Name:________________________________

Tuesday Wednesday Thursday (circle lab day)

ENVG/SC 10110-20110 Planet Earth Laboratory
http://www.nd.edu/~cneal/PhysicalGeo/Lab-Mineral-ID/index.html
Laboratory #2: The Physical Properties of Minerals

Readings: Chapter 1, Laboratory Manual
Objective: You should learn to recognize the various physical properties of minerals and how to use these to aid in mineral identification. **96 points total**.
Introduction: A *mineral* is a naturally occurring, inorganic, crystalline solid, with a fixed or narrowly specified range of chemical compositions. The atomic arrangement and chemical composition results in a set of physical properties characteristic of a mineral. With practice, it is possible to identify at least several hundred minerals by their physical properties. For this course, however, you only have to be able to identify 25 mineral species, which are set out before you.

I. General Physical Properties (applicable to most minerals; page numbers refer to the lab manual).

1. *Luster* *(pages 2 & 3; Fig. 1.2 of lab manual)* http://www.nd.edu/~cneal/PhysicalGeo/Lab-Mineral-ID/Luster.html

Luster is how a mineral surface appears in reflected light. Minerals can be sub-divided into metallic, sub-metallic or non-metallic categories. Some common adjectives for non-metallic minerals that you will see in the lab are: (1) *vitreous* (glassy), (2), *silky*, (3) *dull or earthy*. Other adjectives include *greasy*, *adamantine*, and *resinous*.

Question (1 pt each): Examine the following specimens and identify their luster.

#2 ________________________ #16 ________________________

#5 ________________________ #17 ________________________

#13 ________________________ #23 ________________________

2. *Color* *(page 2; Fig. 1.1 of lab manual)* http://www.nd.edu/~cneal/PhysicalGeo/Lab-Mineral-ID/Color.html

The color of a mineral is determined by examining a freshly fractured (i.e., not weathered/altered) surface, since many minerals will alter into new minerals (think of iron rusting). In some cases color distinguishes between mineral species, e.g., samples #6 and # 7.

Some minerals display unusual color variation, such as a *play of colors* (iridescence).

Question (1): Which specimen shows a "play of colors"? ________________________

Question (2): Examine specimens #18 and #20. Color is one important means for distinguishing between these two minerals. Describe the difference in colors. ________________________

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Color…

NOTE!!! MANY MINERALS DISPLAY A WIDE RANGE OF COLORS. EXAM SPECIMENS MAY NOT BE THE SAME COLOR AS THOSE PRESENTED TO YOU IN THE LAB.

Go to the bank of cabinets at the east end of the corridor outside the lab room (i.e., turn right and look at the bank of cabinets closest to the lift/elevator on your left as you head down the corridor). The next two questions pertain to some of the minerals in these cabinets.

Question (4 pts): *Bottom shelf of the middle cabinet*. Quartz comes in a wide range of colors due to impurities, ionic substitution, or radiation damage. List at least 4 (four) colors for quartz

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3. Streak *(page 4; Fig. 1.4 of lab manual)* http://www.nd.edu/~cneal/PhysicalGeo/Lab-Mineral-ID/Streak.html

The color a mineral leaves behind when rubbed is its streak; this property is particularly useful for distinguishing between the metallic minerals. Some minerals being harder than the streak plate will not leave a streak (i.e., they will scratch the streak plate). If the mineral scratches the streak plate, write "None".

Question (1 pt each): Rub the following specimens against the streak plate. To the best of your ability, describe the color of the streak left behind by each sample.

#2 ____________________	#17 ____________________
#5 ____________________	#18 ____________________
#13 ____________________	#19 ____________________
#15 ____________________	#20 ____________________
#16 ____________________	#25 ____________________

Question (1 pt each): Rub sample #28 **hard** against the edge of the streak plate. What color streak does it leave? ____.

Which of the samples above is its streak most similar to? __________________________.

4. *Specific Gravity* *(page 11 of lab manual)* http://www.nd.edu/~cneal/PhysicalGeo/Lab1/SG.html

Specific gravity (S.G.) is the ratio of the weight of a substance to the weight of an equal volume of water. Quartz has an S.G. of 2.65. You can compare the S.G. of two minerals by *"hefting"*. Ensure the samples are of similar size.

Question (1 pt): Which has a higher S.G., #4 or #8 ?________________________________

Question (2 pts): Which has the highest S.G, #4, #8, or #19?___________________________

Question (1 pt): Which has a higher S.G., #12 or #28 ?______________________________

5. *Form and Habit* *(see Handout and pages 8-10 of lab manual)*
http://www.nd.edu/~cneal/PhysicalGeo/Lab-Mineral-ID/CrystalForm.html

Crystal form is the external geometric appearance of a perfectly formed crystal (not to be confused with cleavage). Such crystals will grow only under special conditions. Crystal habit refers to the overall shape of a crystal or aggregate of crystals

Question (1 pt each): Identify the habit of the following minerals using the handout provided. Be sure to look at your neighbour's specimens for comparison.

#5 ________________________________ #23 __________________________________

#21 _______________________________ #29 __________________________________

Note: It is uncommon for some minerals to grow crystals large enough to be seen with the naked eye. A specimen comprising a large number of very tiny microscopic crystals is known as a granular mass - #12 is an example of this type of form.

6. *Cleavage* *(see Handout and pages 4-7; Figs. 1.6 to 1.14 in lab manual)*
http://www.nd.edu/~cneal/PhysicalGeo/Lab-Mineral-ID/Cleavage.html

Cleavage is the tendency of a mineral to break along a preferred orientation due to weaknesses in the crystalline structure. Cleavage is a particularly important diagnostic property.

Question (2 pts each): Using the handout provided, identify the number of cleavage planes and, if two or more cleavage planes intersect, whether they are at 90° to one another. Example: Mineral #X displays 2 good cleavage directions at 90°. Qualifiers, such as *poor, good*, *fair* or *perfect* are often used to describe how well defined a cleavage plane is. Perfect cleavage describes cleavage planes that are very smooth and flat, with planes that run in continuous parallel lines. Examining a mineral in strong light will help determine if a cleavage plane exists as a perfect cleavage surface should reflect light like a dull mirror.

#3 ____

#6 ____

#8 ____

#9 (Ask!)____

#14 ____

#19 ____

#21 ____

#24 ____

<u>BONUS!!</u> (4 pts): How many cleavages do #10 and #11 have and how well defined are they? (You may have to ask about this one!)

#10 ____________________________________; #11 __________________________________

7. Fracture *(see Handout and pages 4-7 of lab manual)* http://www.nd.edu/~cneal/PhysicalGeo/Lab-Mineral-ID/Fracture.html

Mineral surfaces that do not break along a preferred orientation exhibit fracture. Mineral #1 has 2 cleavage directions and one fracture surface. Fracture may be *conchoidal, uneven, even, earthy,* and *fibrous*.

<u>Question</u> (2): Identify 2 specimens with conchoidal fracture ____________________________

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8. Hardness *(pages 3 & 4; Figs. 1.3, 1.5; Table 1.1 of lab manual)*
http://www.nd.edu/~cneal/PhysicalGeo/Lab-Mineral-ID/MOH.pdf

A German Mineralogist, Friedrich Moh (1773-1839) developed a qualitative scale of mineral hardness by comparing the hardness of one mineral to another, and by using other easily available materials. Hardness is defined as a mineral's resistance to abrasion. Here you will develop your own scale of hardness by comparing several minerals to each other, and to your fingernail, to a penny, glass, and an iron file or nail. See page 7 of this handout.

Note! The hardness scale developed by Moh is non-linear. The hardest mineral on the scale, diamond, is 10 times harder than the next hard mineral, corundum.

<u>Question</u> (5): Compare the following specimens: #21, #3, #22, #23, #13. Rank them from softest to hardest. Remember: minerals of the same hardness cannot scratch each other.

1. ___________ Soft
2. ___________
3. ___________
4. ___________
5. ___________ Hard

<u>Question</u> (4): Which of the **above** mineral(s) can you scratch with your fingernail?__________

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Identify 2 other minerals on the table that can be scratched with your fingernail (2)__________

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<u>Question</u> (1): Where would #19 rank on **your** scale? __________________________________

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II Special Physical Properties (pages 10 & 11) (less commonly used properties but important for identifying some minerals) http://www.nd.edu/~cneal/PhysicalGeo/Lab-Mineral-ID/Other.html

9. Taste *(page 11 of lab manual)*

One mineral in this set has a particularly diagnostic taste. #24 is commonly known as table salt. Guess what it tastes like! IN THE INTERESTS OF HYGIENE, DON'T LICK IT!

10. Feel *(page 11 of lab manual)*

Some minerals have a distinctive texture. Geologists use the following descriptive adjectives to describe the texture of minerals: *greasy, smooth, soft, and rough*.

Question (1 pt. each): Use the descriptive adjectives to describe the feel of the following minerals.

#2 ______________________________ #16 ______________________________

#4 ______________________________ #23 ______________________________

#9 ______________________________ #25 ______________________________

11. Magnetism *(page 10 of lab manual)*

Question (1): Test all of the minerals using the small magnet provided. Which mineral is magnetic? ________________________ ______________________________

12. Chemical Reaction *(page 10; Fig. 1.19 of lab manual)*

Some minerals react to cold or warm dilute hydrochloric acid (HCl), or will react when powdered.

Question: In this lab you will use cold dilute HCl acid to test the following minerals: #14, #21, #22. Place one drop of HCl on the three specimens. Which one(s) react(s)? (2) ___________

Powder a bit of all three specimens using the nail or metal file.

Which one(s) react(s)? (2) __________ ______________________________

13. Odor *(page 11 of lab manual)*

A few minerals give off a characteristic odor when damp. Exhale on specimen #2 and describe its odor. It's odor is ____________________. (1)

14. Transmission of Light

The ability of a thin section of a mineral to transmit light is called *diaphaneity*. If an object is clearly seen through a section of a mineral, the mineral is called *transparent*. If the object is somewhat blurred it is *translucent*, and if no light passes through even the smallest thin section, then the mineral is *opaque*. As we are not dealing with thin sections of minerals this property cannot be accurately tested in the lab.

Light transmitted through a translucent mineral may split into two directions. If an object appears to be doubled when viewed through a transparent mineral, the mineral is said to have double defraction. This property will be displayed in the lab.

Some minerals fluoresce under ultra-violet light. This property will be demonstrated in next weeks lab.

15. Tenacity *(page 11 of lab manual)*

The way a mineral breaks when hit with crushed or bent is its tenacity. A *brittle* mineral shatters when dropped or struck by a hammer. An elastic mineral will bend without breaking and return to its original shape, while a flexible mineral also bends without breaking, but does not return to its original shape. Chlorite is an example of a mineral that is flexible.

III Questions of Understanding

1. Name at least 2 physical properties you would use to differentiate between samples #5 and #8. ______________________________ (2)

2. Diamond is the hardest mineral known to humans, but diamond cutters can shape diamonds into particular cuts. What characteristic physical property of diamond allows the diamond to be shaped? ______________________________ (1)

3. How well do you know your physical properties? **Identify** 5 physical properties that you can use to identify the following specimens: #28, #29, #30. **Include a description of the physical property.**

Example: Specimen #9: Tenacity (Flexible), Color (Green to Brown), Cleavage (1 direction perfect cleavage), Hardness (Scratch with copper penny), Feel (Soapy)

Do only 2 out of 3 minerals. (10 pts each).

Definitions of Cleavage and Parting.

Mineral Cleavage:
Minerals with perfect cleavage cleave without leaving any rough surfaces; a full, smooth plane is formed where the crystal broke.

Minerals with good cleavage also leave smooth surfaces, but often leave over some rough surfaces.

In minerals with poor cleavage, the smooth crystal edge is barely visible, since the rough surface is dominant.

Minerals with no cleavage (none) never exhibit any cleavage, thus broken surfaces are jagged and rough.

If a mineral exhibits cleavage, but it so poor that it is hardly noticeable, it has "indistinct" cleavage.

Parting
Characteristically similar to cleavage.
It is easily confused with cleavage, and is often present on minerals that do not exhibit any cleavage.
There are two causes of parting:

1. Two separate pressures pushed toward the center of a crystal after its formation, causing the crystal interior to evenly dislodge on a flat, smooth plane.
2. Twin crystals that separated from one another, leaving a flat, smooth plane.