tests, have the students correctly name each mineral, using their test results.
8) Have the students at each table name their minerals and the characteristics that led the students to their decisions.

EVALUATION

The students should have learned to perform the basic steps in mineral identification using the properties of the specific mineral. Have students make sure their mineral identification sheets list the basic properties of each of the minerals used.
Information should include the following:

1) Name,
2) Chemical symbol,
3) Hardness,
4) Streak,
5) Chemical reaction,
6) Specific gravity,
7) Luster,
8) Smell,
9) Color.
10) Other tests might include
    a) Magnetic properties,
    b) Feel,
    c) Taste,
    d) Cleavage,

e) Fracture and other tests.

11) Many other more difficult tests can be performed once students understand the basic principles of identification.

MINERAL IDENTIFICATION BACKGROUND SHEETS

What are minerals? Minerals are: 1: naturally occurring, 2: inorganic substances with a 3: fixed chemical composition (some may vary within certain limits).

The following is a description of the physical properties that are used to identify minerals. Rarely is any single property unique to a specific mineral.

Hardness:

Moh's Scale		Name of Mineral		Common Item
1		Talc		
2		Gypsum		
3		Calcite		Fingernail
4		Fluorite		Penny
5		Apatite		Steel (nail, knife)
6		Orthoclase		Window Glass
7		Quartz		Streak Plate
8		Topaz		Hardened steel
9		Corundum		Emery Board
10		Diamond		

The common item refers to an item that scratches or can be scratched the mineral sample.

Specific Gravity:

Specific gravity is the mass of a mineral specimen compared to the mass of an equal volume of water, that is, Specific Gravity = (Mass of sample (g)/Volume of sample (mL))/(specific gravity of water) The specificity gravity of water is one (1) gram per milliliter, so the divisor above is merely 1 g/mL. While actually calculating the specific gravity is useful, even a general determination of density can be helpful. Most minerals have a specific gravity of 3. If you consider this average, some minerals will feel less dense, some more. Some low specific gravity minerals are sulfur, halite, and gypsum; those with a high specific gravity are staurolite, garnet, barite magnetite, pyrite, and galena. For actual measurement of Specific Gravity, see the Density activity. For this activity, estimate the specific gravity of the samples.

Color:

While this is the most obvious of the characteristics, it is also one of the least useful. Only a few minerals have unique color. Many occur in varying shades or have more than one common color. Some even occur in many different colors.

Luster:

Luster is a description of how the mineral reflects light. It is affected by the atomic structure of the surface of the mineral, and to a lesser degree by its transparency. Judgment of luster is subjective and is rarely distinctive for a mineral. Luster terms are descriptive and fairly self-explanatory.

Term	Explanation		Term	Explanation
Metallic	Resembling metal		Vitreous	Like Glass
Adamantin e	Sparkling, gem-like		Silky	Muted, textured
Pearly	Like a natural pearl		Resinous	Like pitch, amber
Waxy	Muted shine like cut wax		Oily, Greasy	Appears coated with clear oil or grease
Earthy	Dull, porous, chalky, lacking obvious luster			

Smell:

Some minerals have a distinctive odor, usually when struck or crushed. The metallic, sulfides, particularly arsenopyrite and sphalerite tend to have a sulfurous, rotten egg smell when scratched or crushed. Certain clay minerals develop a distinctive earthy smell when damp or even breathed upon.

Feel:

Some similar minerals may be distinguished by how they feel. Kaolinite would feel smooth while the rock chalk would feel rough.

Taste:

Minerals, which are water-soluble, may be identified by taste. Halite (rock salt) is salty, while sylvite (potassium chloride) is astringent. Most minerals do not have a taste, and a few are poisonous. Therefore, it is best to use this test with only small amounts of minerals and only when you are already reasonably certain of the identification.

Streak:

The color of the streak left by a mineral specimen on a white, unglazed ceramic tile can be distinctive. This is an especially useful characteristic for the metallic oxides and sulfides.

Chemical Reaction:

Some minerals have particular reactions to common chemicals. The most common is the effervescence (gas release) of calcite when dilute hydrochloric acid is applied.

Magnetism:

Certain iron-bearing minerals will attract a magnet. This is particularly distinctive for magnetite, which is a fairly common mineral. Lodestone is a form of magnetite that is itself magnetic, therefore will attract ordinary iron.

Tenacity:

Tenacity is a mineral's capacity to resist the stress of crushing, tearing, and bending or breaking. The following terms describe tenacity:

Term	Description
brittle	easily broken into powder or small particles. Applies to most minerals.
sectile	can be cut by a knife into thin shavings
malleable	can be hammered into thin sheets
flexible	can be bent and will hold that shape
elastic	can be bent but will return to its original shape

Crystal Form

Crystal form is the shape taken by a mineral when it is allowed to develop in favorable conditions. All minerals have a crystal form, but some will develop crystals in only very specific conditions. While the crystal form is very characteristic for any given mineral, it is one of the more difficult to use, and generally takes a great amount of study to become proficient in its use. Crystal faces can sometimes be easily confused with perfect cleavage. The six crystal systems are described briefly here, with some of the more common minerals in each. Attached is a page with drawings of each to help you visualize them as well as possible.

Cubic (isometric) system: the crystal grows along three axes that are at right angles to each other and of equal length. As the name implies, the simplest form would be a cube, but other shapes fit this system. Examples: galena, pyrite, halite.

Tetragonal system: has three axes at right angles to each other, with two of equal length. This results in simple box shapes with square ends in their most basic form. Examples: rutile, zircon.

Hexagonal system: has four axes, three in a plane, each 120 degrees apart and of equal length. The fourth is at right angles to the plane of the other three, and need not be of equal length to them. This tends to produce elongate crystals with a hexagonal cross-section. Examples: quartz, calcite, beryl (emerald), corundum (emery, ruby, sapphire), tourmaline.

Orthorhombic system: has three axes all at right angles to the others, but all of different lengths. This produces box shapes where no dimensions are equal. Examples: sulfur, barite.

Monoclinic system: has three axes, all of unequal length. Two are not at right angles, the third is at right angles to the plane described by the other two. Examples: gypsum, orthoclase, feldspar, micas.

Triclinic system: has three unequal axes, none of which form right angles with the others. Examples: plagioclase feldspars.

Habit

Mineral habit is the preferred mode of crystal growth.

Term	Description
acicular	fine needle-like rods

bladed	broad and flat, elongated, resembling a knife blade
dendritic	branching, tree-like
equant	having roughly the same dimensions in every direction
prismatic	broad rods clearly elongate in one direction
striated	having shallow parallel groves on one or more faces
tabular	flat plates with two roughly equal dimensions, the third dimension being significantly less

Form

Form is how one crystal grows with respect to another growing next to it.

Term	Description
contact	crystals grow against one another, each in their own space, in more-or-less random fashion (most common type).
penetrating	crystals grow together into a single structure, with the corners of each crystal protruding from the faces of the other
repeated	crystals grow "back-to-back" in parallel groups, or from the ends of existing crystals.

Aggregates

Aggregates are arrangements of crystals that have grown together. Some minerals have preferred or common habits, forms, or aggregate styles.

Term	Description
botryoidal	resembling a cluster of grapes

columnar	slender parallel columns
coxcomb	a serrated arrangement of twinned crystals
druse	a coating or crust of small, projecting crystals
fibrous	thread-like
geode	a round, hollow nodule lined with crystals, usually quartz or calcite
mammillary	smooth rounded masses
massive	interlocking grains lacking apparent structure
micaceous	thin, flat, easily separated sheets
oolitic/pisolitic	forming spheres, oolites are 1 to 2 mm in diameter, pisolites are from 2 to 10 mm
radiating	growing out from a central point, may be in 2 or 3 dimensions
reniform	kidney shaped
stalactitic	slender, icicle-shaped formations
wheat sheaf	a bundle of fine needle-like crystals

MINERAL WORKSHEET

AMPLE #	COLOR	STREAK	FEEL	SMELL	LUSTER	MAGNETIC	CHEMICAL	HARDNESS	SPECIFIC GRAVITY (estimated)

Distributed by Women in Mining Education Foundation
Revised 2014