Minerals are Grouped by their major chemical components

Native Elements (Gold, Silver, Copper, Sulfur, Graphite, Diamond)

Sulfides (pyrite, chalcopyrite, galena, sphalerite, bornite)

- sulfur (a non-metal) is combined with another element (often a metal)

Oxides (ice, hematite, corundum, magnetite)

- metals or non-metals occupy spaces between oxygen atoms

Sulfates (gypsum, selenite, barite, celestite) – all generally soft

- negative sulfate (SO_4) ion is bonded to positive cation

Carbonates (calcite, dolomite, aragonite, malachite, azurite)

- negative carbonate (CO_3) is bonded to positive cation

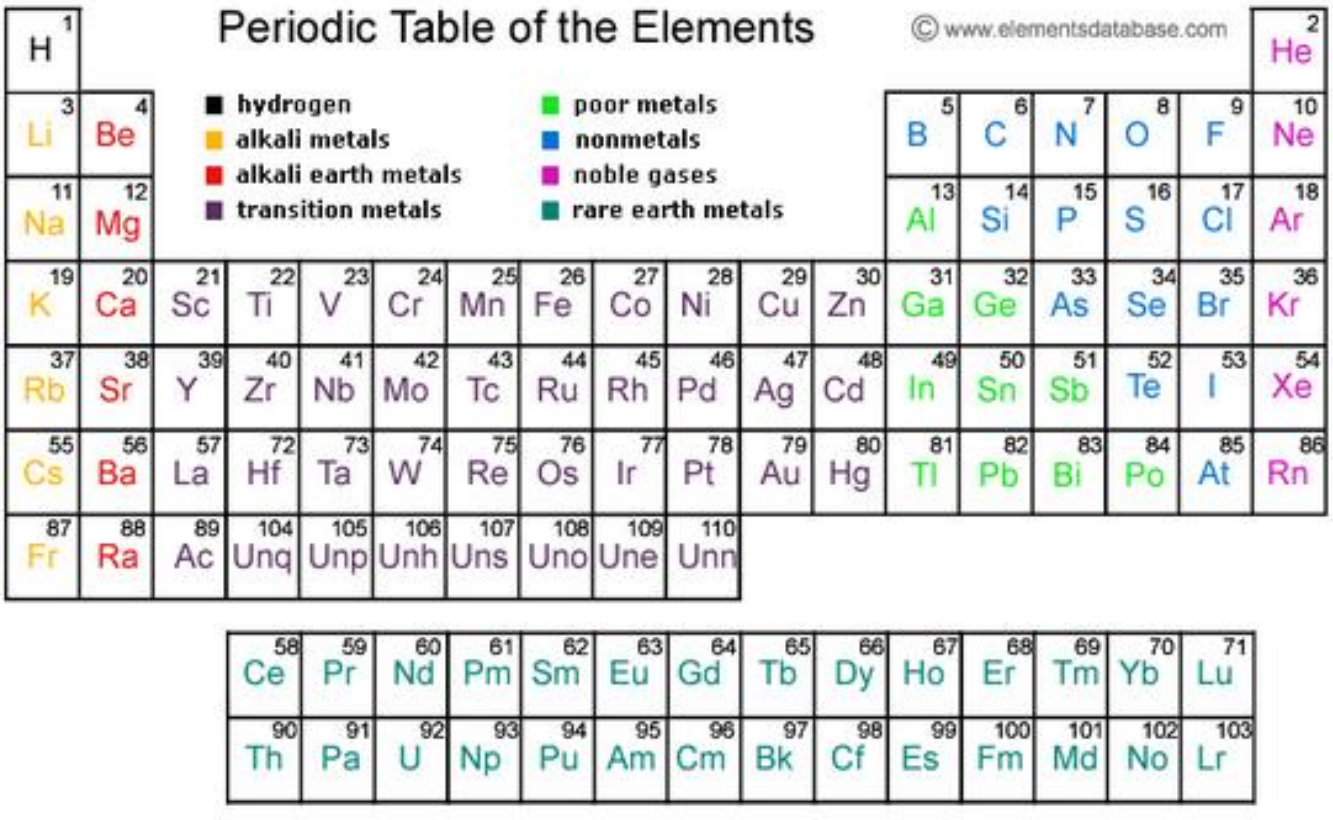
Halides (halite, fluorite, sylvite)

- a halogen element (F, Cl, Br, I) is bonded with a metal

Silicates (quartz, feldspar, pyroxene, olivine, mica)

- the SiO2 tetrathedron stands alone (quartz) or is bonded into simple or complex mineral structures

There are several other minor mineral groups that will be in your books and we will touch on some of them later.

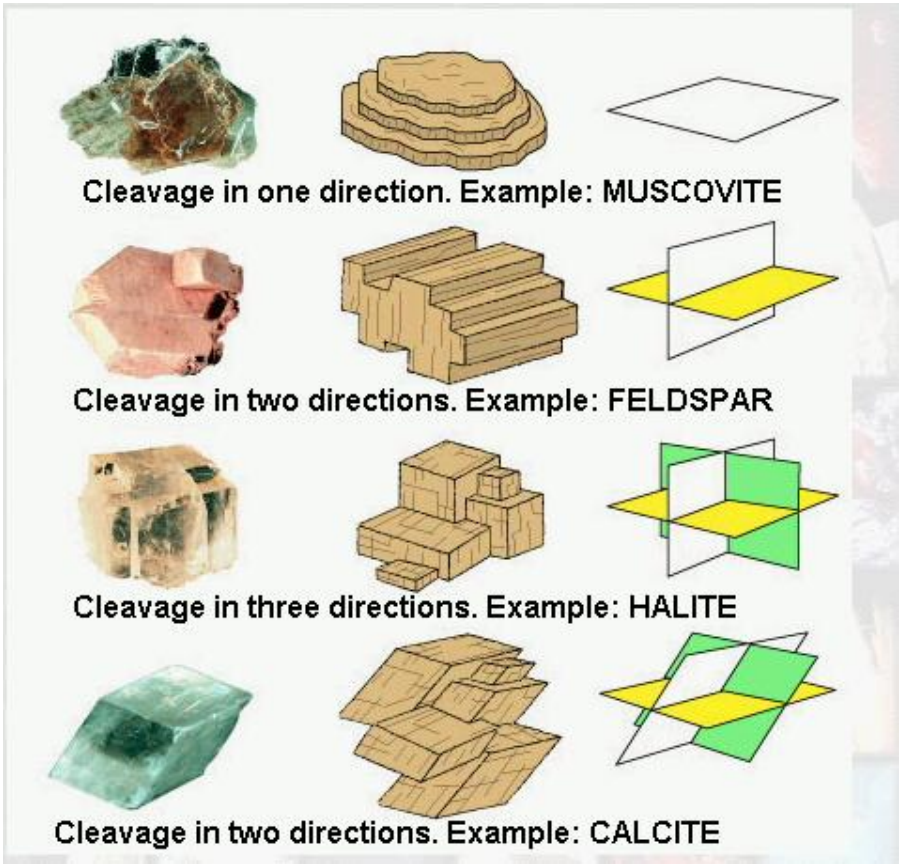


Mineral Physical Properties Chart

PHYSICAL PROPERTY	Definition*	Testing Method
Cleavage	Breakage of a mineral along planes of weakness in the crystal structure.	Examine the mineral for areas where the mineral is broken. Look for areas where the light reflects from planar surfaces. This can be easily confused with a crystal face and is the most difficult properties for students to master.
Color	Visible light spectrum radiation reflected from a mineral.	Look at the sample and determine its color - white, black, green, clear, etc.
Crystal Form	Geometric shape of a crystal or mineral.	Examine and describe the geometric shape of the mineral - cubic, hexagonal, etc. Not commonly seen in most introductory lab samples.
Fracture	Breakage of a mineral, not along planes of weakness in the crystral structure.	Examine the mineral for areas where the mineral is broken. Describe the breakage as either irregular or conchoidal (has the appearance of broken glass)
Hardness	Resistance to scratching or abrasion.	Use minerals of known hardness from the Mohs Hardness Kits. Scratch the unknown mineral with a known hardness to determine which mineral is harder. Continue doing this with harder or softer minerals from the kit until the hardness is determined.
Luster	Character of the light reflected by a mineral.	Look at the sample to determine if the mineral is metallic in appearance (looks like a chunk of metal) or non-metallic (doesn't look like a chunk of metal).
Magnetism	Electromagnetic force generated by an object or electrical field.	Use a magnet to determine if the magnet is attracted to the sample.
Reaction to HCl	Chemical interaction of hydrochloric acid and calcium carbonate ($CaCO_3$).	Place one small drop of HCl on a sample a watch for a reaction - effervesces (bubbles). Click here to see an short animation (351 Kb)
Specific Gravity	Ratio of the mass of a mineral to the mass of an equal volume of water.	Generally not determined in an introductory lab. Look this information up in your lab manual once the mineral has been identified.
Streak	Color of the mineral when it is powdered.	Grind a small amount of a mineral into a powder on a porcelain streak plate and determine the color of the powder.
Taste	Nerve ending reaction in the tongue to different chemicals.	Lick the mineral. (not recommended in an introductory lab - you don't know who has handled or licked the sample before you).
Other Properties	Fluorescence, Radioactivity	Requires special equipment such as a UV lamp and geiger counter. These are not commonly tested for in an introductory lab.

Mineral Cleavage

Cleavage is the tendency of a mineral to break along smooth planes parallel to zones of weak bonding in the mineral's structure.



It may be difficult for the beginner to distinguish between cleavage and crystal faces. After all, both are smooth, planar surfaces. Two hints will help make the distinction easy. (1) If a mineral's outer surface shows a tarnish or alteration, the crystal faces will be tarnished or dull; if cleavage planes are present, they are usually recently made and will be fresher and less altered. (2) If many surfaces are present parallel to one another, they are most likely cleavage surfaces.

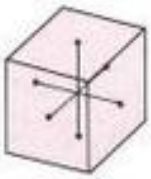
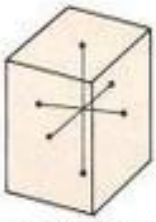
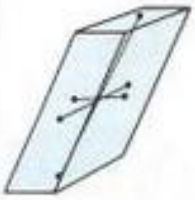
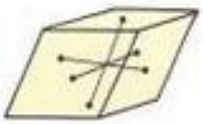
http://www.youtube.com/watch?v=vVOjabg08KE

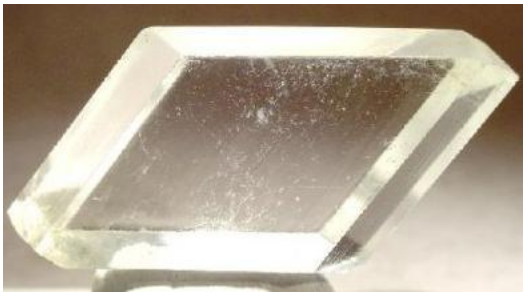
Six Crystal Forms

What are crystals?

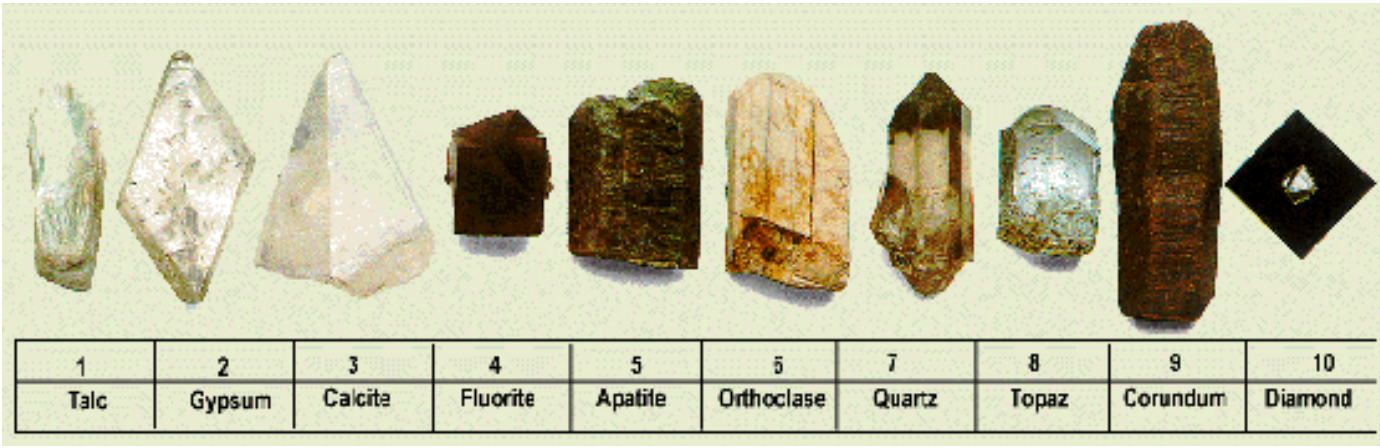
A crystal is a mineral whose internal, geometrical repeating pattern of atoms is consistent throughout the entire structure. This pattern is what gives the crystal its shape.

Minerals are grouped into systems according to their crystal symmetry (regularity of form). The figure below shows the six main systems.

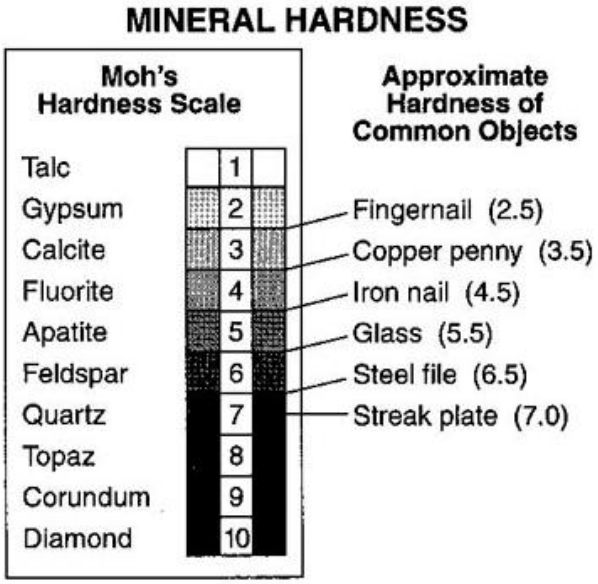
cubic	tetragonal	hexagonal	orthorhombic	monoclinic	triclinic
					
examples: halite galena	examples: zircon chalcopyrite	examples: quartz calcite	examples: sulfur staurolite	examples: mica gypsum	examples: feldspar rhodonite



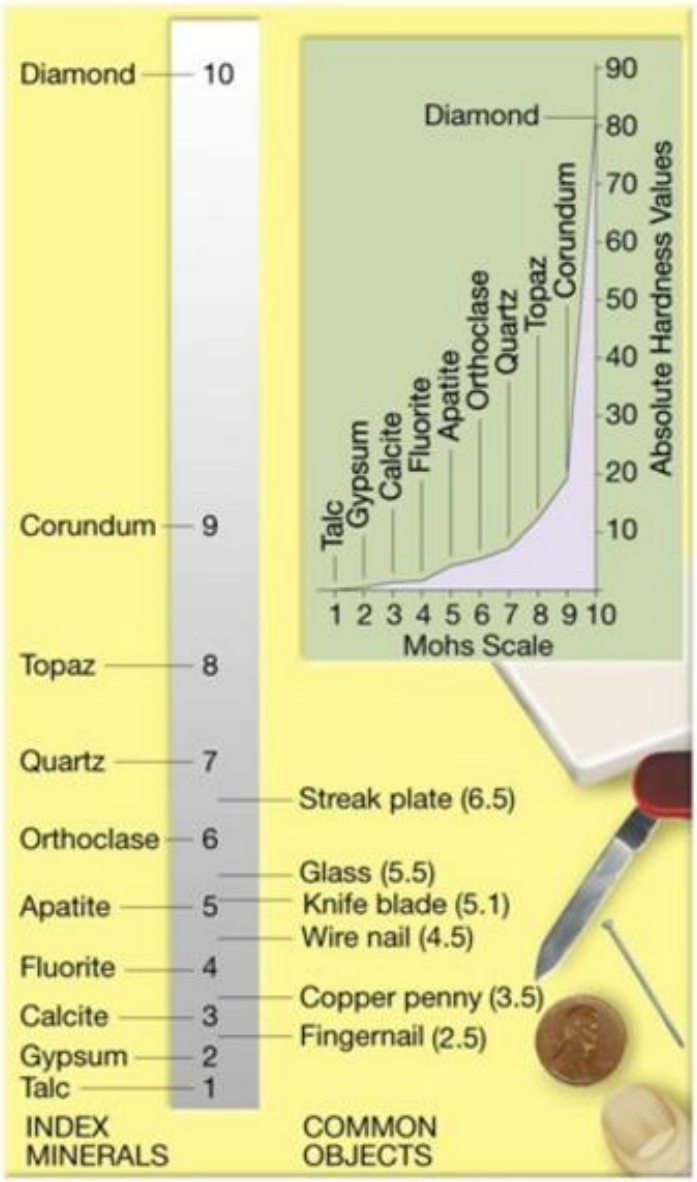
Mohs Hardness Scale for Minerals



1	2	3	4	5	6	7	8	9	10
Talc	Gypsum	Calcite	Fluorite	Apatite	Orthoclase	Quartz	Topaz	Corundum	Diamond



Mohs Hardness scale is not linear



Mineral Property - Luster

Lustre (or **luster**) is the way light interacts with the surface of a crystal, rock, or mineral. The word traces its origins back to the latin *lux*, meaning "light", and generally implies radiance, gloss, or brilliance.

A range of terms are used to describe lustre, such as *earthy*, *metallic*, *greasy*, and *silky*. Similarly, the term *vitreous* (derived from the Latin for glass, *vitrum*) refers to a glassy lustre.

1	2	3	4	5
METALLIC LUSTER	ADAMANTINE LUSTER	VITEOUS LUSTER	RESINOUS LUSTER	GREASY LUSTER
				
PYRITE Moh's Hardness : 6 - 6.5 Specific Gravity : 4.9 - 5.2	GARNET Moh's Hardness : 6.5 - 8.0 Specific Gravity : 3.5 - 4.3	QUARTZ Moh's Hardness : 7 Specific Gravity : 2.6 - 2.7	SULPHUR Moh's Hardness : 1.5 - 2.5 Specific Gravity : 2.0 - 2.1	GRAPHITE Moh's Hardness : 1 - 2 Specific Gravity : 1.9 - 2.3
6	7	8	9	10
PEARLY LUSTER	SHINING LUSTER	SUBMETALLIC LUSTER	DULL LUSTER	METALLIC LUSTER
				
TALC Moh's Hardness : 1 Specific Gravity : 2.7 - 2.8	CALCITE Moh's Hardness : 3 Specific Gravity : 2.7	HEMATITE Moh's Hardness : 5 - 6 Specific Gravity : 4.9 - 5.3	BORAX Moh's Hardness : 2 - 2.5 Specific Gravity : 1.7	CHALCOPYRITE Moh's Hardness : 3.5 - 4 Specific Gravity : 4.1 - 4.3

Fracture Types in Minerals

Obsidian

Conchoidal fracture is a curved breakage that resembles the concentric ripples of a mussel shell. It often occurs in amorphous or fine-grained minerals such as flint, opal or obsidian, but may also occur in crystalline minerals such as quartz. **Subconchoidal fracture** is similar to conchoidal fracture, but with less significant curvature. (Note that obsidian is an igneous rock, not a mineral, but it does illustrate conchoidal fracture well.)

Limonite

Earthy fracture is reminiscent of freshly broken soil. It is frequently seen in relatively soft, loosely bound minerals, such as limonite, kaolinite and aluminite.

Native copper

Hackly fracture (also known as **jagged fracture**) is jagged, sharp and not even. It occurs when metals are torn, and so is often en countered in native metals such as copper and silver.

Chrysotile

Splintery fracture comprises sharp elongated points. It is particularly seen in fibrous minerals such as chrysotile, but may also occur in non-fibrous minerals such as kyanite.

Also wollastonite

Magnetite

Uneven fracture is a rough surface or one with random irregularities. It occurs in a wide range of minerals including arsenopyrite, pyrite and magnetite.