METALLIC AND SUBMETALLIC (M) MINERAL IDENTIFICATION

STEP 1: What is the mineral's hardness?	STEP 2: Does the mineral have cleavage?	STEP 3: What is the mineral's streak?	STEP 4: Match the mineral's physical properties to other characteristic properties below.	STEP 5: Mineral name. Find out more about it in the mineral database (Fig.3.21).
HARD (H > 5.5) Scratches glass Not scratched by masonry nail or knife blade	Cleavage absent, poor, or not visible	Dark gray to black	Color silvery gold; Tarnishes brown; H 6–6.5; Brittle; conchoidal to uneven fracture; Crystals: cubes (may be striated), pyritohedrons, or octahedrons; Distinguished from chalcopyrite, which is soft	Pyrite
			Silvery dark gray to black; Tarnishes gray or rusty yellow-brown; Strongly attracted to a magnet and may be magnetized; H 6–6.5; Crystals: octahedrons	Magnetite
HARD or SOFT		Yellow-brown	Color submetallic silvery brown; Tarnishes to dull and earthy yellow-brown to brown rust colors; H 1–5.5; More commonly occurs in its nonmetallic yellow to brown forms (H 1–5)	Limonite
		Brown	Color silvery black to black; Tarnishes gray to black; H 5.5–6; May be weakly attracted to a magnet; Crystals: octahedrons	Chromite
		Red to red-brown	Color steel gray, reddish-silver, to glittery bright silver (var. specular); Both metallic varieties have the characteristic red-brown streak; May be attracted to a magnet; H 5–6; Also occurs in nonmetallic, dull to earthy, red to red-brown forms	Hematite
SOFT (H ≤ 5.5) Does not scratch glass Scratched by masonry nail or knife blade	Cleavage good to excellent	Dark gray to black	Color bright silvery gray; Tarnishes dull gray; Brittle: breaks into cubes and shapes made of cubes; H 2.5; Crystals: cubes or octahedrons; Feels heavy for its size because of high specific gravity	Galena
		White to pale yellow-brown	Color silvery yellow-brown, silvery red, or black with submetallic to resinous luster; Tarnishes brown or black; H 3.5–4.0; smells like rotten eggs when scratched, powdered, or in acid test	Sphalerite
	Cleavage absent, poor, or not visible	Dark gray to black	Color bright silvery gold; Tarnishes bronze brown brassy gold, or iridescent blue-green and red; H 3.5–4.0; Brittle; uneven fracture; Crystals: tetrahedrons	Chalcopyrite
			Color characteristically brownish-bronze; Tarnishes bright iridescent purple, blue, and/or red, giving It its nickname "peacock ore"; May be weakly attracted to a magnet; H 3; Usually massive, rare as cubes or dodecahedrons	Bornite
			Color opaque brassy to brown-bronze; Tarnishes dull brown, may have faint iridescent colors; Fracture uneven to conchoidal; No cleavage; Attracted to a magnet; H 3.5–4.5; Usually massive or masses of tiny crystals; Resembles chalcopyrite, which is softer and not attracted to a magnet	Pyrrhotite
			Color dark silvery gray to black; Can be scratched with your fingernail; Easily rubs off on your fingers and clothes, making them gray; H 1–2	Graphite
		Yellow-brown	Metallic or silky submetallic luster, Color dark brown, gray, or black; H 5–5.5; Forms layers of radiating microscopic crystals and botryoidal masses	Goethite
		Copper	Color copper; Tarnishes dull brown or green; H 2.5–3.0; Malleable and sectile; Hackly fracture; Usually forms dendritic masses or nuggets	Copper (native copper)
		Gold	Color yellow gold; Does not tarnish; Malleable and sectile; H 2.5–3.0; Forms odd-shaped masses, nuggets, or dendritic forms	Gold (native gold)
		Silvery white	Color silvery white to gray; Tarnishes gray to black; H 2.5–3.0; Malleable and sectile; Forms dendritic masses, nuggets, or curled wires	Silver (native silver)

FIGURE 3.18 **Identification chart for opaque minerals with metallic or submetallic luster (M) on freshly broken surfaces.**

DARK TO MEDIUM-COLORED NONMETALLIC (NM) MINERAL IDENTIFICATION

STEP 1: What is the mineral's hardness?	STEP 2: What is the mineral's cleavage?	STEP 3: Compare the mineral's physical properties to other distinctive properties below.	STEP 4: Find mineral name(s) and check the mineral database for additional properties (Figure 3.21).
HARD (H > 5.5) Scratches glass Not scratched by masonry nail or knife blade	Cleavage excellent or good	Translucent to opaque dark gray; blue-gray, or black; May have silvery iridescence; 2 cleavages at nearly 90° and with striations; H 6	Plagioclase feldspar
		Translucent to opaque brown, gray, green, or red; 2 cleavages at nearly right angles; Exsolution lamellae; H 6	Potassium feldspar (K-spar)
		Green to black; Vitreous luster; H 5.5–6.0; 2 cleavages at about 124° and 56° plus uneven fracture; Usually forms long blades and masses of needle-like crystals	Actinolite (amphibole)
		Dark gray to black; Vitreous luster; H 5.5–6.0; 2 cleavages at about 124° and 56° plus uneven fracture; Forms long crystals that break into blade-like fragments	Hornblende (amphibole)
		Dark green to black; Dull to vitreous luster; H 5.5–6.0; two cleavages at nearly right angles (93° and 87°) plus uneven fracture; Forms short crystals with squarish cross sections; Breaks into blocky fragments	Augite (pyroxene)
	Cleavage absent, poor, or not visible	Transparent or translucent gray, brown, or purple; Greasy luster; Massive or hexagonal prisms and pyramids; H 7	Quartz Smoky quartz (black/brown var.), Amethyst (purple var.)
		Gray, black, or colored (dark red, blue, brown) hexagonal prisms with flat striated ends; H 9	Corundum Emery (black impure var.), Ruby (red var.) Sapphire (blue var.)
		Opaque red-brown or brown; Luster waxy; Cryptocrystalline; H 7	Jasper (variety of quartz)
		Transparent to translucent dark red to black; Equant (dodecahedron) crystal form or massive; H 7	Garnet
		Opaque gray; Luster waxy; Cryptocrystalline; H 7	Chert (gray variety of quartz)
		Opaque black; Luster waxy; Cryptocrystalline; H 7	Flint (black variety of quartz)
		Black or dark green; Long striated prisms; H 7–7.5	Tourmaline
		Olive green, Transparent or translucent; No cleavage; Usually has many cracks and conchoidal to uneven fracture; Single crystals or masses of tiny crystals resembling green granulated sugar or aquarium gravel; The crystals have vitreous (glassy) luster	Olivine
		Opaque dark gray to black; Tarnishes gray to rusty yellow-brown; Cleavage absent; Strongly attracted to a magnet; May be magnetized; H 6–6.5	Magnetite
		Opaque green; Poor cleavage; H 6–7	Epidote
		Opaque brown prisms and cross-shaped twins; H 7	Staurolite
SOFT (H ≤ 5.5) Does not scratch glass Scratched by masonry nail or knife blade	Cleavage excellent or good	Yellow-brown, brown, or black; vitreous to resinous luster (may also be submetallic); Dodecahedral cleavage; H 3.5–4.0; Rotten egg smell when scratched or powdered	Sphalerite
		Purple cubes or octahedrons; Octahedral cleavage; H 4	Fluorite
		Black short opaque prisms; Splits easily along 1 excellent cleavage into thin sheets; H 2.5–3	Biotite (black mica)
		Green short opaque prisms; Splits easily along 1 excellent cleavage into thin sheets; H 2–3	Chlorite
	Cleavage absent, poor, or not visible	Opaque rusty brown or yellow-brown; Massive and amorphous; Yellow-brown streak; H 1–5.5	Limonite
		Rusty brown to red-brown, may have shades of tan or white; Earthy and opaque; Contains pea-sized spheres that are laminated internally; H 1–5; Pale brown streak	Bauxite
		Deep blue; Crusts, small crystals, or massive; Light blue streak; H 3.5–4	Azurite
		Opaque green or gray-green; Dull or silky masses or asbestos; White streak; H 2–5	Serpentine
		Opaque green in laminated crusts or massive; Streak pale green; Effervesces in dilute HCl; H 3.5–4	Malachite
		Translucent or opaque dark green; Can be scratched with your fingernail; Feels greasy or soapy; H 1	Talc
		Transparent or translucent green, brown, blue, or purple; Brittle hexagonal prisms; Conchoidal fracture; H 5	Apatite
		Opaque earthy brick red to dull red-gray, or gray; H 1.5–5; Red-brown streak; Magnet may attract the gray forms	Hematite

FIGURE 3.19 Identification chart for dark to medium-colored minerals with nonmetallic (NM) luster on freshly broken surfaces.

LIGHT-COLORED NONMETALLIC (NM) MINERAL IDENTIFICATION

STEP 1: What is the mineral's hardness?	STEP 2: What is the mineral's cleavage?	STEP 3: Compare the mineral's physical properties to other distinctive properties below.	STEP 4: Find mineral name(s) and check the mineral database for additional properties (Figure 3.21).
HARD (H > 5.5) Scratches glass Not scratched by masonry nail or knife blade	Cleavage excellent or good	White or pale gray; 2 good cleavages at nearly 90° plus uneven fracture; May have striations; H 6	Plagioclase feldspar
		Orange, pink, pale brown, green, or white; H 6; 2 good cleavages at 90° plus uneven fracture; exsolution lamellae	Potassium feldspar
		Pale brown, white, or gray; Long slender prisms; 1 excellent cleavage plus fracture surfaces; H 6–7	Sillimanite
		Blue, very pale green, white, or gray; Crystals are blades; H 4–7	Kyanite
	Cleavage absent, poor, or not visible	Gray, white, or colored (dark red, blue, brown) hexagonal prisms with flat striated ends; H 9	Corundum vars. ruby (red), sapphire (blue)
		Colorless, white, gray, or other colors; Greasy luster; Massive or hexagonal prisms and pyramids; Transparent or translucent; H 7	Quartz: vars. rose (pink), rock crystal (colorless), milky (white), citrine (amber)
		Opaque gray or white; Luster waxy; H 7	Chert (variety of quartz)
		Colorless, white, yellow, light brown, or pastel colors; Translucent or opaque; Laminated or massive; Cryptocrystalline; Luster waxy; H 7	Chalcedony (variety of quartz)
		Pale green to yellow; Transparent or translucent; H 7; No cleavage; Usually has many cracks and conchoidal to uneven fracture; Single crystals or masses of tiny crystals resembling green or yellow granulated sugar or aquarium gravel; Crystals vitreous (glassy)	Olivine
SOFT (H ≤ 5.5) Does not scratch glass Scratched by masonry nail or knife blade	Cleavage excellent or good	Colorless, white, yellow, green, pink, or brown; 3 excellent cleavages; Breaks into rhombohedrons; Effervesces in dilute HCl; H 3	Calcite
		Colorless, white, gray, creme, or pink; 3 excellent cleavages; Breaks into rhombohedrons; Effervesces in dilute HCl only if powdered; H 3.5–4	Dolomite
		Colorless or white with tints of brown, yellow, blue, black; Short tabular crystals and roses; Very heavy; H 3–3.5	Barite
		Transparent, colorless to white; H 2, easily scratched with your fingernail; White streak; Blade-like crystals or massive	Gypsum var. selenite
		Colorless, white, gray, or pale green, yellow, or red; Spheres of radiating needles; Luster silky; H 5–5.5	Natrolite (zeolite)
		Colorless, white, yellow, blue, brown, or red; Cubic crystals; Breaks into cubes; Salty taste; H 2.5	Halite
		Colorless, purple, blue, gray, green, yellow; Cubes with octahedral cleavage; H 4	Fluorite
		Colorless, yellow, brown, or red-brown; Short opaque prisms; Splits along 1 excellent cleavage into thin flexible transparent sheets; H 2–2.5	Muscovite (white mica)
	Cleavage absent, poor, or not visible	White, gray or yellow; Earthy to pearly; massive form; H 2, easily scratched with your fingernail; White streak	Gypsum var. alabaster
		White to gray; Fibrous form with silky or satiny luster; H 2, easily scratched with your fingernail	Gypsum var. satin spar
		Yellow crystals or earthy masses; Luster greasy; H 1.5–2.5; Smells like rotten eggs when powdered	Sulfur (Native sulfur)
		Opaque pale blue to blue-green; Conchoidal fracture; H 2-4; Massive or amorphous earthy crusts; Very light blue streak	Chrysocolla
		Opaque green, yellow, or gray; Dull or silky masses or asbestos; White streak; H 2–5	Serpentine
		Opaque white, gray, green, or brown; Can be scratched with fingernail; Greasy or soapy feel; H 1	Talc
		Opaque earthy white to very light brown masses of "white clay"; H 1–2; Powdery to greasy feel	Kaolinite
		Mostly pale brown to tan or white; Earthy and opaque; Contains pea-sized spheres that are laminated internally; H 1–5; Pale brown to white streak	Bauxite
		Colorless to white, orange, yellow, blue, gray, green, or red; May have internal play of colors; H 5.0–5.5; Amorphous; Often has many cracks; Conchoidal fracture	Opal
		Colorless or pale green, brown, blue, white, or purple; Brittle hexagonal prisms; Conchoidal fracture; H 5	Apatite

FIGURE 3.20 **Identification chart for light-colored minerals with nonmetallic (NM) luster on freshly broken surfaces.**