SCI 3410 Fall 2011
Earth Science Dr. Waggoner

LAB 1
MINERAL IDENTIFICATION

I. BASIC PROPERTIES

A. Luster is the technical name for "shininess," or the ability to reflect light. Some minerals, like the pyrite shown here, have a *metallic* luster—they reflect light in the way that metal does. Other minerals are said to be *nonmetallic*. These may be described as *vitreous* (glassy), *pearly* (like a pearl), or *earthy* (dull, like soil or concrete). Look at the samples provided and compare them.

Describe your unknowns' lusters as best you can:

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B. Minerals may be *opaque* (no light can shine through); *translucent* (light can shine through, but no image is transmitted) or *transparent* (an image can be seen through the specimen). Place the specimen of crystalline calcite over some print. What do you observe?

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Describe your unknowns' transparency as best you can:

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C. Color is not always a trustworthy property. Some minerals do have very distinctive colors, but in other cases the colors can vary. Look at the three crystals shown here. All three of them are basically quartz (SiO_2, silicon dioxide). However, one of them is nearly pure quartz (sometimes called rock crystal) and looks clear; one of them has impurities that give it a yellow-brown color (smoky quartz), and one has different impurities that give it a purple color (amethyst). Other types of quartz include pinkish rose quartz and golden citrine. Are the shapes of all three crystals similar?

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Although color can be deceptive, it's still a good idea to record it. However, different people often see colors differently, or record them in different ways—"bright purple" to me might be"medium violet" to you, for example. Geologists often use a standard color chart, so that they can be sure their color names are the same. Match your unknowns to the chips on the color chart, and record their colors. If a mineral has several shades of color, record a range of color names:

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II. SPECIFIC GRAVITY

1. Weigh the sample of pyrite provided, using the scale. Record the weight in grams: ______________________________________

2. Fill the graduated cylinder about half full of water. Record the water level in the cylinder: ________________________________

3. Gently place your sample of pyrite into the cylinder of water. Record the water level after adding the pyrite: ________________________________

Subtract this second value from the first to get the sample's volume—that is, the amount of space that it takes up: ________________________________

4. Pour out the water, take out the pyrite and dry it off with paper towels.

5. Divide the weight of the pyrite by its volume to get the specific gravity: ________________________________ (You should get a value of about 5.2, if you've done this right.)

5. Repeat the above procedure with the sample of galena provided. Its specific gravity should be about 7.6.

6. Now measure the weight and volume of your unknown samples. Record their specific gravity: ____

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III. ULTRAVIOLET FLUORESCENCE

Some minerals *fluoresce* in ultraviolet (UV) light. In other words, if you shine UV light on them, they reradiate the energy in the form of visible light. This is not easy to see in "broad daylight", so we need to look at this effect in darkness. Some minerals fluoresce different colors, depending on whether they are exposed to longwave UV (wavelength of 300-400 nm) or shortwave UV (wavelength of 254 nm). We have a lamp that generates both longwave and shortwave UV light, so we can look for fluorescence using both.

IMPORTANT: DO NOT LOOK DIRECTLY AT THE UV LIGHT WHILE IT IS ON! PERMANENT EYE DAMAGE COULD RESULT! AVOID LETTTING THE UV LIGHT SHINE ON YOUR SKIN. UV LIGHT, ESPECIALLY SHORTWAVE UV, IS CARCINOGENIC.

1. Drape the black cloth over the UV lamp and your head. The UV light should be off.
2. Place one of the mineral samples under the shortwave UV light.
3. Turn the UV light on. What do you observe?
4. Slide the lamp so that the sample is under the longwave UV light. What do you observe?
5. Turn the light off, and repeat steps 2-4 for the other mineral specimens. Record the natural color and the fluorescence colors in the chart below.
6. Now test your unknowns. Record their natural-light and fluorescence colors.

Mineral	Natural light	Shortwave UV	Longwave UV
Willemite			
Scheelite			
Fluorite			
Unknown _____			
Unknown _____			
Unknown _____			

IV. STREAK

Another test to identify minerals is to rub a sample over a small plate of unglazed porcelain (called a streak plate). The powdered mineral making up the streak sometimes has a different color from the solid mineral.

Name of mineral	Streak color
Pyrite	
Hematite	
Chalcopyrite	
Unknown _____	
Unknown _____	
Unknown _____	

V. CRYSTAL FORM

Minerals usually grow in a specified shape or form that is caused by the way the atoms pack together. Sometimes this is easy to see. In other cases, such as native metals, the crystals are so small that they cannot be seen.

1. Use the contact goniometer provided to measure the angles between the faces of the quartz crystal provided. You should get a value of 120°.
2. Use the goniometer to measure the angles between the faces of the fluorite crystal provided. What do you get?

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3. Use the goniometer to measure the angles between the faces of the calcite crystal provided. Note that not all the angles are equal. What do you get?

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4. If possible, use the goniometer to measure the angles between the faces of your unknowns. (It may not be possible for every unknown.) What do you get?

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You can also describe the crystal form in words. There is a very complicated way of describing crystal form, which fortunately we don't have to go into here. To simplify matters a bit: Crystals may be

- planar (sheetlike)
- acicular (needlelike)
- trigonal (like a three-sided prism)
- cubic
- rectangular (all right angles, but unequal sides)
- rhomboidal ("squashed cube"; all faces have four sides, not all angles right)
- octohedral (eight-sided)
- hexagonal (like a six-sided prism)
- dodecahedral (twelve-sided)

. . . or even stranger shapes. Some minerals have no obvious crystal form: they are *irregular* or *amorphous*. A mineral that grows in circular lumps packed together is said to be *botryoidal*. Look at examples of all of these.

Describe your unknowns' crystal forms as best you can:

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Note that you cannot always see crystal forms. Compare the samples of quartz crystal and agate. Both are made of the same material (SiO_2)—but the crystals of quartz in the agate are microscopic in size, far too small to see. Such a mineral is called *cryptocrystalline*.

VI. CLEAVAGE

Because of the way that the atoms are arranged in a mineral, many minerals have lines along which they are relatively weak and easily broken. A mineral will tend to crack or split more or less smoothly along these lines. The best way to measure cleavage is to break a mineral with a hammer, but you don't get to do that. To study cleavage, you can look at broken surfaces, and look at the way that cracks seem to be developing.

If the mineral is broken in a different direction from its cleavage, it will fracture—break irregularly. Some minerals have no direction of cleavage and always break by fracturing. The fracture may be described as irregular, splintered, or conchoidal (smooth surfaces something like broken glass). Examples of some of these have been set out.

Cleavage is not the same thing as crystal form. Some minerals, such as quartz, form crystals—but the crystals do not cleave along any particular lines.

Number of fracture planes	**Type of Cleavage**
0	No cleavage
1	Flat sheet
2 at 90°	Rectangular prism
2 not at 90°	Parallel prism
3 at 90°	Cubic
3 not at 90°	Rhombohedron
4	Octahedron
6	Dodecahedron

VII. HARDNESS

Geologists use a scale of relative hardness ranging from 1 to 10, known as the Mohs scale. Relative hardness is measured by the fact that a harder substance will scratch a softer one. The mineral talc (Mohs hardness 1) can be scratched with a fingernail. Diamonds (Mohs hardness 10) will scratch any other naturally occurring substance. Don't confuse hardness with tenacity (resistance to breaking). Plain glass, for instance, is fairly hard (Mohs 5.5) but very brittle. Acrylic plastic is not as hard, but is much more resistant to breakage.

1. We will estimate hardness by taking mineral specimens and scratching them with different objects. Take the first unknown mineral specimen and try to scratch it with your fingernail. If your fingernail leaves a scratch, the mineral's hardness is less than

2.5; if not, the hardness is greater.

2. Repeat the exercise using the penny, nail, glass slide, and steel file.
3. Estimate the hardness of your unknown. Repeat for the other two.

Diamond	10	
Corundum (ruby / sapphire)	9	
Topaz	8	
Quartz	7	
	6.5	High-grade steel
Orthoclase	6	
	5.5	Glass
Apatite	5	
	4.5	Iron nail
Fluorite	4	
	3.5	Copper penny
Calcite	3	
	2.5	Fingernail
Gypsum	2	
Talc	1	

VIII. SPECIAL TESTS:

A) Some iron-containing minerals are magnetic; others aren't. There are specimens of three iron-containing minerals at this station. Use the magnets and paperclips provided to test which of these is magnetic. (The magnetic one is called magnetite; the other one is hematite.) The magnetic effect may be extremely weak; observe carefully.

Now test your unknown samples. What do you observe? ___________________________

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B) Some carbonates—minerals with a CO_3 atomic group—give off carbon dioxide gas when they react with acid. Carefully place a small drop of weak hydrochloric acid (HCl) on the specimen of the mineral calcite (calcium carbonate) and dolomite (magnesium carbonate). Do not get this stuff on your fingers. Rinse the mineral in clean water when you are finished. What do you observe? ____

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Now try this with your unknown samples. What do you observe? ____________________

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C) The mineral halite is also known as rock salt. Gently touch the tip of your tongue to the sample of halite. What do you observe? (Do NOT try this with your unknown. Some rocks and minerals are potentially poisonous—it's not a good idea to put unknown substances in your mouth!) ____

D) Some minerals are distinguished by feel. Graphite (native carbon) is usually described as feeling"greasy". Talc usually has a"soapy" feel—in fact, another name for talc is"soapstone." Feel the specimens of graphite and talc. Compare them with the feel of your unknown.

Describe the feel of your unknowns as best you can:

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E) Some minerals contain grains, fibers, or sheets of other minerals inside them. This isn't technically a property of the mineral itself, but it can be useful for identification in some cases.

Examine the unusual quartz crystal. Notice the "sheets" of the mineral rutile (titanium oxide) inside the quartz. (Wonder how they got there?)

Examine the cat's-eye. This is a form of cryptocrystalline quartz, like flint or agate. However, embedded within the quartz are tiny fibers of rutile, all lying parallel. Tilt the cat's-eye back and forth; as the rutile fibers catch the light, you should see a shimmering, "velvety" effect. (The technical name for this is *chatoyance.*)

Now examine the crystals of selenite. Feel a broken end with your finger. The brown "hourglass" shape is caused by sand grains inside the crystal. Wonder how they got there? (HINT: These "hourglass" crystals formed on a salt lake bed.)

If you observe any of these features in your unknowns, make a note of it here:

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For your three unknowns, record all of your data in the charts below.

###	Luster	Translucence	Color	Sp. Grav.

###	Hardness	Fluorescence	Streak

###	Crystal Form	Cleavage	Other Properties

2) Use the key provided to identify your minerals as best you can. Then check with your instructor to find out whether you were right.

###	Your ID	Actual ID

3) Get on the WWW. Look up your three minerals. Find out whether they have any economic uses. Pick one of the three minerals, and write a one-paragraph report, telling me what it is, what its properties are, where in the world it is found, and what its economic use is, if any.