MINERALS

Minerals are the building blocks of the earth. All rocks are made up of minerals and minerals are a critical source of raw materials for our industrial society. Though there are several thousand known minerals, only a few dozen make up most rocks. In this lab you will learn to use a few simple tools and some careful observations to identify the most common rock forming minerals. Skill in identifying minerals will be important in later labs dealing with rock identification and description.

THE PHYSICAL PROPERTIES OF MINERALS

Sample Type

A mineral crystal has a regularly repeating internal atomic order. A mineral's properties relate directly to the nature of this internal structure. It's important that you examine a crystal or crystal fragment, not an aggregate, when you're trying to describe its properties. (An aggregate is simply a bunch of crystals stuck together.) An aggregate's properties are often determined by the way in which its grains are stuck together, not the properties of the mineral from which it is made. When you look at any mineral sample, think about whether it's a ***crystal***, ***crystal fragment*** or an ***aggregate.***

◈**Important**: It is difficult to impossible to reliably determine the physical properties of aggregates. Be skeptical about properties you determine for aggregates!

Color

The color of fresh, un-weathered surfaces is useful for identifying a few minerals, particularly those with metallic lusters. But for most minerals, color is an unreliable identification aid. Don't depend on it!

Luster

Luster describes the intensity and quality of light reflected from a mineral. Luster does not describe a mineral's color or whether it transmits light (transparency). A mineral might look glassy = **vitreous,** like dirty or weathered glass = **subvitreous**, like polished metal =**metallic**, like unpolished metal = **submetallic,** or like pearls=**pearly**.

Streak

Streak is tested by dragging the mineral specimen across a "streak plate" of unglazed ceramic tile, powdering the mineral in the process and leaving a "streak" of color behind. This test is most useful for minerals with an opaque, metallic luster.

Hardness

Hardness is a measure of a mineral's resistance to scratching and is determined by the chemical bonding and internal structure of the mineral. Hardness is measured relative to a standard group of ten minerals that are assigned hardness values from 1 (the softest, talc) to 10 (the hardest, diamond) known as the Mohs Scale. For example, if an unknown mineral specimen will scratch a mineral of hardness three, but can be scratched by a mineral of hardness four, the unknown mineral is assigned a hardness of 3.5. (Note that there is no 3.4, 3.6, etc—the ".5" simply designates that the sample is intermediate in the sequence of hardness). The hardness of your fingernail is 2.5 and of most steels about 5.5.

◈**Important**: always make sure that you're testing a crystal, not an aggregate, when you're testing for hardness. Make sure you are testing fresh, unaltered mineral surfaces. It is easy to get incorrect results!

Cleavage and Fracture

Cleavage and fracture are ways that a crystal or mineral fragment may break.

Cleavage—If a mineral's internal structure has distinct planes of weakness, the mineral may break along smoothly along such planes. The smooth planes are called cleavage planes and the orientation of these planes is called a cleavage direction. Because cleavage direction is controlled by the internal structure of the mineral,

cleavage is a diagnostic feature of those minerals in which it occurs. A mineral may have one, two, or several different cleavage directions. Each direction may manifest itself as a set of one or more parallel planes within a single crystal fragment. Cleavage is described by noting the number of different cleavage directions (not planes!) and the approximate angles between these directions.
Fracture — If a mineral does not break (cleave) along a cleavage plane, it fractures. Most mineral fractures or ***irregular***, but some are ***conchoidal***. You can recognize conchoidal fractures by their sharp edges and smooth, curved faces with concentric ridges. Thick pieces of broken glass often have conchoidal fracture.

Tenacity
Minerals resist breakage in different ways and this resistance is called their tenacity.. Mineral tenacity can be described as
Brittle – the crystal snaps when stressed
Elastic – the crystal can be bent and will return to its original shape
Flexible – the crystal can be bent and it will stay bent

Acid Reactivity
Two common rock-forming minerals are ***reactive*** when in contact with cold, dilute, hydrochloric acid. Calcite reacts vigorously, producing lots of bubbles (fizzing). The mineral dolomite will also react, but the surface must be first powdered by scratching for the reaction to be visible. The acid test must be used carefully. Some mineral aggregates are cemented with bits of calcite between the crystals and dropping acid on such an aggregate will produce fizzing, even though the minerals themselves do not react to HCl. Also please make sure you rinse off any samples you test with acid.

Magnetism
The mineral magnetite is always strongly ***magnetic*** and will attract a magnet. A few other minerals are weakly magnetic.

Other properties
Striations – Striations, fine, straight, parallel lineations (lines), can be seen on cleavage planes of most plagioclase feldspar crystals, but are not present on orthoclase feldspar crystals.
Intergrowths – Intergrowths are fine wispy zones of one mineral intergrown with another. Orthoclase feldspar crystals commonly possess intergrowths of plagioclase feldspar. Lack of striations and the presence of intergrowths is good evidence that a crystal specimen is orthoclase feldspar.
Density – Density differences are difficult to measure without special equipment unless the mineral is very dense. Galena, a lead sulfide, is noticeably dense when handled. (That is, it feels heavy compared to other minerals with similar volumes.)

Task 1: You will get a wooden box divided up into compartments, a chart labeling each compartment with a mineral property and a box of mineral samples. For each compartment's mineral property, find an example of a mineral that shows that property, then put it in the appropriate compartment. Yell "BINGO" when you get them all sorted out and get them checked. Get them all right, get 2 points.

Task 2: Use the mineral key to identify each mineral in your box. Yell "DOUBLE BINGO" when you have them all identified and get them checked. Get them all right, get 2 points.

Task 3: Study up on minerals! Your final score on this lab will be determined next week during lab when you will have to take a mineral ID quiz. You will have access to an acid bottle, a streak plate, a steel needle, a magnet and a handlens, but the quiz is CLOSED BOOK! This quiz will be worth 6 points. A few sets of samples will be in the lab for you to study at your convenience.

MINERAL IDENTIFICATION

These are the minerals you will need to be able to identify for the Mineral ID Quiz. There is a key that identifies most of these minerals in the Appendix of Portrait of a Planet, pages A-3 and A-4. Not included in that key is ilmenite (black, submetallic luster, looks like magnetite but only weakly magnetic.

Oxides

Magnetite	Fe_3O_4
Ilmenite	$FeTiO_3$
Hematite	Fe_2O_3

Sulfides

Pyrite	FeS_2
Galena	PbS

Sulfates

Gypsum	$CaSO_4(H_2O)_2$

Carbonates

Calcite	$CaCO_3$
Dolomite	$CaMg(CO_3)_2$

Silicates

Olivine	$(Mg,Fe)SiO_4$
Garnet	Complex Ca,Fe,Mg,Al silicate
Hornblende	Complex Na,Ca,Fe,Mg,Al silicate
Pyroxene	$Ca(Mg,Fe)Si_2O$
Talc	$Mg_3Si_4O_{10}(OH)_2$
Biotite	$K(Mg,Fe)_3AlSi_3O_{10}(OH)_2$
Muscovite	$KAl_3Si_3O_{10}(OH)_2$
Quartz	SiO_2
Plagioclase	$(Na,Ca)Al_{1-2}Si_{2-3}O_8$
Orthoclase	$KalSi_3O_8$

The chemical families are based on the anions or anion groups (negatively charged ions) in the family.