7 Matter and Minerals

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7.1 INTRODUCTION

Have you used a mineral yet today? While many people may initially say no, answer these questions: Have you brushed your teeth? Have you eaten anything that might contain salt? Did you put on make-up this morning, or do you have painted fingernails or toenails? Have you used a cellphone? What about a car, bike, or public transportation? If you have done any of those things, you have used at least one mineral, and in many cases you have used a great number of minerals. Minerals are very useful and common in everyday products, but most people do not even realize it.

A **mineral** is defined as a naturally occurring, inorganic solid with a definite chemical composition and a characteristic crystalline structure. Let's break that definition down. By naturally occurring, it means that anything man has created, like the beautiful synthetic bismuth in Figure 7.1, does not count as a mineral. To be an inorganic solid, the mineral must not be composed of the complex carbon molecules that are characteristic of life and must be in the solid state, rather than vapor or liquid. This means that water, a liquid, is not a mineral, while ice, a solid, would be (as long as it is not man-made). A definite chemical composition refers to the chemical formula of a mineral. For most minerals, this does not vary (ex. halite is NaCl), though some minerals have a range of compositions, since one element can substitute for another of similar size and charge (ex. olivine is (Mg,Fe)2SiO4, and its magnesium and iron content can vary). The atoms within minerals are lined up in an orderly fashion, so that the characteristic crystalline structure is just an outward manifestation of the internal atomic arrangement.

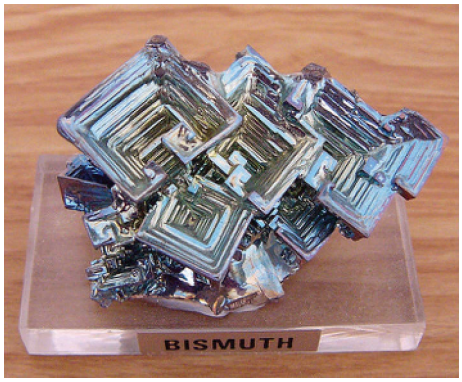

Figure 7.1 | Synthetic bismuth
Author: Philippe Giabbanelli
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Minerals are not only important for their many uses, but also as the building blocks of rocks. In this lab, you will lay the foundation for all the future rock labs in the course. Correct mineral identification is critical in geology, so work through this lab carefully. There are several thousand minerals, but we will focus on only eighteen of the most common ones.

7.1.1 Learning Outcomes

After completing this chapter, you should be able to:

- Know the definition of a mineral
- Understand the many different physical properties of minerals, and how to apply them to mineral identification
- Be able to distinguish mineral cleavage from mineral fracture
- Identify 18 minerals

7.1.2 Key Terms

- Cleavage
- Crystal Form
- Fracture
- Hardness
- Luster
- Mineral
- Specific Gravity
- Streak
- Tenacity

7.2 PHYSICAL PROPERTIES

Identifying a mineral is a little like playing detective. Minerals are identified by their physical properties. For example, look at Figure 7.2. How would you describe it? You may say that it is shiny, gold, and has a particular shape. Each of these descriptions is actually a physical property (shiny=luster, gold=color, shape=crystal form). Physical properties can vary within the same minerals, so caution should be applied. For example, color is a property that is not a very realistic diagnostic tool in many cases. Quartz is a mineral that comes in a variety of colors, as evidenced by Figure 7.3. Occasionally color can be helpful, as in the case of the mineral olivine. Olivine is said to be “olive green” (a light to dark green)

Figure 7.2 | Describe this mineral.
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Figure 7.3 | Examples of the different varieties of quartz (jasper, rose quartz, smoky quartz, agate, amethyst, citrine, and petrified wood), demonstrating the difficulty of identifying this mineral.
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Figure 7.4 | The mineral olivine is "olive green."
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as seen in Figure 7.4. Make sure you use caution when using color to help identify minerals. We will cover each of the physical properties in detail to help you identify the minerals.

7.2.1 Hardness

Hardness refers to the resistance of a mineral to being scratched by a different mineral or other material and is a product of the strength of the bonds between the atoms of a mineral. Whatever substance does the scratching is harder; the item scratched is softer. Hardness is based off a scale of 1 to 10 created by a mineralogist named Friedrich Mohs (Figure 7.5). Mohs' scale lists ten minerals in order of relative hardness. Each mineral on the scale can scratch a mineral of lower number. Your mineral kit comes with several items of a known hardness. The glass plate has a hardness of 5.5, the iron nail has a hardness of 4, the copper wire has a hardness of 3, and your fingernail has a hardness of 2.5. If you can scratch a mineral, then it would be softer than your fingernail, so therefore its hardness would be <2.5. When trying to scratch a surface, use force, but be cautious with the glass plate. **ALWAYS lay the glass plate on a flat surface rather than holding it in your hand in case it breaks.** Do not confuse mineral powder with a scratch – use your finger to feel for a groove created by a scratch (mineral powder is left behind when a soft mineral scratches a harder surface). Materials of similar hardness have difficulty scratching each other, so that, for example, your fingernail may not be able to always scratch biotite mica, which has a hardness of 2.5.

Number	Mineral	Hardness of Test Kit Items
1	Talc	(softest mineral)
2	Gypsum	2.5 – Fingernail
3	Calcite	3 – Copper Wire
4	Fluorite	4 – Nail
5	Apatite	5.5 – Glass Plate
6	Orthoclase Feldspar	
7	Quartz	
8	Topaz	
9	Corundum	
10	Diamond	(hardest mineral)

Figure 7.5 | Mohs' Scale of Hardness

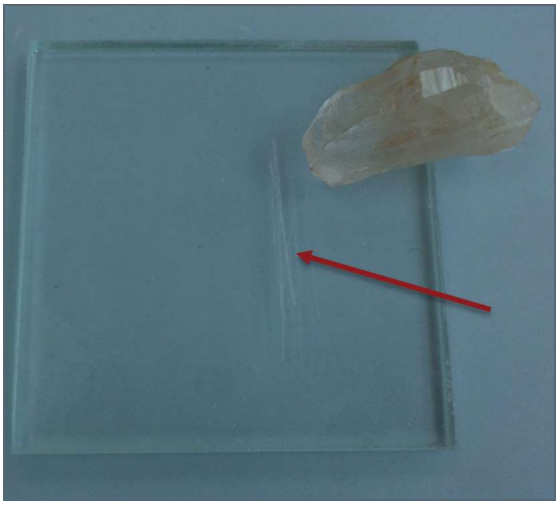

Figure 7.6 | An example of a scratch made by the mineral quartz on a streak plate. The red arrow is pointing to the scratch. Quartz, therefore, is harder than glass.
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Figure 7.7 | An example of a scratch made by a fingernail on the mineral gypsum. The red arrow is pointing to the scratch. Gypsum, therefore, is softer than a fingernail.
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7.3 LAB EXERCISE

Materials

Your HOL Lab Kit contains 18 numbered mineral samples, separated into 3 bags (labeled as Mineral Bag 1, 2, or 3). Use these instructions to test and identify them. You will test for different properties after learning about them, then work on identification at the end of the lab. The HOL kit has been specifically tailored to this class – make sure that you are using the kit required by this class, as other rock and mineral kits will not work. Images will be provided of the correct kit; make sure that you closely compare your kit to the images so that you are working with the correct samples. Empty the contents of the testing kit. It will contain:

a. A 3” copper wire
b. Glass plate (wrapped in paper) – this will be used in testing hardness
c. Zinc coated nail
d. Unglazed porcelain plate (wrapped in paper) – this will be used as a streak plate
e. Hydrochloric acid
f. Magnifying glass (10x). To use this, hold it very close to your eye and bring the sample near the glass until it is in focus (approximately one inch from your eye).
g. Gloves and protective goggles (for use with the acid)

Take out Minerals Bag 1 and lay the six mineral samples out on a white sheet of paper. It should appear like Figure 7.8. We will first examine hardness from these six samples, and will answer more questions about them later in the lab. Look closely at each of the minerals, using the hand lens to observe them. In this bag, you have the following minerals (not listed in order): Microcline (also called Potassium Feldspar), Fluorite, Quartz, Olivine, Talc, and Selenite (also called Gypsum). They are numbered 1-6.

You need to experiment with each sample to test for its hardness and use Figure 7.5 for reference. Remember that hardness is determined by scratching the mineral (or using the mineral to scratch something else). First, decide which minerals have a hardness greater than 5.5 (the hardness of glass). Lay the glass on a flat surface (not in your hand), then try to scratch it with each mineral. Bare down hard with the mineral, much like trying to leave a scratch on a car with a key. Table 7.1 is given at the end of this lab for you to make notations about each mineral. Note that you do not have to fill in every physical property for every mineral (that would be very time-consuming with 18 samples). Just fill in the properties you are asked about as you work. Note now on the table which minerals have a hardness greater than 5.5. You may also test samples by using materials to scratch them. The copper wire has a hardness of 3. Any mineral that it can scratch will have a hardness less than 3. You can further refine this by using your fingernail (only natural fingernails work for this). Your fingernail has a hardness of 2.5, so if the copper wire scratches a mineral and your fingernail also scratches it, you know its hardness must be <2.5. The zinc coated nail has a hardness of 4. Also use it to scratch the minerals. Minerals may also be used to scratch each other. For example, if you have two minerals that have a hardness of <2.5, you can see if one will scratch the other. Then you know it is harder, since it did the scratching.

Figure 7.8 | The six minerals (#1-6) in Minerals Bag 1 in the HOL kit.
Author: Randa Harris
Source: Original Work

1. Sample 1: What is this sample's hardness?

    a. harder than glass

    b. softer than glass but harder than nail

    c. softer than nail but harder than copper

    d. softer than copper but harder than a fingernail

    e. softer than a fingernail

2. Sample 2: What is this sample's hardness?

    a. harder than glass

    b. softer than glass but harder than nail

    c. softer than nail but harder than copper

    d. softer than copper but harder than a fingernail

    e. softer than a fingernail

3. Sample 3: What is this sample's hardness?

    a. harder than glass

    b. softer than glass but harder than nail

    c. softer than nail but harder than copper

    d. softer than copper but harder than a fingernail

    e. softer than a fingernail

4. Sample 4: What is this sample's hardness?

    a. harder than glass

    b. softer than glass but harder than nail

    c. softer than nail but harder than copper

    d. softer than copper but harder than a fingernail

    e. softer than a fingernail

5. Sample 5: What is this sample's hardness?

    a. harder than glass

    b. softer than glass but harder than nail

    c. softer than nail but harder than copper

    d. softer than copper but harder than a fingernail

    e. softer than a fingernail

6. Sample 6. What is this sample's hardness?

    a. harder than glass

    b. softer than glass but harder than nail

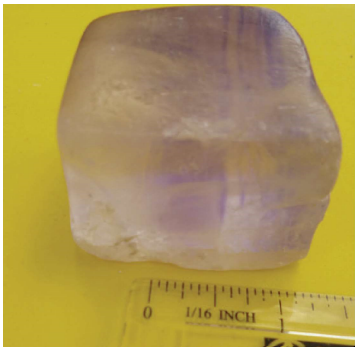
    c. softer than nail but harder than copper

    d. softer than copper but harder than a fingernail

    e. softer than a fingernail

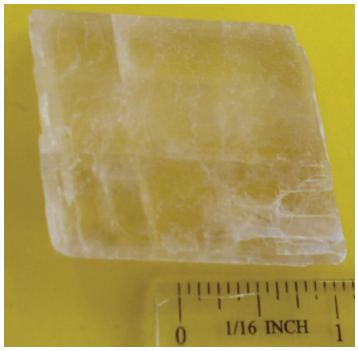
7.4 CRYSTAL FORM

This property refers to the geometric shape that a crystal naturally grows into, and is a reflection of the orderly internal arrangement of atoms within the mineral. If minerals have space to grow when they are developing, they will display their **crystal form**. These ideal growth conditions do not always occur, however, so many minerals do not display their ideal crystal form due to crowded conditions during growth. Examples of crystal form are shown in Figure 7.9.



Cube

Hexagonal Prism



Rhombohedron

Octahedron (8 faces)

Dodecahedron (12 faces)

Figure 7.9 | Examples of crystal form
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7.5 CLEAVAGE

As minerals are broken (such as with a rock hammer, for example), some may cleave, or break, along smooth flat planes known as **cleavage.** These flat surfaces are parallel to directions of weakness within the crystal. All the bonds among the atoms within a mineral may not be of the same strength, so that when a mineral is broken, it breaks along these zones of weakness. This results in flat cleavage planes. Minerals with perfect cleavage break along a smooth, flat plane, while those with poor cleavage break in a more irregular fashion. Some minerals do not contain zones of weakness either because all of the bonds are the same strength or the weaker bonds are not aligned within a plane. If this is the case it will not have cleavage, but rather breaks in a random and irregular fashion. Make sure to distinguish cleavage from crystal form. Crystal form occurs as a mineral *grows*, while cleavage only forms as a mineral *breaks*. See Figure 7.10 for the main types of cleavage and an example of each.

# of Cleavages & Direction	Cleavage Name	Example
0 (none) – mineral fractures	No cleavage planes	
1	Basal cleavage – flat sheets	
2 – cleavages at or near 90°	Prismatic cleavage – rectangular cross-sections	
2 – cleavages not at 90°	Prismatic cleavage – parallelogram cross-sections	

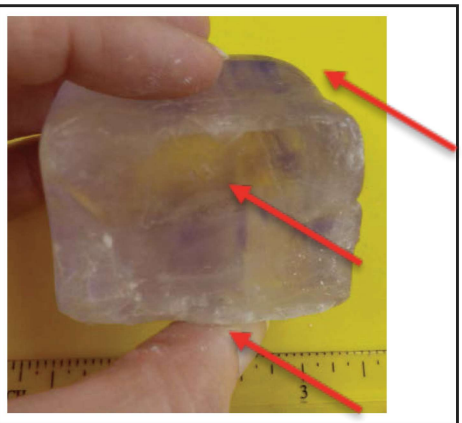
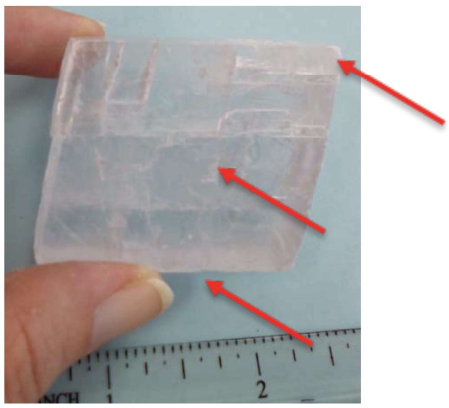
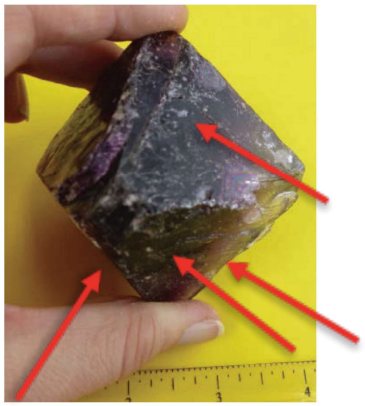
3 – cleavages at 90°	Cubic cleavage – cubes	
3 – cleavages not at 90°	Rhombohedral cleavage – rhombs	
4	Octahedral cleavage	

Figure 7.10 | Chart with the main types of cleavage, along with picture examples. Red arrows are pointing to the different cleavage planes in each picture.
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A mineral may have one or more cleavage planes. Planes that are parallel are considered the same direction of cleavage and should only count as one. One direction of cleavage is termed basal cleavage. Minerals that display this cleavage will break off in flat sheets. Two directions of cleavage is termed prismatic, while three directions of cleavage at 90° is referred to as cubic. A mineral with four directions of cleavage is termed octahedral. With 2 or more cleavage planes present, it is important to pay attention to the angle of the cleavage planes. To determine the

angle of cleavage, look at the intersection of cleavage planes. Commonly, cleavage planes will intersect at 60º, 90º (right angles), or 120º. Be cautious when you see a flat surface on a mineral – not every flat surface is a cleavage plane. Crystal faces can be flat, but remember they form as a mineral grows, while cleavage forms as a mineral breaks. The crystal form of quartz is a hexagonal prism, with nice flat sides. But when quartz is hit with a rock hammer, it breaks in an irregular fashion and does not exhibit cleavage. Also use caution when trying to distinguish the minerals pyroxene and amphibole. Both minerals are black or greenish-black, with similar hardness, making them difficult to tell apart. You must observe the cleavage angles to tell them apart. Cleavage angles in pyroxene are near 90º, so expect it to look boxy and form right angles. Cleavage angles in amphibole are 60º and 120º, so expect a more bladed or pyramid like appearance (Figure 7.11).

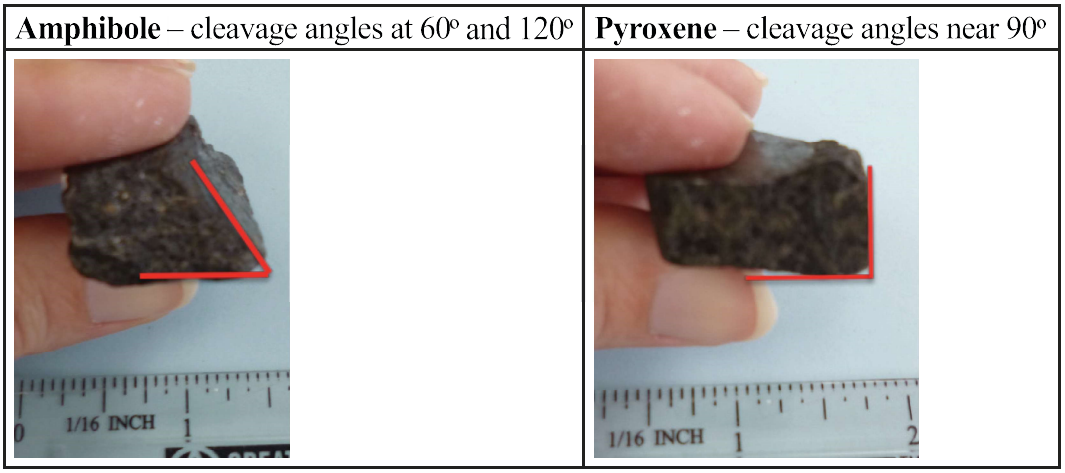

Figure 7.11 | Comparison of cleavage angles between amphibole and pyroxene.
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7.6 FRACTURE

When minerals do not break along cleavage planes, but rather break irregularly, they are said to **fracture**. Commonly fracture surfaces are either uneven or conchoidal, a ribbed, smoothly curved surface similar to broken glass (Figure 7.12).

Figure 7.12 | This piece of igneous rock called obsidian has been hit with a hammer and is displaying conchoidal fracture.
Author: Randa Harris
Source: Original Work
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7.7 LAB EXERCISE

Take out Minerals Bag 2 and lay the six mineral samples out on a white sheet of paper. It should appear like Figure 7.13. We will first examine cleavage and fracture, along with hardness, from these six samples, and will answer more questions about them later in the lab. Look closely at each of the minerals, using the hand lens to observe them. In this bag, you have the following minerals (not listed in order): Pyroxene, Muscovite Mica, Halite, Amphibole, Calcite, and Biotite Mica. They are numbered 7-12.

Figure 7.13 | The six minerals (#7-12) in Minerals Bag 2 in the HOL kit.
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7. Sample 7: This sample has:

a. no cleavage (it fractures)
b. 1 cleavage plane
c. 2 cleavage planes at 90°
d. 3 cleavage planes at 90°
e. 4 cleavage planes

8. Sample 8: This sample has:

a. no cleavage (it fractures)
b. 1 cleavage plane
c. 2 cleavage planes not at 90°
d. 3 cleavage planes not at 90°
e. 4 cleavage planes

9. Sample 9: This sample has:

    a. no cleavage (it fractures)
    b. 1 cleavage plane
    c. 2 cleavage planes not at 90°
    d. 3 cleavage planes at 90°
    e. 4 cleavage planes

10. Sample 10: This sample has:

    a. no cleavage (it fractures)
    b. 1 cleavage plane
    c. 2 cleavage planes not at 90°
    d. 2 cleavage planes at 90°
    e. 4 cleavage planes

11. Sample 11: This sample has:

    a. no cleavage (it fractures)
    b. 1 cleavage plane
    c. 2 cleavage planes not at 90°
    d. 2 cleavage planes at 90°
    e. 3 cleavage planes at 90°

12. Sample 11: What is this sample's hardness?

    a. harder than glass
    b. softer than glass but harder than nail
    c. softer than nail but harder than copper
    d. softer than copper but harder than a fingernail
    e. softer than a fingernail

13. Sample 12: This sample has:

    a. no cleavage (it fractures)
    b. 1 cleavage plane
    c. 2 cleavage planes not at 90°
    d. 2 cleavage planes at 90°
    e. 3 cleavage planes not at 90°

14. Sample 12: What is this sample's hardness?

a. harder than glass b. softer than glass but harder than nail

c. softer than nail but harder than copperd. softer than copper but harder than a fingernail

e. softer than a fingernail

7.8 LUSTER

Luster refers to the appearance of the reflection of light from a mineral's surface. It is generally broken into two main types: metallic and non-metallic. Minerals with a metallic luster have the color of a metal, like silver, gold, copper, or brass (Figure 7.14). While minerals with a metallic luster are often shiny, not all shiny minerals are metallic. Make sure you look for the color of a metal, rather than for just a shine. Minerals with non-metallic luster do not appear like metals. They may be vitreous (glassy), earthy (dull), waxy (similar to a candle's luster), greasy (oily), or other types (Figure 7.15).

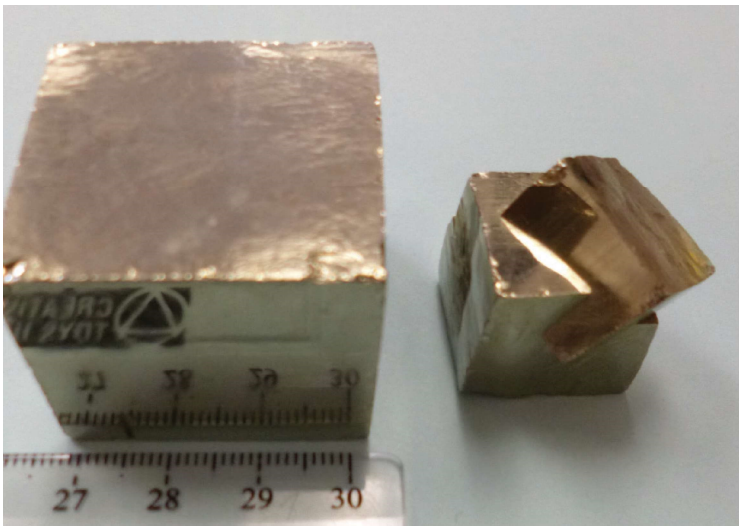

Figure 7.14 | Examples of the metallic luster of pyrite, also known as "fool's gold."
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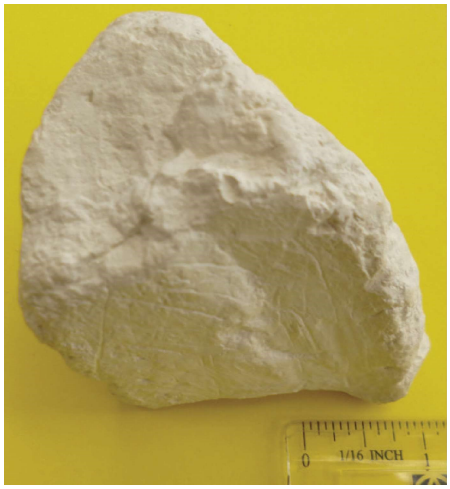
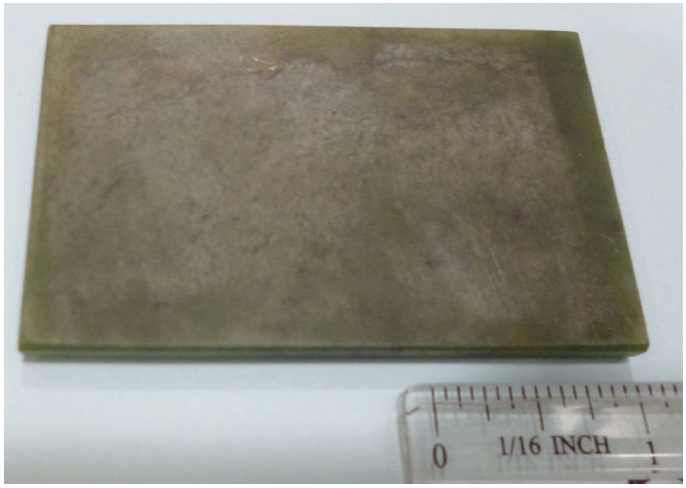
Vitreous	
Earthy	
Waxy	

Figure 7.15 | Examples of different types of non-metallic lusters.
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7.9 STREAK

Streak is an easily detectable physical property. It refers to the color left behind on an unglazed piece of porcelain when a mineral is rubbed along its surface. A streak plate is included in your rock and mineral kit to test this property. Often a mineral will have a streak of a different color than the color of the mineral (for example, pyrite has a dark gray streak, Figure 7.16). Some minerals will have a white streak, which is difficult to see along the white streak plate. If you rub a mineral along the streak plate and do not see an obvious streak, wipe your finger along the streak plate. A mineral with a white streak will leave a white powder behind that will rub on your finger (Figure 7.17).

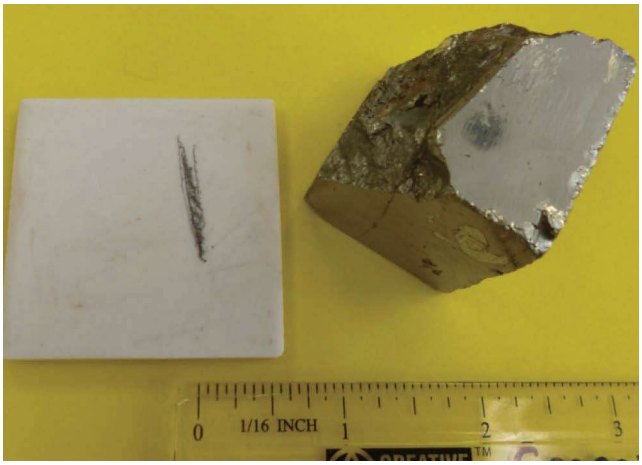

Figure 7.16 | An example of the dark gray streak left behind when pyrite is rubbed along a streak plate.
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Figure 7.17 | An example of the white streak (on finger) left behind when fluorite is rubbed along a streak plate.
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7.10 SPECIAL PHYSICAL PROPERTIES

Several minerals have unique properties that aid in their identification. **Tenacity** refers to the way a mineral resists breakage. If a mineral shatters like glass, it is said to be brittle (like quartz), while minerals that can be hammered are malleable (like copper, Figure 7.18). Minerals may be elastic, in which they are flexible and bend like a plastic comb, but return to their original shape (like mica, Figure 7.19). Sectile minerals are soft like wax, and can be separated with a knife (like gypsum).

Figure 7.18 | Copper, which can be hammered into thin sheets, is malleable.
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Some minerals react when dilute hydrochloric acid is placed on them. Carbonate

minerals (minerals that include CO_3 in their chemical formula) will effervesce or fizz when acid is applied to them. When you test a mineral with acid, be cautious and use just a drop of the acid. Use your magnifying glass to look closely for bubbles (Figure 7.20). The acid is very dilute and will not burn your skin or clothing, but wash your hands after use (gloves and goggles are provided). Also make sure that you rinse with water and wipe off the acid from the minerals that you test.

Minerals may be magnetic, and this property is simply tested by seeing if your nail is attracted to a mineral. Magnetite is an example of a magnetic mineral. The mineral halite is simply table salt, so it will taste salty. Graphite is used in pencils, and makes a nice smudge when rubbed along paper. Talc will feel soapy when touched.

Specific gravity is the ratio of a mineral's weight to the weight of an equal volume of water. A mineral with a specific gravity of 2 would weigh twice as much as water. Most minerals are heavier than water, and the average specific gravity for all minerals is approximately 2.7. Some minerals are quite heavy, such as pyrite with a specific gravity of 4.9-5.2, native copper, with a specific gravity of 8.8-9.0, and native gold at 19.3, which makes panning useful for gold, as the heavy mineral stays behind as you wash material out of the pan.

Figure 7.19 | Muscovite mica, which bends but returns to its original shape, is elastic.
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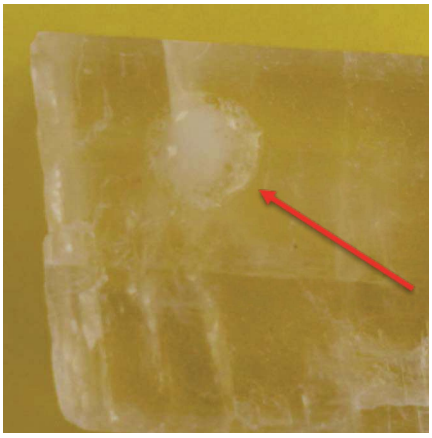

Figure 7.20 | Note the effervescing acid bubbles at the red arrow on this piece of calcite.
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7.11 LAB EXERCISE

Take out Minerals Bag 3 and lay the six mineral samples out on a white sheet of paper. It should appear like Figure 7.21. We will first examine several properties, including streak, from these six samples, and will answer more questions about them later in the lab. Look closely at each of the minerals, using the hand lens to observe them. In this bag, you have the following minerals (not listed in order): Magnetite, Graphite, Copper, Sulfur, Hematite, and Pyrite. They are numbered 13-18.

Figure 7.21 | The six minerals (#13-18) in Minerals Bag 3 in the HOL kit.
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15. Sample 13: What is the streak of this sample?

a. dark gray streak
b. white streak
c. reddish brown streak
d. pale yellow streak

16. Sample 13: What is the luster of this sample?

a. non-metallic, vitreous
b. non-metallic, earthy
c. non-metallic, greasy
d. non-metallic, waxy
e. metallic

17. Sample 14: What is the streak of this sample?

a. dark gray to black streak
b. white streak
c. reddish brown streak
d. pale yellow streak

18. Sample 14: Which other item(s) is/are characteristic(s) of this sample?

    a. stains the fingers
    b. harder than glass
    c. greasy feel
    d. both a and b
    e. both a and c

19. Sample 15: What is the streak of this sample?

    a. dark gray to black streak
    b. white streak
    c. reddish brown streak
    d. pale yellow streak

20. Sample 16: What is the luster of this sample?

    a. non-metallic, vitreous
    b. non-metallic, earthy
    c. non-metallic, greasy
    d. non-metallic, waxy
    e. metallic

21. Sample 16: Due to its appearance, this sample has often been confused with native gold, a mineral with a hardness of 2.5-3. How does its hardness compare with that of gold?

    a. Sample 16 is harder than gold.
    b. Sample 16 is softer than gold.

22. Sample 17: What is the streak of this sample?

    a. dark gray to black streak
    b. white streak
    c. reddish brown streak
    d. pale yellow streak

23. Sample 17: What another unique property does this sample have?

    a. effervescence in acid
    b. it is magnetic
    c. it tastes salty
    d. it feels soapy
    e. it writes on paper

24. Sample 18. Examine this entire sample closely with a hand lens. What is the luster of this sample?

a. non-metallic, vitreous
b. non-metallic, earthy
c. non-metallic, greasy
d. non-metallic, waxy
e. metallic

Now that you have had practice at detecting the properties of your 18 mineral samples, take the next step of identifying each sample and answering the questions below. Use the Mineral Identification Chart (Figure 7.22) to help you.

25. Sample 1: What is this sample?

a. Microcline
b. Fluorite
c. Quartz
d. Olivine
e. Talc
f. Selenite (Gypsum)

26. Sample 2: What is this sample?

a. Microcline
b. Fluorite
c. Quartz
d. Olivine
e. Talc
f. Selenite (Gypsum)

Luster	Hardness	Cleavage	Other Properties	Mineral Name
Non-Metallic	> Glass	Poor Cleavage	Red-brown, black, silver in color. H=6. St=red-brown	**Hematite**
			Olive-green in color. H=6. St=white. Commonly granular	**Olivine**
			Variety of colors. H=7. Conchoidal fracture. Vitreous luster.	**Quartz**
		Clearly Shows Cleavage	Black to greenish black in color. H=6. C=2 planes at ~60° and 120°. Elongated crystals.	**Amphibole**
			Tan-pink, white, green in color. H=6. C=2 planes at 90°.	**Microcline**
			Black to greenish black in color. H=6. C=2 planes at ~90°. Short stub-by crystals.	**Pyroxene**
	< Glass	Poor Cleavage	Dark gray to black in color. H=1. Greasy feel - will smudge fingers.	**Graphite**
			Yellow in color. H=1.5-2.5. St=white to yellow.	**Sulfur**
			White to green in color. H=1. Soapy feel.	**Talc**
		Clearly Shows Cleavage	Brown to black in color. H=2.5. C=1 perfect. Breaks into thin sheets that are elastic.	**Biotite Mica**
			White to transparent in color. H=3. C=3 rhombohedral. Strong efferves-cence in acid.	**Calcite**
			Transparent, yellow, purple, green in color. H=4. C=4 - octahedral.	**Fluorite**
			Transparent to white in color. H=2. C=3, though 2 directions may be difficult to see.	**Gypsum**
			White to transparent in color. H=2.5. C=3, cubic. Tastes salty.	**Halite**
			Transparent, light brown, to yellow in color. H=2.5. C=1 perfect. Breaks into thin sheets that are elastic.	**Muscovite Mica**
Metallic	> Glass	Poor Cleavage	Black in color. H=6. St=black. Strongly magnetic.	**Magnetite**
			Brass-yellow in color. H=6.5. St=dark gray.	**Pyrite**
	<Glass	Poor Cleavage	Copper-red in color. Tarnishes to green or black in air. H=2.5-3. St=copper-red.	**Copper**

Figure 7.22 | Mineral Identification Chart
Author: Randa Harris
Source: Original Work

27. Sample 3: What is this sample?

a. Microcline b. Fluorite c. Quartz

d. Olivine e. Talc f. Selenite (Gypsum)

28. Sample 4: What is this sample?

a. Microcline b. Fluorite c. Quartz

d. Olivine e. Talc f. Selenite (Gypsum)

29. Sample 4: What other unique property does this sample have?

a. effervescence in acid b. it is magnetic

c. it tastes salty d. it feels soapy

e. it writes on paper

30. Sample 5: What is this sample?

a. Microcline b. Fluorite c. Quartz

d. Olivine e. Talc f. Selenite (Gypsum)

31. Sample 6: What is this sample?

a. Microcline b. Fluorite c. Quartz

d. Olivine e. Talc f. Selenite (Gypsum)

32. Sample 7: What is this sample?

a. Pyroxene b. Muscovite Mica c. Halite

d. Amphibole e. Calcite f. Biotite Mica

33. Sample 7: What other unique property does this sample have?

a. effervescence in acid b. it is magnetic c. it tastes salty

d. it feels soapy e. it writes on paper

34. Sample 8: What is this sample?

a. Pyroxene b. Muscovite Mica c. Halite

d. Amphibole e. Calcite f. Biotite Mica

35. Sample 8: What other unique property does this sample have?

a. effervescence in acid b. it is magnetic

c. it tastes salty d. it feels soapy

e. it writes on paper

36. Sample 9: What is this sample?

a. Pyroxene b. Muscovite Mica c. Halite

d. Amphibole e. Calcite f. Biotite Mica

37. Sample 10: What is this sample?

a. Pyroxene b. Muscovite Mica c. Halite

d. Amphibole e. Calcite f. Biotite Mica

38. Sample 10: Test this tenacity of this mineral by trying to bend it. Which way does it behave?

a. sectile b. malleable c. elastic d. brittle

39. Sample 11: What is this sample?

a. Pyroxene b. Muscovite Mica c. Halite

d. Amphibole e. Calcite f. Biotite Mica

40. Sample 12: What is this sample?

a. Pyroxene b. Muscovite Mica c. Halite

d. Amphibole e. Calcite f. Biotite Mica

41. Sample 13: What is this sample?

a. Magnetite b. Graphite c. Copper

d. Sulfur e. Hematite f. Pyrite

42. Sample 14: What is this sample?

a. Magnetite b. Graphite c. Copper

d. Sulfur e. Hematite f. Pyrite

43. Sample 15: What is this sample?

a. Magnetite b. Graphite c. Copper

d. Sulfur e. Hematite f. Pyrite

44. Sample 16: What is this sample?

a. Magnetite b. Graphite c. Copper

d. Sulfur e. Hematite f. Pyrite

45. Sample 17: What is this sample?

a. Magnetite b. Graphite c. Copper

d. Sulfur e. Hematite f. Pyrite

46. Sample 18: What is this sample?

a. Magnetite b. Graphite c. Copper

d. Sulfur e. Hematite f. Pyrite

Table 7.1 | **Mineral Notation Chart –** Fill in this chart as you work through the lab. An example of a mineral you do not have in your kit (#0) is included. You do not have to fill out every column for every mineral – just follow along in the lab and determine the properties you are asked about.

Author: Randa Harris
Source: Original Work

Mineral #	Luster	Hardness	Cleavage/Fracture	Streak	Other Notable Properties (include color when diagnostic)	Name
0	Metallic	~2.5 – may scratch fingernail	3 - cubic	gray	High specific gravity because it is heavy	Galena

Mineral #	Luster	Hardness	Cleavage/Fracture	Streak	Other Notable Properties (include color when diagnostic)	Name

Mineral #	Luster	Hardness	Cleavage/Fracture	Streak	Other Notable Properties (include color when diagnostic)	Name

Mineral #	Luster	Hardness	Cleavage/Fracture	Streak	Other Notable Properties (include color when diagnostic)	Name

7.12 STUDENT RESPONSES

The following is a summary of the questions in this lab for ease in submitting answers online.

1. Sample 1: What is this sample's hardness?

    a. harder than glass

    b. softer than glass but harder than nail

    c. softer than nail but harder than copper

    d. softer than copper but harder than a fingernail

    e. softer than a fingernail

2. Sample 2: What is this sample's hardness?

    a. harder than glass

    b. softer than glass but harder than nail

    c. softer than nail but harder than copper

    d. softer than copper but harder than a fingernail

    e. softer than a fingernail

3. Sample 3: What is this sample's hardness?

    a. harder than glass

    b. softer than glass but harder than nail

    c. softer than nail but harder than copper

    d. softer than copper but harder than a fingernail

    e. softer than a fingernail

4. Sample 4: What is this sample's hardness?

    a. harder than glass

    b. softer than glass but harder than nail

    c. softer than nail but harder than copper

    d. softer than copper but harder than a fingernail

    e. softer than a fingernail

5. Sample 5: What is this sample's hardness?

    a. harder than glass

    b. softer than glass but harder than nail

    c. softer than nail but harder than copper

    d. softer than copper but harder than a fingernail

    e. softer than a fingernail

6. Sample 6. What is this sample's hardness?

    a. harder than glass

    b. softer than glass but harder than nail

    c. softer than nail but harder than copper

    d. softer than copper but harder than a fingernail

    e. softer than a fingernail

7. Sample 7: This sample has:

    a. no cleavage (it fractures)

    b. 1 cleavage plane

    c. 2 cleavage planes at 90°

    d. 3 cleavage planes at 90°

    e. 4 cleavage planes

8. Sample 8: This sample has:

a. no cleavage (it fractures)
b. 1 cleavage plane
c. 2 cleavage planes not at 90°
d. 3 cleavage planes not at 90°
e. 4 cleavage planes

9. Sample 9: This sample has:

a. no cleavage (it fractures)
b. 1 cleavage plane
c. 2 cleavage planes not at 90°
d. 3 cleavage planes at 90°
e. 4 cleavage planes

10. Sample 10: This sample has:

a. no cleavage (it fractures)
b. 1 cleavage plane
c. 2 cleavage planes not at 90°
d. 2 cleavage planes at 90°
e. 4 cleavage planes

11. Sample 11: This sample has:

a. no cleavage (it fractures)
b. 1 cleavage plane
c. 2 cleavage planes not at 90°
d. 2 cleavage planes at 90°
e. 3 cleavage planes at 90°

12. Sample 11: What is this sample's hardness?

a. harder than glass
b. softer than glass but harder than nail
c. softer than nail but harder than copper
d. softer than copper but harder than a fingernail
e. softer than a fingernail

13. Sample 12: This sample has:

    a. no cleavage (it fractures)
    b. 1 cleavage plane
    c. 2 cleavage planes not at 90°
    d. 2 cleavage planes at 90°
    e. 3 cleavage planes not at 90°

14. Sample 12: What is this sample's hardness?

    a. harder than glass
    b. softer than glass but harder than nail
    c. softer than nail but harder than copper
    d. softer than copper but harder than a fingernail
    e. softer than a fingernail

15. Sample 13: What is the streak of this sample?

    a. dark gray streak
    b. white streak
    c. reddish brown streak
    d. pale yellow streak

16. Sample 13: What is the luster of this sample?

    a. non-metallic, vitreous
    b. non-metallic, earthy
    c. non-metallic, greasy
    d. non-metallic, waxy
    e. metallic

17. Sample 14: What is the streak of this sample?

    a. dark gray to black streak
    b. white streak
    c. reddish brown streak
    d. pale yellow streak

18. Sample 14: Which other item(s) is/are characteristic(s) of this sample?

    a. stains the fingers
    b. harder than glass
    c. greasy feel
    d. both a and b
    e. both a and c

19. Sample 15: What is the streak of this sample?

    a. dark gray to black streak
    b. white streak
    c. reddish brown streak
    d. pale yellow streak

20. Sample 16: What is the luster of this sample?

    a. non-metallic, vitreous
    b. non-metallic, earthy
    c. non-metallic, greasy
    d. non-metallic, waxy
    e. metallic

21. Sample 16: Due to its appearance, this sample has often been confused with native gold, a mineral with a hardness of 2.5-3. How does its hardness compare with that of gold?

    a. Sample 16 is harder than gold.
    b. Sample 16 is softer than gold.

22. Sample 17: What is the streak of this sample?

    a. dark gray to black streak
    b. white streak
    c. reddish brown streak
    d. pale yellow streak

23. Sample 17: What another unique property does this sample have?

    a. effervescence in acid
    b. it is magnetic
    c. it tastes salty
    d. it feels soapy
    e. it writes on paper

24. Sample 18. Examine this entire sample closely with a hand lens. What is the luster of this sample?

    a. non-metallic, vitreous
    b. non-metallic, earthy
    c. non-metallic, greasy
    d. non-metallic, waxy
    e. metallic

25. Sample 1: What is this sample?

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a. Microcline b. Fluorite c. Quartz

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c. it tastes salty d. it feels soapy

e. it writes on paper

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d. Olivine e. Talc f. Selenite (Gypsum)

31. Sample 6: What is this sample?

a. Microcline b. Fluorite c. Quartz

d. Olivine e. Talc f. Selenite (Gypsum)

32. Sample 7: What is this sample?

a. Pyroxene b. Muscovite Mica c. Halite

d. Amphibole e. Calcite f. Biotite Mica

33. Sample 7: What other unique property does this sample have?

a. effervescence in acid b. it is magnetic c. it tastes salty

d. it feels soapy e. it writes on paper

34. Sample 8: What is this sample?

a. Pyroxene b. Muscovite Mica c. Halite

d. Amphibole e. Calcite f. Biotite Mica

35. Sample 8: What other unique property does this sample have?

a. effervescence in acid b. it is magnetic c. it tastes salty

d. it feels soapy e. it writes on paper

36. Sample 9: What is this sample?

a. Pyroxene b. Muscovite Mica c. Halite

d. Amphibole e. Calcite f. Biotite Mica

37. Sample 10: What is this sample?

a. Pyroxene b. Muscovite Mica c. Halite

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42. Sample 14: What is this sample?

a. Magnetite b. Graphite c. Copper

d. Sulfur e. Hematite f. Pyrite

43. Sample 15: What is this sample?

a. Magnetite b. Graphite c. Copper

d. Sulfur e. Hematite f. Pyrite

44. Sample 16: What is this sample?

a. Magnetite b. Graphite c. Copper

d. Sulfur e. Hematite f. Pyrite

45. Sample 17: What is this sample?

a. Magnetite b. Graphite c. Copper

d. Sulfur e. Hematite f. Pyrite

46. Sample 18: What is this sample?

a. Magnetite b. Graphite c. Copper

d. Sulfur e. Hematite f. Pyrite