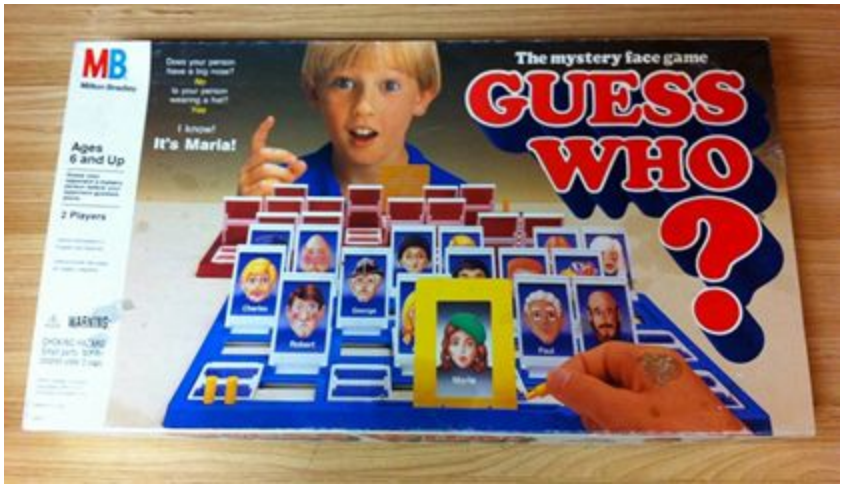
Mineral identification

The main goal of this lab is to:
1) learn how to identify each of the 28 minerals we present to you
2) learn how to perform each of the mineral properties tests
3) practice approaches to fast problem solving by elimination of incorrect choices
4) obtain an introduction to modern mineral identification methods



Identifying minerals is a bit like the childhood game **guess who**. In **guess who** each player tries to guess the other players person by asking questions and eliminating wrong answers. Does your person have blonde hair? Yes? Great, now I know that your person must not have brown, black, grey, or red hair. Each named person has a completely unique set of properties. For example, “Joe” must have blond hair, be male, have glasses, brown eyes, and must be named Joe.
Instead of hair color, glasses, hats, and gender, hand held mineral identification relies on the following diagnostic properties:

Shape (what shape and size does it typically have?)
Color (what colors can it have? Which of these colors are typical?)
Luster (Beyond color, is there a property (dull, shiny, metallic, sparkly) that is common?)
Streak (when scratched onto a streak plate, what color is the mark it makes?)
Hardness (what things can the mineral scratch? And what can scratch it?)
Cleavage or fracture (when the mineral breaks, does it break in a specific way?)
Relative weight (Specific gravity) (Is it heavy or light for its size?)
Magnetism (Do magnets stick to this material?)
Odor (Does the mineral smell? Does the mineral smell when scratched?)
Note that “**taste**” is sometimes included in this list, but geologists have stopped licking rocks because 1) It is dangerous to their health and 2) It is entirely unnecessary.

Each of these properties is a bit like a question we can ask a mineral, and each test we do on a mineral will tell us an answer. In our mineral lab we will only have 33 samples to work though, and after asking each of these questions we will be able to match each mineral to its name.

Test taking hint: In the game "guess who" there is only one person who wears a green hat (Maria), and so asking the question "are they wearing a green hat?" and getting a "yes" answer, can make you absolutely certain that you know it is Maria. Many of the minerals for our class also have a "green hat" like question. Magnetite, for example, is the only class mineral that is magnetic, and having a magnet stick to the mineral is a "yes" answer to its green hat questions. I recommend you rely first on your eyes (hey this thing looks kind of like "magnetite") but always use at least one additional test (since it looks like magnetite, I am going to use the magnetic test to check for sure).

Modern geology often involves advanced spectroscopic tools/machines which expose unknown samples to electromagnetic energy (such as light, X-rays, infrared light, radio waves, and others) and observe the resulting changes in the electromagnetic energy. Although these tools are often expensive to own and operate, geologist like using them because often one test, on one machine, can tell you exactly which mineral is present, and sometimes give even more information beyond mineral identification, (such as chemical composition or the crystal structure, which is the way that the atoms inside the mineral are arranged).

Shape:

When you find a mineral, it will be in one of two types of shapes A) the shape that it was made in, and B) a shape it has been broken into.

A) The shape that is was made in can be controlled by:

a. The shape of the crystal grows in.

Each mineral typically only has one or a few shapes that it can form as it grows. For example, Halite will always grow in a cube like shape.

b. The space (or room) that the crystal has to grow in.

As you can see above, in the top case, the crystal shape could be useful in determining which mineral is present, but in the bottom case, the crystal shape information is lost.

B) The shape that a mineral can “break” is referred to as its cleavage or fracture. This property is discussed later in more detail. However when identifying minerals by shape, be sure to remember that it could be the original shape it formed in, or it could be the shape that someone or something has broken it into.

How to test for shape? Look at it! Getting to know the common shapes that a given mineral can form in can be very useful and fast. Be sure to look at multiple versions of the same mineral (the ones in your box, the ones in your neighbors box, the teachers set, and pictures online)

Color:

Minerals can come in all sorts of colors, and since we live in a very colorful world, and have interacted with colors all of our lives. Some minerals, are almost always found with the same color (such as pyrite) but other minerals have many different colors they can be found in.

How to test for color? Look at it! Getting to know the common colors of a given mineral is often a fast way to get to a good guess of what mineral you are looking at. Sine some minerals can form many different colors, be sure to look at many different examples. You may notice that some minerals (like pyrite) has a very limited range of colors, where as other minerals (like quartz) can be found naturally in almost every color. Mineral colors may also change depending on the light under which they are viewed, so do not be surprised if minerals look a little different outside vs. in the classroom.

Luster

In addition to color, minerals also can be classified by their luster. Although the word “luster” is not used in everyday English, in some respects it is very similar to the concept of “shininess”. You may have thought about luster before if you have ever been to pick out paints. Some paints have a high “gloss” to them (Like most car paints), whereas other paints are “matte”, and they have a dull, non-reflective appearance. Luster is independent of color, and just like paints on a wall, you can have a very glossy white, or a very dull white, but both are a white color. Here are

Dull (Earthy): This luster lacks a shine to it, and could also be described as a “matte” finish. A good example of a dull luster is most soil (or dirt). Most times this luster is also associated with a gritty or earthy feel to a mineral. If you held a dull mineral up to the light, no light should be able to pass though it.

Greasy: This luster has a glossy look on the surface, but a creamy slightly see through interior. This luster is very similar to a “waxy” luster, but it has an added glossiness to it. Also many minerals with a greasy luster also have a greasy/oily feel.
Waxy: This luster looks just like candle wax (when it is cold). The surface of wax is dull, and it has a creamy inside that you can kind of peer into. Just like candle wax, a little bit of light should be able to pass though minerals with this luster .
Resinous: This is the luster of amber (if you have ever seen that). Most plastics have this same type of luster, and fishes with a “semi-gloss” appearance do as well.

Metallic: This is an appearance like aluminum foil, or any other piece of metal for that matter.
Submetallic: This luster is similar to metallic luster, but is slightly less reflective than metallic (duller). It may still look metallic, but it is missing that extra flash and glimmer that the metallic luster has.

Adamantine: This luster is rare in minerals on earth, but it is so captivating to the eye, that when we find minerals with this luster we usually like to display them for others to see. This is the “fire” of a diamond (or cubic Zirconia), and is describing that extra flash that makes a diamond look different from a piece of ordinary glass.
Vitreous (Glossy): A glass bottle is a perfect example of a vitreous luster. It usually has a glossy surface and you can peer into the mineral past its glossy surface.
Pearly: This luster has a gloss shine to it, but with an added reflection and shimmer. A good example of a pearly luster is Muscovite Mica, and it is named pearly because pearls have this same luster.
Silky: This luster has a spider web or silk thread appearance, and the mineral may look like a whole bunch of threads glued together.

How to test for luster? Just like looking at color, you have to use your eyes, however unlike color (which we have been learning since kindergarten) some of these lusters might be “new” to you. In this case it’s just a case of practicing seeing and identifying a luster, and getting good at matching a luster from one mineral to another mineral with the same luster. I find it helps to hold a mineral and wiggle it around when looking at luster.

Streak

Streak is the color of the mineral when powdered. It is called streak, because instead of grinding up a mineral, it is much easier to just drag a mineral across a rough piece of ceramic, which

leaves a streak of powdered mineral. The streak color may not always be the same color as the whole mineral.

How to test for streak? Drag a mineral across a ceramic tile. Sometimes you need to push down harder than others to get a streak. Then look at the color of the streak that the mineral left.

Hardness

Hardness is a bit like a wrestling match for minerals and rocks, and when performed correctly can be a very useful question to help identify a mineral. In geology, we use the Mohs hardness scale, which identifies 10 references minerals at increasing hardness.

Talc	1
Gypsum	2
Finger nail	2.5
Calcite	3
Penny	3.5
Flourite	4
Iron nail	4.5
Apatite	5
Glass	5.5
Feldspar	6
Steel	6.5
Quartz	7
Topaz	8
Corundum	9
Diamond	10

How to test for hardness? Take your unknown mineral, and you either use it to scratch something or see if something scratches it. I like to start with the glass plate (by setting the glass plate down on the desk, and seeing if I can draw a scratch mark on the glass). The glass plate

has a hardness of 5.5, and it is often easier to see scratches on the glass than on other minerals. If the mineral scratches the glass, it must have a hardness above 5.5, if it does not, it must have a hardness below 5.5. To further narrow down the hardness of your mineral, pick a test mineral (which is numbered in your hardness kit with the hardness) and try scratching the test mineral or vice versa. If it can scratch the test mineral, it must be harder than the test mineral, if it cannot, it must be weaker. Sometimes it can be hard to figure out who scratched who because minerals might mark each other, and in these cases what you are looking for is a scratched groove left in the mineral. A grove won't be smudged away if you rub your finger over it, unlike a mark, which will.

Cleavage or fracture

Minerals break (cleave or fracture) in very specific ways, which often times makes this property a valuable identification tool. Cleavage is when a mineral breaks along a flat surface. In some minerals the surface is not too flat, but may still be along a cleavage plane. Unfortunately in class we cannot break all of our mineral samples to get a better handle of this, but in the field, breaking apart rocks and looking at the broken surfaces of the minerals inside of a rock can be very useful.

How to test for Cleavage or fracture? Look for a part of the mineral that looks like it has been broken, and see if you can identify any flat surfaces. Sometimes minerals break with a rough surface, however if there is a cleavage plane, light will suddenly reflect at the same angle despite this rough surface. To look for this, slowly rock the mineral back and forth in your hand. If the reflected light looks sparkly and about the same regardless of the angle, then you are not looking at a cleavage plane. If the mineral suddenly reflects a bunch of light (sort of like a mirror) and then goes dark again, you are looking at a cleavage plane. Identifying a cleavage plane takes some practice! Fracture looks a bit like glass (or a chipped Native American arrow head), or sometimes just like a big crack. Using the light test again, if you cant seem to find one angle that reflects a lot of light, you are probably looking at a fracture.

Relative weight (Specific gravity)

Specific gravity is a measurement of how dense (heavy) a material is in reference to a reference standard of the same volume (size). Usually scientists in a lab will use "water" at a specific temperature to use as a reference standard; but depending on the circumstances, a pocket compass, cellphone or rock hammer might be more practical.

How to test for relative weight? All your life you have been picking things up and feeling how heavy or light they are, and this test puts all your practice doing this to use. If a mineral is really heavy, that's a good clue. If a mineral is really light, that is also a good clue. Some minerals will

feel about as heavy as you though they should. For identifying hand samples this rough idea of weight is about as good as we can get.

Magnetism

Most minerals are non-magnetic, and magnets do not stick to them. In some cases a mineral IS magnetic, and a small magnet will stick to it. Since only a few minerals on earth are magnetic, if a magnet sticks to your mineral you can narrow down the possible minerals it could be quite a bit.

How to test for magnetism? If a magnet sticks to it, it is magnetic. If a magnet does not stick to it, it is non-magnetic.

Odor

Most minerals do not have a distinct or unique odor, but a few of them do. If a mineral does have a unique odor, this test can be a great tool to help you identify it. These minerals (such as sulfur) may need to be scratched or broken to smell.

How to test for odor? First start by just smelling the mineral, some minerals smell right away. If there is no smell, try scratching the mineral and then smelling the scratched region.

Minerals in our lab boxes:

Magnetite
Hematite
Goethite

Sphalerite
Galena
Pyrite
Chalcopyrite
Sulfur

Calcite
Gypsum

Malachite

Graphite
Halite
Fluorite

Orthoclase
Plagioclase
Quartz
Chalcedony
Muscovite
Biotite
Augite
Hornblende
Olivine
Talc
Garnet