# ES 202: Laboratory: PHYSICAL PROPERTIES OF MINERALS

Student Name: {Type your name in this Space}

##### **Instructions**: Log on to Moodle and navigate to the following course shell: ES202 Online Labs - Winter Term 2021. Complete the Part I minerals lab assignment by navigating to each of the "Mineral Properties Specimen Stations" set up in the Minerals Lab Section.  For each station, first watch one or more very brief videos to familiarize yourself with a given physical property that pertains to the station.  Then, open the Station PDF document which contains graphical images of various minerals and their corresponding physical properties.  Use the Station PDF document and images as your virtual hand sample, then examine your "lab specimen".  Follow the directions on the worksheet below and answer all the questions by filling in the blanks.  When completed, the Task 3-5 worksheet will be uploaded via the Week 3 assignment submission process on the ES202 Principles of Geology lecture Moodle shell, along with your other weekly assignments, as per our usual weekly upload process.

## Introduction

**Minerals** are naturally occurring, usually inorganic, solids that possess a definite chemical composition and a specific, orderly arrangement of atoms. This lab will help you to develop the ability to identify common minerals found at the earth's surface. Although there are literally thousands of minerals, the small number of the most common rock forming, ore, and industrial minerals studied here constitute a large part of the earth's crust. Identification is accomplished by testing and observing the physical properties of a given mineral. This week’s laboratory assignment will focus on describing the physical properties of minerals. In the next lab, you will use these observations to identify of a set of minerals using the physical properties.

Minerals exhibit certain diagnostic properties, called physical properties, which can be tested and observed, thereby leading to the correct identification of the mineral. Many (but not all) of these properties are unique to a given mineral. One of the keys to identifying minerals is observing a combination of physical properties displayed by a mineral. Therefore, you must be sure of the meaning of each of the physical properties. Through a series of “stations”, you will explore these properties: color, luster, streak, magnetism, effervescence, crystal form, cleavage, fracture, hardness, and density. In the online environment, we will not be able to engage in the same hands-on experience as the in-person lab allows, but hopefully this series of high-quality images and graphics will introduce to the main concepts.

## Objective

* Recognize and describe the physical properties of minerals

## STATION #1: *Color*

Study the images of mineral specimens of quartz shown in the PDF (Station 1-Color). Describe the color that you observe for each sample in the table below.

|  |  |
| --- | --- |
| **Sample 1-A:** | Pink |
| **Sample 1-B:** | Purple |
| **Sample 1-C:** | White |

What is the reason for the variety of colors that you observe in the mineral quartz? (Hint: Think about what happens if you add several drops food coloring to water.)

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| There may be impurities or other elements that change the visible color of the sample. |

Is color a reliable physical property to help identify a given mineral specimen? Explain your answer.

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| Color may not be the best property to use to identify minerals since one mineral can have many color variations and two different minerals may have the same color. |

## STATION #2: *Luster*

Study the images of the various mineral specimens shown in the PDF (Station 2-Luster). Describe the luster that you observe for each sample in the table below. The options are as follows: **Metallic**, **Nonmetallic-Vitreous/Glassy**, **Nonmetallic-Waxy/Pearly**, and **Nonmetallic-Earthy/Dull**.

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| --- | --- |
| **Sample 2-A:** | Metallic |
| **Sample 2-B:** | Nonmetallic-Waxy/Pearly |
| **Sample 2-C:** | Metallic |
| **Sample 2-D:** | Nonmetallic-Vitreous/Glassy |
| **Sample 2-E:** | Metallic |
| **Sample 2-F:** | Nonmetallic-Vitreous/Glassy |
| **Sample 2-G:** | Nonmetallic-Waxy/Pearly |
| **Sample 2-H:** | Nonmetallic-Vitreous/Glassy |
| **Sample 2-I:** | Nonmetallic-Earthy/Dull |

For **Sample J**: describe the color AND luster of the two minerals present in this specimen (labeled i and ii).

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| --- | --- | --- |
|  | **COLOR** | **LUSTER** |
| **Sample 2-J-i:** | Gold | Metallic |
| **Sample 2-J-ii:** | White | Nonmetallic-Vitreous/Glassy |

Describe Luster in your own words.

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| Luster describes how light interacts with the surface or a mineral. |

## STATION #3: *Streak*

Study the images of the various mineral specimens shown in the PDF (Station 3: Streak). Describe the color of the streak that you observe for each sample in the table below. .

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| --- | --- |
| **Specimen #** | **Describe the color of the streak.** |
| **41.** | Gray and Metallic |
| **42.** | Clearish to yellowish |
| **43.** | Blueish green |
| **44.** | Gray |
| **45.** | Brown |
| **46.** | Clear/ white |
| **47.** | Clear/ white |
| **48.** | Red/ brown |
| **49.** | Yellow |
| **50.** | Blue |
| **51.** | Brown |

For **Samples 3-A and 3-B**: describe Luster AND the color of the Streak for these two minerals. Select the best match from the specimens studied above that best corresponds to the samples given below and enter the number in the appropriate space.

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| --- | --- | --- | --- |
|  | **LUSTER** | **STREAK** | **Spec # from Above** |
| **Sample 3-A:** | Metallic | Grey | #44 |
| **Sample 3-B:** | Nonmetallic-Earthy/Dull | Red/Brown | #45 |

**STATION #4: *Magnetism and Effervescence***

Describe how to test whether a sample is magnetic.

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| Place a magnet on the sample to see if it sticks to it or not. |

Describe how to determine whether a sample reacts in HCl acid.

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| Drop some HCl on to the sample. If the sample fizzes it indicates a reaction. |

Samples 4-A and 4-B display magnetism and effervescence, respectively. For each sample, describe the Color and Luster using terminology from previous stations. Study the AGI lab manual and determine the most likely mineral shown in each image.

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| --- | --- | --- |
|  | **COLOR** | **LUSTER** |
| **Sample 4-A:** | Gray | Metallic |
| **Sample 4-B:** | Brownish orange | Waxy-nonmetallic |

Study the AGI lab manual and determine the most likely mineral shown in each image.

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| --- | --- |
|  | **IDENTIFY MINERAL** |
| **Sample 4-A:** | Magnetite |
| **Sample 4-B:** | Calcite |

## STATION #5: *Crystal Form*

**Crystal Form** refers to the shape a mineral takes because it GROWS this way and is controlled by the internal atomic structure. There are hundreds of descriptive terms applied to the crystal shapes, habit, and form. It is beyond the realms of this class to delve into this too deeply, but to introduce you to some of these terms, complete this activity.

Study the images of the various mineral specimens shown in the PDF for Station 5: Crystal Form. Assign the correct name of the crystal form from the set of crystal from images to the set of mineral samples.

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| **Sample 5-A:** | Cubic |
| **Sample 5-B:** | Dodecahedron |
| **Sample 5-C:** | Hexagonal Dipyramid Prism |
| **Sample 5-D:** | Octahedron |
| **Sample 5-E:** | Monoclinic Prisms |

**STATION #6: *Cleavage and Fracture***

**Cleavage** and **Fracture** are related to how a mineral breaks apart. They are controlled by the internal atomic arrangement of the mineral.

Between cleavage and fracture, which is controlled by weak chemical bonding, and which is controlled by strong chemical bonding? Briefly explain.

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| Cleavage is controlled by weak bonds and Fracture is controlled by strong bonds.  (Action is controlled by James Bonds ) |

Study the group of mineral images shown in the PDF for Station 6: Cleavage and Fracture. Most of the images exhibit cleavage and one shows fracture. Complete the data table by describing the cleavage in each sample in terms of the number of directions and the angle between them. Refer to the graphics provided in the PDF document for guidance in completing this exercise.

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| --- | --- | --- |
|  | **# of Directions** | **Angle**  **(90º or not 90º)** |
| **Sample 6-A:** | Fracture | NA |
| **Sample 6-B:** | 1 | NA |
| **Sample 6-C:** | 2 | 90º |
| **Sample 6-D:** | 2 | not 90º |
| **Sample 6-E:** | 3 | 90º |
| **Sample 6-F:** | 3 | not 90º |

**STATION #7: *Hardness***

The following hardness guide is useful to bracket the hardness of an unknown sample.

Hardness Guide:

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| --- | --- |
| **Hardness** | **Description** |
| **less than 2.5**  **(<2.5)** | Mineral can be scratched by fingernail (H = 2.5). |
| **2.5 to 3.5** | Mineral cannot be scratched by fingernail (H = 2.5) and cannot scratch penny (H = 3.5). |
| **3.5 to 5.5** | Mineral can scratch penny (H = 3.5) and cannot scratch glass (H = 5.5). |
| **greater than 5.5**  **(>5.5)** | Mineral can scratch glass (H = 5.5). |

Determine the hardness for the small group of minerals provided in the Station 7: Hardness PDF and complete the data table.

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| **Sample** | **Hardness** |
| **Sample 7-A:** | greater than 5.5 (>5.5) |
| **Sample 7-B:** | less than 2.5 (<2.5) |

## STATION #8: *Density*

One of the physical properties is called heft. This term is a person's estimation of how heavy a mineral is. Obviously different people have different ideas of what is heavy. Therefore, heft is not very "scientific". The physical property called density determines exactly how heavy a mineral is. Density can be measured with a high degree of accuracy. Perhaps of greater importance, any person doing the determination should get the same answer. In other words, the answer is objective and not subjective. The concept that anyone doing the experiment should get the same answer is fundamental to science. The images in the PDF for Station 8 show one of the basic methods for determining density.

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The density of a substance is mass per volume, shown by the equation: **Density = Mass/Volume**.

**First step:** Specimen is weighed on a scale. **7.35 grams**

**Second step:** Refer to the image provided in the PDF for Station 8. Determine the volume of the specimen by displacement of water in a graduated cylinder (1 mL = 1 cm3).

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| 2.8 cm3 |

**Third step:** Use the equation given above to determine the value of the density.

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| 7.35g / 2.8 cm3 = 2.63g/cm3 |

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**Questions for thought:**

A term, quite similar to density that is often used is specific gravity (S. G.). It also gives the idea of "heaviness" of a mineral, but it does so by comparison with water, which has a SG of one. Specific gravity can be thought of as the number of times the mineral is heavier than if the piece of mineral were made of water. So, a mineral with a specific gravity of 2.7, means it is 2.7 times heavier than if that same specimen were made of water.

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| What would you guess the specific gravity of oil is? (greater than or less than one) | less than one |
| If a substance had a specific gravity of 2.65, would it float or sink in water? | sink |
| What must be the specific gravity of ice? (greater than or less than one) | less than one |