Name: _____

Lab 4: Mineral Identification
April 14, 2009

While about 3000 minerals have been recognized as valid species, very few of these are commonly seen. Comprehensive mineralogy texts typically deal with about 200 minerals and even that number is greatly in excess of the number of minerals most geologists encounter in the field during their careers. Most rocks are composed from among fewer than two-dozen common minerals. We will focus on 22 major rock-forming minerals summarized in the table below.

Major Rock–Forming Minerals

Mineral or Mineral Group	Chemical Group	Chemical Formula
Quartz	Framework silicate	SiO_2
Potassium Feldspar (Orthoclase)	Framework silicate	$KAlSi_3O8$
Plagioclase Feldspar	Framework silicate	$(Ca, Na)Al_{1-2}Si_{2-3}O_8$
Garnet	Isolated silicate	$(Ca, Mg, Fe)_3Al_2(SiO_4)_3$
Olivine	Isolated silicate	$(Mg, Fe)_2SiO_4$
Pyroxene	Single-chain silicate	$(Mg, Fe, Al, Ca)SiO_3$
Amphibole	Double-chain silicate	$(Ca, Na, Fe, Mg, Al)Si_8O_{22}(OH)_2$
Muscovite Mica	Sheet silicate	$KAl_2Si_3O_{10}(OH)_2$
Biotite Mica	Sheet silicate	$K(Mg, Fe, Al)AlSi_3O_{22}(OH)_2$
Talc	Sheet silicate	$Mg_3Si_4O_{10}(OH)_2$
Hematite	Oxide	Fe_2O_3
Magnetite	Oxide	Fe_3O_4
Limonite	Oxide	$Fe_2O_3 \bullet nH_2O$
Galena	Sulfide	PbS
Pyrite	Sulfide	FeS_2
Sphalerite	Sulfide	ZnS
Calcite	Carbonate	$CaCO_3$
Graphite	Native element	C
Sulfur	Native element	S
Halite	Halide	NaCl
Fluorite	Halide	CaF_2
Gypsum	Sulfate	$CaSO_4 \bullet 2H_2O$

The necessary information for identifying these minerals is presented in two often-used formats on the following pages. First, the minerals are tabulated by property. Second, they are arranged into flowcharts. Examine both while working with the specimens, as either one may be encountered.

Mineral Properties for 22 of the Common Rock-Forming Minerals

Hardness	Streak Color	Cleavage and Fracture	Mineral Color, Specific Gravity, etc.	Luster	Mineral Name
6 to 6.5	Gray to greenish-black	Conchoidal fracture	Brassy yellow, high specific gravity	Metallic	Pyrite
6	Black to dark gray	Irregular fracture	Black to gray, high specific gravity, magnetic	Metallic	Magnetite
1.5 to 5.5	Red-brown	Irregular fracture	Steel gray to red, high specific gravity	Metallic to dull or earthy	Hematite
1.5 to 5.5	Yellow to yellow brown	Irregular fracture	Yellow, brown, orange to brown, or brownish black	Dull or earthy to metallic	Limonite
3.5 to 4	Pale yellow	6 cleavage planes	Yellow to brown	Sub-metallic to resinous	Sphalerite
2.5	Gray	3 cleavage planes at 90°	Silvery gray, very high specific gravity	Metallic	Galena
1 to 2	Gray to black	Poorly defined cleavage in one direction	Dark gray to black, marks paper	Metallic to dull or greasy	Graphite
7	No streak	Conchoidal or irregular fracture	Colorless, white, or other colors, transparent to translucent	Vitreous	Quartz
7	No streak	Conchoidal or irregular fracture	Red to dark brown, greenish or yellowish	Vitreous	Garnet
6.5 to 7	No streak	Conchoidal fracture	Green to yellow green, translucent	Vitreous to dull	Olivine
6	No streak	2 cleavage planes at ~90°	White, pale or dark gray, translucent to nearly opaque	Dull to vitreous	Plagioclase Feldspar
6	No streak	2 cleavage planes at ~90°	Pink to white or gray, translucent to nearly opaque	Dull to vitreous	Potassium Feldspar (Orthoclase)
5 to 6	Green to black or no streak	2 cleavage planes at 60° and 120°	Black to dark green, splintery appearance	Vitreous to dull	Amphibole

Hardness	**Streak Color**	**Cleavage and Fracture**	**Mineral Color, Specific Gravity, etc.**	**Luster**	**Mineral Name**
5 to 6	Green to black or no streak	2 cleavage planes at 90°	Black to dark green, blocky appearance	Dull to vitreous	Pyroxene
1.5 to 2.5	Yellow to white	Conchoidal to irregular fracture	Yellow, translucent, smells like sulfur	Earthy to pearly	Sulfur
1 to 2	White	1 weak cleavage plane	Gray, green, white, opaque, greasy feel	Pearly	Talc
2 to 3	White	1 perfect cleavage plane	Colorless to white or faintly colored, transparent to translucent	Sub-metallic to vitreous	Muscovite Mica
2 to 3	Brownish (hard to streak)	1 perfect cleavage plane	Dark brown to black, thin sheets are translucent	Vitreous	Biotite Mica
4	White	4 cleavage planes	Colorless, yellow, white, blue, green, or violet, transparent to translucent	Vitreous	Fluorite
3	White to gray	3 cleavage planes at ~75°	Colorless to white, gray, or black, transparent to translucent, reacts with acid	Dull to greasy	Calcite
2 to 2.5	White	3 cleavage planes at 90°	Colorless to white, transparent to translucent, tastes salty	Dull to greasy	Halite
2	White	1 good and 2 poor cleavage planes	Colorless to white, transparent to translucent	Waxy to vitreous	Gypsum

Classification Chart for Light-Colored Minerals with Non-metallic Luster

Non-metallic luster, light color	**Harder than glass**	**Cleavage prominent**	**Good cleavage in two directions at about 90°; commonly light to dark pink;** pearly to vitreous luster; H=6-6.5; D=2.5	**Potassium Feldspar (Orthoclase)**
			Good cleavage in two directions at about 90°; white to gray; striations on good cleavage planes	**Plagioclase Feldspar**
		Cleavage absent	**Conchoidal fracture;** H=7; D=2.65; transparent to translucent; vitreous to waxy luster; 6-sided prismatic crystals in well-developed crystal form; colors often vary from colorless to white, rose pink, violet, or smoky gray	**Quartz**
	Softer than glass	**Cleavage prominent**	**Perfect cubic cleavage; salty taste;** colorless to white, soluble in water; H=2-2.5; D=2	**Halite**
			Perfect cleavage in one direction, poor in two others; H=2; white; transparent; D=2.3	**Gypsum**
			Perfect cleavage in three directions at approximately 75°; effervesces in HCl; H=3; colorless, white, or pale yellow – rarely gray or blue; transparent to opaque; D=2.7	**Calcite**
			Good cleavage in four directions; H=4; D=3; colorless, yellow, blue, green, or violet; transparent to translucent; cubic crystals	**Fluorite**
			Perfect cleavage in one direction, producing thin sheets; H=2-3; D=2.8; transparent and colorless in thin sheets	**Muscovite**
			Green to white; soapy feel; pearly luster; H=1; D=2.8; foliated or compact masses; one direction of cleavage forms thin scales and shreds	**Talc**
		Cleavage absent	**Yellow;** H= 1.5-2.5; D=2; dull or resinous luster; commonly in irregular masses; transparent to translucent	**Sulfur**

Classification Chart for Dark-Colored Minerals with Non-metallic Luster

Non-metallic luster, dark color	**Harder than glass**	**Cleavage prominent**	**Cleavage in two directions at about 90°;** dark green to black; short, prismatic crystals; H=6; D=3.5	**Pyroxene**
			Cleavage in two directions at about 60° and 120°; dark green to black or brown; long prismatic crystals which may appear splintery; H=6; D=3.35	**Amphibole**
			Good cleavage in two directions at about 90°; gray to blue-gray; striations on some cleavage planes	**Plagioclase**
		Cleavage absent	**Various shades of green, sometimes yellowish; commonly occurs in aggregates of small glassy grains;** transparent to translucent; glassy luster; H=6.5-7; D=3.5-5	**Olivine**
			Red, brown, yellow to yellow-green; glassy luster; conchoidal fracture may resemble poor cleavage; commonly occurs in well-formed 12-sided crystals; H=7-7.5; D=3.5-4.5	**Garnet**
			Conchoidal fracture; H=7; gray to gray-black; vitreous luster	**Quartz**
	Softer than glass	**Cleavage prominent**	**Brown to black; one perfect cleavage;** H-2.5-3; D=3-3.5	**Biotite**
			Green to very dark green; one perfect cleavage; commonly occurs in foliated or scaly masses; H=2-2.5; D=2.5-3.5	**Chlorite**
			Yellowish brown; resinous to sub-metallic luster; cleavage in six directions; yellow-brown or white streak; H=3.5-4; D=4	**Sphalerite**
			Four perfect cleavage directions; H=4; D=3; green through deep purple; transparent to translucent; cubic crystals	**Fluorite**
		Cleavage absent	**Red earthy appearance;** red streak; H=1.5	**Hematite**
			Yellowish-brown streak; yellowish brown to dark brown; commonly in compacted earth masses; H=1.5	**Limonite**

Classification Chart for Minerals with Metallic Luster

Metallic luster	**Black, gray, greenish black streak**	**Perfect cubic cleavage; silver gray color;** heavy, D=7.6; H=2.5, bright metallic luster	**Galena**
		Magnetic; black to dark gray; D=5.2; H=6; commonly occurs in granular masses	**Magnetite**
		Steel gray; soft, H=1, smudges fingers and marks paper; D=2; luster may also be dull	**Graphite**
		Golden yellow; may tarnish purple; H=4; D=4.3; streak is greenish black	**Chalcopyrite**
		Brass yellow; cubic crystals; striated faces common; common in granular aggregates; H=6-6.5; D=5; uneven fracture	**Pyrite**
	Brown to reddish-brown streak	**Steel gray; red to red-brown streak;** may also be black to dark brown; H=5-6; D=5; uneven fracture	**Hematite**
	Yellow brown streak	**Yellow, brown, or black; yellow brown streak;** hard; structureless or radial fibrous masses; H=5-5.5; D=3.5-4	**Limonite**
		Yellowish brown; resinous to sub-metallic luster; cleavage in six directions; yellow-brown or white streak; H=3.5-4; D=4	**Sphalerite**

Sample Number	Color/Streak Color	Luster	Hardness	Cleavage	Other properties	Mineral Name
1						
2						
3						
4						
5						
6						
7						
8						

Sample Number	Color/Streak Color	Luster	Hardness	Cleavage	Other properties	Mineral Name
9						
10						
11						
12						
13						
14						
15						
16						

Sample Number	Color/Streak Color	Luster	Hardness	Cleavage	Other properties	Mineral Name
17						
18						
19						
20						
21						
22						

1. How would you distinguish between samples 1, 3, and 6? How about 9, 10, 12, and 22? Explain your procedures on the reverse of this sheet.

Table A-2. Light Colored Non-metallic Mineral Identification Chart

Luster & Color	Relative Hardness	Hardness	Cleavage	Color	Specific Gravity	Other Properties	Name
	Harder than Glass	7.0	Yes-d	pistachio green	3.3-3.6	surface coatings, or massive	**EPIDOTE**
		7.0	No	variable	2.7	vitreous luster; conchoidal fracture; massive but also occurs as 6-sided crystals	**QUARTZ**
	Similar to Glass	6.0	Yes	pinkish-orange (variable)	2.5	vitreous luster; banding; 2 cleavages at 90^{o}	**ORTHOCLASE** (Potassium Feldspar)
		6.0	Yes	white to gray	2.6-2.8	vitreous luster; 2 cleavages at 90^{o}; striations common on cleavage faces	**PLAGIOCLASE** (Na & Ca Feldspar)
		5.0-7.0	Yes-d	bluish-gray	3.5	vitreous luster; blade shaped crystals	**KYANITE**
Non-Metallic Light Colored	Softer than Glass	4.0	Yes	clear, purple, yellow (variable)	3.2	vitreous luster; 4 perfect cleavages forming octahedrons	**FLUORITE**
		3.0	Yes	white to clear (variable)	2.7	reacts with HCl; rhombic cleavage; 3 perfect cleavages not at 90^{o}	**CALCITE**
		2.5	Yes	clear to milky white	2.2	3 perfect cleavages at 90^{o} (cubes); salty taste	**HALITE**
		2.0-2.5	Yes-d	white to tan	2.6	dull luster, powdery; earthy odor; white streak	**KAOLINITE**
		2.0-2.5	Yes	clear to light yellow	2.5-3.0	vitreous luster; perfect cleavage in 1 dir.;forms flexible, transparent, thin sheets	**MUSCOVITE**
		2.0	Yes	clear, white, yellow (variable)	2.3	vitreous to pearly luster; brittle flakes; perfect cleavage in 1 direction	**GYPSUM**
		1.5-2.5	No	yellow	2.0	yellow streak; distinctive sulfurous odor	**SULFUR**
		1.0	Yes-d	apple green to silvery white	2.7	pearly luster; greasy feel	**TALC**

Note: Yes-d means cleavage is present but may be difficult to see.

Table A-3. Dark Colored Non-metallic Mineral Identification Chart

Luster & Color	Relative Hardness	Hardness	Cleavage	Color	Specific Gravity	Other Properties	Name
Non-Metallic Dark Colored	Harder than Glass	9.0	No	brown (variable)	4.0	six-sided prismatic crystals	**CORUNDUM**
		7.0	Yes-d	brown	3.8	vitreous to dull luster; prismatic to cross-shaped crystals	**STAUROLITE**
		7.0	No	red or brown	3.5-4.3	twelve-sided crystals common; vitreous luster	**GARNET**
		7.0	No	variable	2.7	vitreous luster; conchoidal fracture; massive but also occurs as 6-sided crystals	**QUARTZ**
		6.5-7.0	No	olive green	3.3-4.4	vitreous luster; granular	**OLIVINE**
	Similar to Glass	6.0	Yes	gray to white	2.6-2.8	vitreous luster; 2 cleavages at 90^{o}; striations common on cleavage faces	**PLAGIOCLASE**
		5.0-6.0	Yes-d	dark green to black	3.3	vitreous to dull luster; 2 poor cleavages at 90^{o}	**PYROXENE**
		5.0-6.0	Yes	dark green to black	3.3	vitreous luster; splintery appearance; 2 perfect cleavages at 120^{o} and 60^{o}	**AMPHIBOLE**
		5.0-6.0	No	reddish-brown to black	5.0	red-brown streak; dull luster; massive	**HEMATITE**
		5.0	Yes-d	green, brown, blue, black	3.2	vitreous luster; six-sided crystals common	**APATITE**
	Softer than Glass	3.5-4.0	Yes-d	grass green	4.0	occurs as surface coatings, masses, or tiny crystals; green streak	**MALACHITE**
		2.5-3.0	Yes	brown to black	2.8-3.0	vitreous luster; perfect cleavage in 1 direction; forms flexible thin sheets	**BIOTITE**
		2.0-2.5	Yes-d	dark or light green	2.6-2.9	flexible crystal flakes; crystal aggregates common	**CHLORITE**

Note: Yes-d means cleavage is present but may be difficult to see.