Chapter 2: Minerals

Adapted by Lyndsay R. Hauber & Joyce M. McBeth (2018) University of Saskatchewan from Deline B, Harris R & Tefend K. (2015) "Laboratory Manual for Introductory Geology". First Edition. Chapter 7 "Minerals" by Randa Harris, CC BY-SA 4.0. Last edited: 8 Jan 2020

Note: much of the overview material for this chapter is replicated in this exercise section for your reference as you complete the lab.

Your name: _____

NSID and Student number: _____

Date and lab section time: _____

TAs' names: _____ _____

Your TAs will check that you have completed the questions correctly at the end of the lab period. Please hold on to your lab notes to help you prepare for the rock and mineral quiz and your lab final exam.

Overview of minerals

2.2 PHYSICAL PROPERTIES

Identifying a mineral is a little like playing detective. Minerals are identified by their physical properties. How would you describe the mineral in Figure 2.2? You may say that it is shiny, gold, and has a particular shape. Each of these descriptions is a physical property (shiny is lustre, gold is colour, shape is crystal form). Physical properties can vary within the same minerals, so caution should be applied when identifying minerals. For example, colour is a property that is not a very realistic diagnostic tool in many cases, as some minerals, such as Quartz, can come in a variety of colours (e.g. Figure 2.3). Occasionally, colour can be helpful, as in the case of olivine, which is said to be “olive green”, a light to dark green (e.g. Figure 2.4). We will cover each of the physical properties in detail to help you identify the minerals.

Figure 2.2 | Describe this mineral. Source: Randa Harris (2015) CC BY-SA 3.0

Figure 2.3 | 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. Source: Randa Harris (201) CC BY-SA 3.0

Figure 2.4 | The mineral olivine has an "olive green" colour. Source: Joyce M. McBeth (2018) CC BY 4.0

2.2.1 Hardness

Hardness refers to the resistance of a mineral to being scratched by a different mineral or material and is a product of the strength of the bonds between the atoms of a mineral. Whatever substance does the scratching is harder and the item scratched is softer. Hardness is based off a scale of 1 to

10 created by a mineralogist named Friedrich Mohs (Figure 2.5). Mohs' scale lists ten minerals in order of relative hardness, with each mineral on the scale able to scratch a mineral of lower number.

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

Figure 2.5 | Mohs Scale of Hardness. Note that the hardness of a steel nail will vary depending on the kind of steel. Source: Randa Harris (2015) CC-BY 3.0

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 coin 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

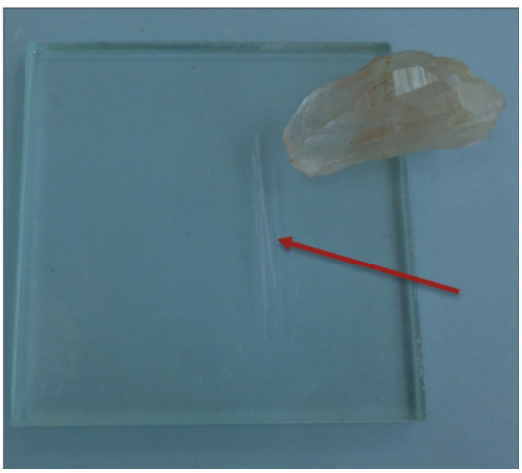


Figure 2.6 | An example of a scratch made by the mineral quartz on a streak plate. The red arrow is pointing to the scratch. Quartz, therefore, is harder than glass. Source: Randa Harris (2015) CC BY-SA 3.0

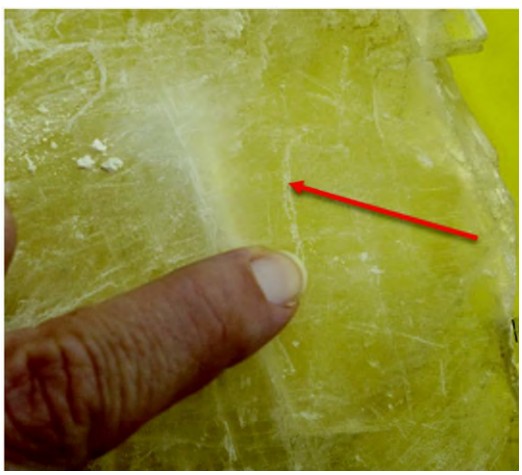


Figure 2.7 | An example of a scratch made by a fingernail on the mineral gypsum. The red arrow is pointing to the scratch. Gypsum, therefore, is softer than a fingernail. Source: Randa Harris (2015) CC BY-SA 3.0

groove created by a scratch (Figure 2.6). in contrast, 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, which has a hardness of 2.5 or gypsum which has a hardness of 2 (Figure 2.7).

2.2.2 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

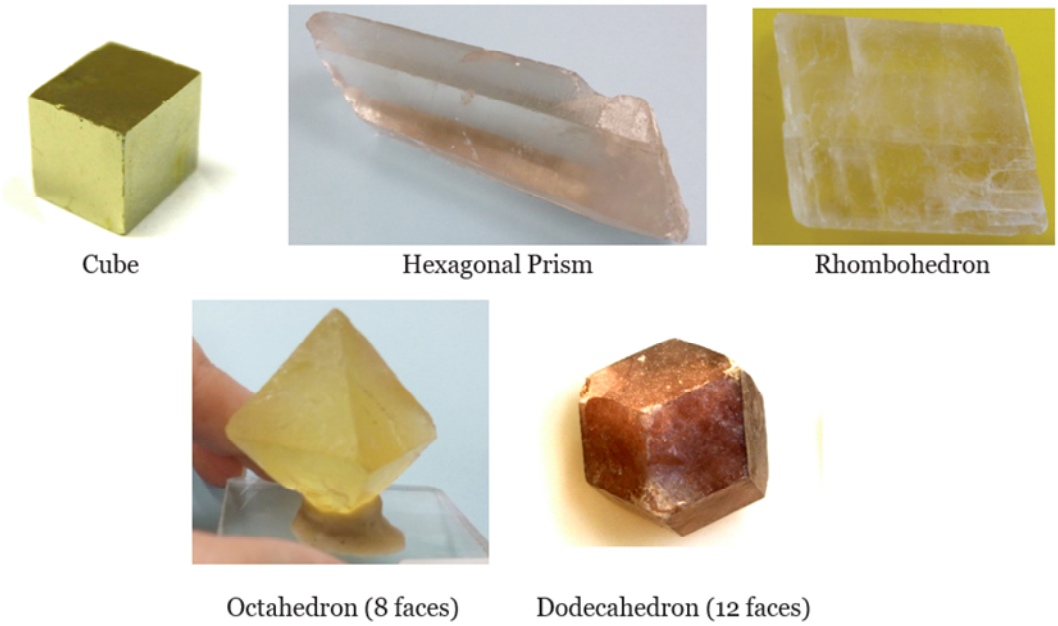


Figure 2.8 | Examples of crystal form. Source: Lyndsay Hauber & Joyce M. McBeth (2018) CC BY 4.0, after Randa Harris (2015) CC BY-SA 3.0

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 2.8.

2.2.3 Cleavage

As minerals are broken, 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

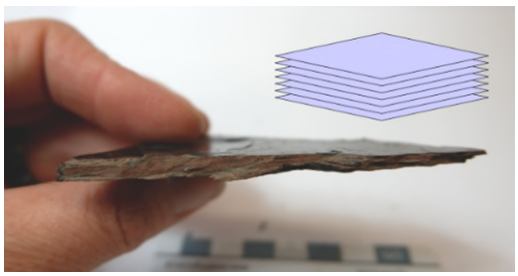
are the same strength or the weaker bonds are not aligned within a plane. If this is the case it will not have cleavage; instead, it will fracture, similar to the curved fracture of glass when you get crack in a windshield.

Be careful not to confuse cleavage with crystal form. Crystal form occurs as a mineral grows (e.g., cubes of pyrite), while cleavage only forms as a mineral breaks. See Figure 2.9 for the main types of cleavage and an example of each.

No cleavage; mineral fractures

No cleavage planes

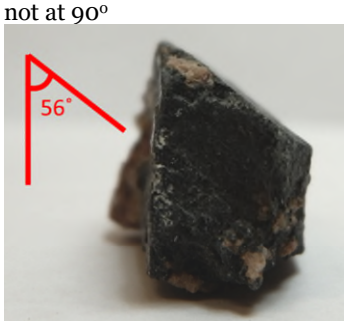
One cleavage plane



Basal cleavage – flat sheets

Two cleavage planes, at or near 90°

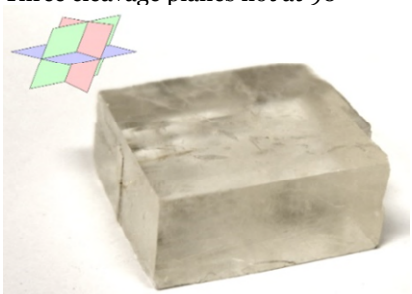
Two cleavage planes not at 90°



Three cleavage planes at 90°

Cubic cleavage – cubes

Three cleavage planes not at 90°



Four cleavage planes

Figure 2.9 | Main types of cleavage, along with illustrations indicating the cleavage angles and directions. Source: Lyndsay Hauber & Joyce M. McBeth (2018) CC BY 4.0, after Randa Harris (2015) CC BY-SA 3.0

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 60°, 90° (right angles), or 120°. 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.

Figure 2.10 | Comparison of cleavage angles between amphibole and pyroxene. Amphibole has cleavage angles at or near 600 and 1200, and pyroxene has angle at or near 900. Source: Joyce M. McBeth (2018) CC BY 4.0, after Randa Harris (2015) CC BY-SA 3.0

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 90°, so expect it to look boxy and form right angles, while cleavage angles in amphibole are 60° and 120°, so expect a more bladed or pyramid like appearance (e.g. Figure 2.10).

2.2.4 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 (e.g. Figure 2.11).

Figure 2.11 | This piece of igneous rock called obsidian has been hit with a hammer and is displaying conchoidal fracture. Source: Joyce M. McBeth (2018) CC BY 4.0

2.2.5 Lustre

Lustre 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 lustre have the colour of a metal, like silver, gold, copper, or brass (e.g. Figure 2.12). While minerals with a metallic lustre are often shiny, not all shiny minerals are metallic. Make sure you look for the colour of a metal, rather than for just a shine. Minerals with non-metallic lustre do not appear like metals. They may be vitreous or glassy (e.g. Figure 2.13A), earthy or dull (e.g. Figure 2.13B), waxy (e.g. Figure 2.13C), greasy or oily, etc.

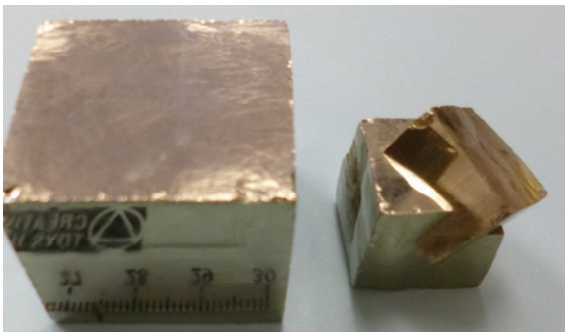


Figure 2.12 | Examples of the metallic lustre of pyrite, also known as "fool's gold." Source: Randa Harris (2015) CC BY-SA 3.0

Figure 2.13A | Example of a vitreous, or glassy, lustre. Source: Randa Harris (2015) CC BY-SA 3.0

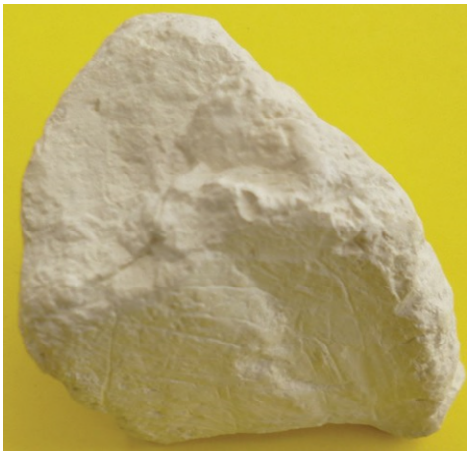


Figure 2.13B | Example of an earthy, or dull. lustre. Source: Randa Harris (2015) CC BY-SA 3.0

2.2.6 Streak

Figure 2.13C | Example of a waxy lustre. Source: Randa Harris (2015) CC BY-SA 3.0

Streak is an easily detectable physical property. It refers to the colour 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 colour than the mineral (e.g. Figure 2.14). 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,

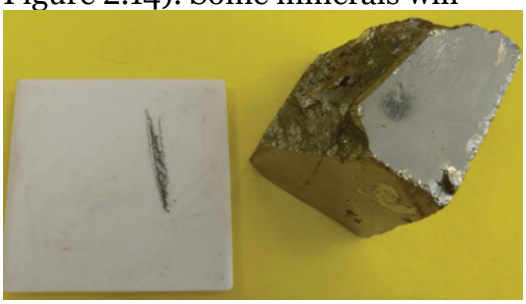


Figure 2.14 | An example of the dark grey streak left behind when pyrite is rubbed along a streak plate. Source: Randa Harris (2015) CC BY-SA 3.0

Figure 2.15 | An example of the white streak (on finger) left behind when fluorite is rubbed along a streak plate. Source: Randa Harris (2015) CC BY-SA 3.0

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 (e.g. Figure 2.15). Alternatively, you may use the black streak plate, which was provided in your mineral identification kit.

2.2.7 Special Physical Properties

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. Sphalerite will release a sulfurous smell when streaked, and 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.

2-E1 LAB EXERCISES – MINERAL IDENTIFICATION

This lab contains 27 numbered mineral samples, labelled 1 – 27, separated into drawers. 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. As you identify properties of each sample, fill in the table provided in this lab and complete the multiple-choice questions to test your knowledge. It is recommended that you obtain a mineral identification kit from the campus bookstore. It will contain:

- A copper coin
- Glass plate (wrapped in paper) – this will be used in testing hardness
- Zinc coated nail
- Unglazed porcelain plate – this will be used as a streak plate
- Black streak plate – this will be used to identify white streaks
- Hydrochloric acid bottle (empty)
- 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).
- Magnet – this will be used to test for magnetism in minerals

Take the drawers provided by your TA and view the minerals, numbered 1-27; there are 21 different minerals provided, so expect to see some repeat minerals. We will first examine hardness from these 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.

You need to experiment with each sample to test for its hardness, using Figure 2.5 for reference. Remember that hardness is determined by scratching the mineral. First, decide which minerals have a hardness greater than 5.5 (the hardness of glass). Lay the glass on a flat surface, then try to scratch it with each mineral by pressing down hard with the mineral. Table 2.1 is provided for you to make notations about each mineral. Note that you do not have to fill in every physical property for every mineral, just fill in the properties you are asked about as you work. Note 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 coin 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), which has an approximate hardness of 2.5, so if both the copper coin and your fingernail scratches it, you know its hardness must be <2.5. Additionally, you can use a zinc coated nail, which

has a hardness of 4, and other minerals to test the hardness. 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 which mineral is harder.

1. 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
2. Sample 25: 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 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
4. Sample 26: 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 10: 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 19. 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 27. 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

Lustre	*Hardness*	*Cleavage*	*Other Properties*	*Mineral Name*
Non-Metallic	**> Glass**	**Poor**	Red-brown in colour. H=5-6. SG=5.3. St=red-brown. Dull, earthy lustre.	**Hematite** Fe_2O_3
			Red-brown to brown in colour. H=6-7.5. SG=3.5-4.5. Conchoidal fracture. Vitreous lustre. Crystals are 12-sided and common.	**Garnet** Fe,Mg,Ca,Al, Silicate
			Pale-yellow to olive-green in colour. H=6.5-7. Commonly granular, with glassy grains	**Olivine** $(Fe,Mg)SiO_4$
			Variety of colours. H=7. SG=2.7. Conchoidal fracture. May have a 6-sided prism shape topped with a 6-sided pyramid. Vitreous lustre.	**Quartz** SiO_2
			Variety of colours [grey=chert; black=flint; red=jasper; banded=agate]. H=7. SG=2.7. Conchoidal fracture. Dull lustre.	**Cryptocrystalline Quartz** SiO_2
		Clearly Shows	Black to greenish black in colour. H=5-6.5. SG=3.3 C=2 planes at ~90°. Short, stubby crystals.	**Pyroxene** Ca,Mg,Fe,Al Silicate
			Black to greenish black in colour. H=6. SG=3.3. C=2 planes at ~60° and 120°. Elongated crystals.	**Amphibole** Na,Ca,Mg,Fe,Al Silicate
			Tan-pink, white, green in colour. H=6-6.5. SG=2.6. C=2 planes at 90°. Colour variation lines on cleavage surface.	**Potassium Feldspar** $KAlSi_3O_8$
			White to blue-grey to black in colour. H=6-6.5. SG=2.7. C=2 planes at ~90°. Striations on cleavage plane. Blue play of colours may be present.	**Plagioclase Feldspar** $NaAlSi_3O_8$ to $CaAl_2Si_2O_8$
	< Glass	**Poor**	White to grey to pale green in colour. H=1. SG=2.7. C=1, though rarely seen. Soapy feel.	**Talc** $Mg_3Si_4O_{10}(OH)_8$
			Yellow to yellow-brown in colour. H=4-5.5. SG=4.5. St=yellow-brown. Earthy lustre.	**Limonite** $Fe_2O_3 \cdot nH_2O$
		Clearly Shows	Colourless to white in colour. H=2. SG=2.3. C=3, though 2 directions may be difficult to see.	**Gypsum** $CaSO_4 2H_2O$
			Colourless to white, blue, yellow, or red in colour. H=2. SG=1.9. C=3 at 90°. Bitterer than halite.	**Sylvite** KCl
			Colourless to white in colour. H=2.5. SG=2.2. C=3 planes at 90°, cubic. Tastes salty.	**Halite** NaCl
			Colourless, light brown, to yellow in colour. H=2.5. SG=2.8. C=1 perfect. Breaks into thin sheets that are elastic.	**Muscovite** $KAl_2(AlSi_3O_{10})(OH)_2$
			Brown to black in colour. H=2.5-3. SG=3. C=1 perfect. Breaks into thin, elastic sheets.	**Biotite** $K(Mg,Fe)_3AlSi_3O_{10}(OH)_2$
			Colourless, white, yellow in colour. H=3. SG=2.7. C=3 rhombohedral. Strong effervescence in acid.	**Calcite** $CaCO_3$
			Yellow-brown in colour. H=3.5-4. SG=4. C=6. St=white to pale-yellow. Sulphur odour to streak. Resinous lustre.	**Sphalerite** (Zn,Fe)S
	> Glass	**Poor**	Steel grey to black in colour. H=5-6. SG=5.3. St=red-brown. Metallic lustre.	**Hematite** Fe_2O_3
			Black in colour. H=6. SG=5.2. St=black. Strongly magnetic.	**Magnetite** Fe_3O_4
			Brass-yellow in colour. H=6-6.5. SG=5. St=green- or brown-black.	**Pyrite** FeS_2
Metallic	**<Glass**	**Poor**	Yellow-brown to dark-brown in colour. H=3.5-4. SG=4. C=6. St=yellow-brown to brown-black. Sulphur odour to streak. Resinous and submetallic lustre.	**Sphalerite** (Zn,Fe)S
			Brass-yellow in colour. H=3.5-4.5. SG=4.2. St=greenish black. Tarnishes to green or black in air.	**Chalcopyrite** $CuFeS_2$
			Yellow-brown to dark-brown in colour. H=4-5.5. SG=4.5. St=yellow-brown.	**Limonite** $Fe_2O_3 \cdot nH_2O$
		Clearly Shows	Silver grey in colour. H=2.5. SG=7.5. C=3 planes at 90°. Very heavy.	**Galena** PbS

Figure 2.19 | Mineral Identification Chart.
Source: Lyndsay Hauber (2018) CC BY 4.0, after Randa Harris (2015) CC BY-SA 3.0

8. Sample 24: This sample has:
    a. no cleavage (it fractures)
    b. 1 cleavage plane
    c. 2 cleavage planes at 90°
    d. 3 cleavage planes at 90° (cubic)
    e. 4 cleavage planes
9. Sample 24: 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 smells like sulfur
10. Sample 21: This sample has:
    a. no cleavage (it fractures)
    b. 1 cleavage plane
    c. 2 cleavage planes at 90°
    d. 3 cleavage planes that are not at 90° (rhombohedral)
    e. 4 cleavage planes
11. Sample 15: 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
12. Sample 13: 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
13. Sample 18: 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
14. Sample 18: What is this sample's hardness?
    a. harder than glass
    b. similar to glass
    c. softer than nail but harder than copper
    d. softer than copper but harder than a fingernail
    e. softer than a fingernail
15. Sample 20: 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
16. Sample 16: 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. 2 cleavage planes at 60° /120°

17. Sample 16: 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
18. Sample 17: 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
19. Sample 22: 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
20. Sample 22: 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
21. Sample 4: What is the streak of this sample?
    a. dark grey streak
    b. white streak
    c. reddish brown streak
    d. pale yellow streak
22. Sample 4: What is the lustre of this sample?
    a. non-metallic, vitreous
    b. non-metallic, earthy
    c. non-metallic, resinous
    d. non-metallic, waxy
    e. metallic
23. Sample 1: What is the lustre of this sample?
    a. non-metallic, vitreous
    b. non-metallic, earthy
    c. non-metallic, resinous
    d. non-metallic, waxy
    e. metallic
24. Sample 6: What is the streak of this sample?
    a. dark grey to black streak
    b. grey streak
    c. reddish brown streak
    d. pale yellow streak
25. Sample 6: Which other item(s) is/are characteristic(s) of this sample?
    a. very heavy
    b. harder than glass
    c. metallic lustre
    d. both a and b
    e. both a and c

26. Sample 8: What is the streak of this sample?
    a. dark grey to black streak
    b. grey streak
    c. reddish brown streak
    d. pale yellow streak
27. Sample 8: What is the lustre of this sample?
    a. non-metallic, vitreous
    b. non-metallic, earthy
    c. non-metallic, greasy
    d. non-metallic, waxy
    e. metallic
28. Sample 9: What is the lustre of this sample?
    a. non-metallic, vitreous
    b. non-metallic, earthy
    c. non-metallic, greasy
    d. non-metallic, waxy
    e. metallic
29. Sample 9: 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 9 is harder than gold.
    b. Sample 9 is softer than gold.
30. Sample 14: What is the lustre of this sample?
    a. non-metallic, vitreous
    b. non-metallic, earthy
    c. non-metallic, greasy
    d. non-metallic, waxy
    e. metallic
31. Sample 2: What is the streak of this sample?
    a. dark grey to black streak
    b. grey streak
    c. reddish brown streak
    d. pale yellow streak
32. Sample 2: 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 smells like sulfur
33. Sample 5: Examine this entire sample closely with a hand lens. What is the lustre of this sample?
    a. non-metallic, vitreous
    b. non-metallic, earthy
    c. non-metallic, greasy
    d. non-metallic, waxy
    e. metallic
34. Sample 23: What is the streak of this sample?
    a. dark grey to black streak
    b. white streak
    c. reddish brown streak
    d. pale yellow streak
35. Sample 7: What is the lustre of this sample?
    a. non-metallic, vitreous
    b. non-metallic, earthy
    c. non-metallic, resinous
    d. non-metallic, waxy
    e. metallic
36. Sample 7: What is the streak of this sample?
    a. dark grey to black streak
    b. grey streak
    c. yellow-brown to brown-black streak
    d. pale yellow streak

37. Sample 3: What is the streak of this sample?
    a. dark grey to black streak
    b. grey streak
    c. reddish brown streak
    d. pale yellow streak
38. Sample 3: What is the lustre of this sample?
    a. non-metallic, vitreous
    b. non-metallic, earthy
    c. non-metallic, greasy
    d. non-metallic, waxy
    e. metallic
39. Sample 1: What is this sample?
    a. chalcopyrite
    b. limonite
    c. galena
    d. sphalerite
    e. magnetite
    f. hematite
40. Sample 2: What is this sample?
    a. chalcopyrite
    b. limonite
    c. galena
    d. sphalerite
    e. magnetite
    f. hematite
41. Sample 2: 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 smells like sulfur
42. Sample 3: What is this sample?
    a. chalcopyrite
    b. limonite
    c. galena
    d. sphalerite
    e. magnetite
    f. hematite
43. Sample 4: What is this sample?
    a. chalcopyrite
    b. limonite
    c. galena
    d. sphalerite
    e. magnetite
    f. hematite
44. 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 smells like sulfur
45. Sample 5: What is this sample?
    a. chalcopyrite
    b. limonite
    c. galena
    d. sphalerite
    e. magnetite
    f. hematite
46. Sample 6: What is this sample?
    a. chalcopyrite
    b. limonite
    c. galena
    d. sphalerite
    e. magnetite
    f. hematite
47. Sample 7: What is this sample?
    a. chalcopyrite
    b. limonite
    c. galena
    d. sphalerite
    e. magnetite
    f. hematite

48. 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 smells like sulfur
49. Sample 8: What is this sample?
    a. chalcopyrite
    b. limonite
    c. galena
    d. pyrite
    e. magnetite
    f. hematite
50. Sample 9: What is this sample?
    a. chalcopyrite
    b. limonite
    c. galena
    d. pyrite
    e. magnetite
    f. hematite
51. Sample 10: What is this sample?
    a. quartz
    b. muscovite
    c. potassium feldspar
    d. calcite
    e. biotite
    f. plagioclase feldspar
52. Sample 11: What is this sample?
    a. quartz
    b. muscovite
    c. potassium feldspar
    d. calcite
    e. biotite
    f. plagioclase feldspar
53. Sample 12: What is this sample?
    a. quartz
    b. muscovite
    c. potassium feldspar
    d. calcite
    e. biotite
    f. plagioclase feldspar
54. Sample 13: What is this sample?
    a. quartz
    b. muscovite
    c. potassium feldspar
    d. calcite
    e. biotite
    f. plagioclase feldspar
55. Sample 14: What is this sample?
    a. quartz
    b. muscovite
    c. potassium feldspar
    d. calcite
    e. biotite
    f. plagioclase feldspar
56. Sample 15: What is this sample?
    a. quartz
    b. muscovite
    c. potassium feldspar
    d. calcite
    e. biotite
    f. plagioclase feldspar
57. Sample 16: What is this sample?
    a. quartz
    b. amphibole
    c. potassium feldspar
    d. olivine
    e. pyroxene
    f. plagioclase feldspar

58. Sample 17: What is this sample?
    a. quartz
    b. amphibole
    c. potassium feldspar
    d. olivine
    e. pyroxene
    f. plagioclase feldspar
59. Sample 18: What is this sample?
    a. quartz
    b. amphibole
    c. potassium feldspar
    d. olivine
    e. pyroxene
    f. plagioclase feldspar
60. Sample 19: What is this sample?
    a. quartz
    b. amphibole
    c. potassium feldspar
    d. olivine
    e. pyroxene
    f. plagioclase feldspar
61. Sample 20: What is this sample?
    a. quartz
    b. amphibole
    c. potassium feldspar
    d. olivine
    e. pyroxene
    f. plagioclase feldspar
62. Sample 21: What is this sample?
    a. quartz
    b. gypsum
    c. cryptocrystalline quartz
    d. calcite
    e. halite
    f. plagioclase feldspar
63. Sample 22: What is this sample?
    a. quartz
    b. gypsum
    c. cryptocrystalline quartz
    d. calcite
    e. halite
    f. plagioclase feldspar
64. Sample 23: What is this sample?
    a. quartz
    b. gypsum
    c. cryptocrystalline quartz
    d. calcite
    e. halite
    f. plagioclase feldspar
65. Sample 24: What is this sample?
    a. talc
    b. gypsum
    c. cryptocrystalline quartz
    d. garnet
    e. halite
    f. plagioclase feldspar
66. Sample 24: What other unique property does this sample have?
    a. it effervescence in acid
    b. it is magnetic
    c. it tastes salty
    d. it feels soapy
    e. it smells like sulfur
67. Sample 25: What is this sample?
    a. talc
    b. gypsum
    c. cryptocrystalline quartz
    d. garnet
    e. halite
    f. plagioclase feldspar

68. Sample 26: What is this sample?
    a. talc
    b. gypsum
    c. cryptocrystalline quartz
    d. garnet
    e. halite
    f. plagioclase feldspar
69. Sample 26: What other unique property does this sample have?
    a. it effervescence in acid
    b. it is magnetic
    c. it tastes salty
    d. it feels soapy
    e. it smells like sulfur
70. Sample 27: What is this sample?
    a. talc
    b. gypsum
    c. cryptocrystalline quartz
    d. garnet
    e. halite
    f. plagioclase feldspar

Table 2.1 | Mineral Notation Chart – Fill in this chart as you work through the lab. An example of a mineral you do not have available (#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.
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Sample #	Lustre	Hardness	Cleavage/ Fracture	Streak	Other Notable Properties (include colour when diagnostic)	Mineral Name
0	Non-metallic	Less than 2.5 (softer than a fingernail)	3 cleavage planes at 90^{o}	white	Bitter taste; key mineral in potash	Sylvite
1						
2						
3						
4						
5						
6						
7						

Sample #	Lustre	Hardness	Cleavage/ Fracture	Streak	Other Notable Properties (include colour when diagnostic)	Mineral Name
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						

Sample #	Lustre	Hardness	Cleavage/ Fracture	Streak	Other Notable Properties (include colour when diagnostic)	Mineral Name
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						