

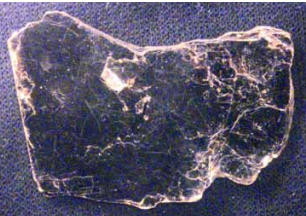









Dr. Rider's Brief Bestiary of Minerals






Minerals that are common components of rocks:

<p>Quartz Clear/white hard hexagonal crystals SiO_2, hardness 7, SG 2.65 In sand, granite Color: amethyst/rose/smoky quartz Microscopic xtals: flint/agate/onyx</p> 	<p>Feldspar White/pink shiny hard "rock" $(\text{Na,K,Ca})\text{AlSi}_3\text{O}_8$, hard: 6, SG ~2.6 Types: microcline, plagioclase, etc. In granite</p> 	<p>Mica Flat, shiny, brittle, thin sheets Silicates, hard: 2.5-4, SG ~2.8 Biotite if black, muscovite if silver In granite, schist, etc.</p> 	<p>Calcite Causes double images if clear May be white or colored; not cubic CaCO_3, hardness 3, SG 2.71 In caves, limestone, marble</p> 	<p>Augite Black shiny crystals/layers $(\text{Ca,Mg,Fe})\text{SiO}_3$, hard: 5.5-6, SG ~3.4 In basalt Hornblende is similar</p> 
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Minerals that are major sources of metals:

<p>Magnetite Black, heavy, magnetic Fe_3O_4, hardness 5.5-6.5, SG 5.2 Source of iron for magnets, steel Hematite (Fe_2O_3) is similar but reddish (ruined) and not magnetic</p> 	<p>Pyrite Heavy golden cubes or clusters "Fool's gold"—not really gold FeS_2, hardness 6-6.5, SG 5.0 Source of iron and sulfur</p> 	<p>Malachite Greenish cluster of round pieces $\text{Cu}_2\text{CO}_3(\text{OH})_2$, hardness 3.5-4, SG 4.0 Source of copper for wires, pipes Azurite is similar but bluish crystals</p> 	<p>Bornite Shiny red/blue/purple metal "Peacock copper ore" Cu_5FeS_4, hardness 3, SG 5.0 May have yellow/green chalcocopyrite</p> 	<p>Bauxite Gray/tan with round pieces inside Breathe on it → smells like wet clay $\text{Al}(\text{OH})_3$, etc., hardness 1-3, SG ~2.5 Aluminum for foil, pots, etc.</p> 
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Minerals that are major sources of non-metals:

<p>Graphite Silvery black, soft, fine layers 2D carbon atoms, hard: 1-2, SG ~2.2 Used in pencils, circuits, lubricant Diamond is 3D carbon atoms</p> 	<p>Sulfur Yellow, soft, smells bad S, hardness 1.5-2.5, SG ~2 Used in rubber, explosives, acid</p> 	<p>Halite Clear or whitish cubic crystals NaCl, hardness 2, SG ~2.15 Left when ancient oceans dried up Used for table salt, road salt</p> 	<p>Fluorite 8-sided crystals, various colors CaF_2, hardness 4, SG 3.2 Fluorine for toothpaste, acid</p> 	<p>Gypsum White/brown fragile crystals/"roses" $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$, hardness 2, SG 2.32 Used for plaster, wallboard</p> 
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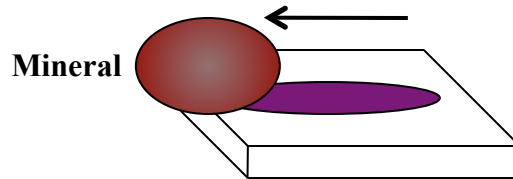
Mineral Identification Methods

Mohs scale of hardness

A softer mineral can be scratched by a harder one:

- Increasing hardness of mineral
- 1: Talc
- 2: Gypsum ← 2.5: Fingernail
- 3: Calcite ← 3.5: Penny
- 4: Fluorite ← 4.5: Nail
- 5: Apatite ← 5.5: Knife blade
- 6: Feldspar ← 6.5: Ceramic tile
- 7: Quartz
- 8: Topaz, beryl
- 9: Corundum/ruby/sapphire
- 10: Diamond

Streak test



Unglazed ceramic tile

Streak color may be different than surface of mineral and is a better identifier

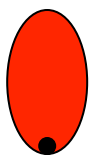
Specific gravity (SG)

$$SG = \frac{\text{Density of mineral}}{\text{Density of water}}$$

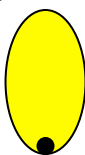
Calculate by weighing a mineral in and out of water using a jolly balance

Flame test

Flame color depends on elements in mineral



Red for strontium



Yellow for sodium

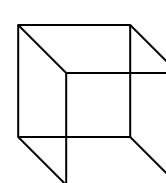


Blue-green for copper

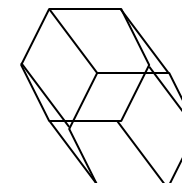


Violet for potassium

Crystal form



Cubic



Hexagonal

Etc.

Can also use surface appearance, response to acid, how minerals break, etc. to identify them. See books below for details on identification methods.

Minerals vs. Rocks

Minerals are fairly pure chemical substances, like sulfur, gold, quartz (silicon dioxide), etc.

Rocks are mixtures of minerals (e.g., granite contains quartz, mica, and feldspar minerals).

Wanna Play with Minerals?

Order rocks and minerals online:

- www.geod1.com
- www.djminerals.com
- www.homesciencetools.com

Good books:

- Shaffer & Zim, *Rocks, Gems and Minerals* (St. Martin's Press Golden Guide, 2001)
- Frank Rhodes, *Geology* (St. Martin's Press Golden Guide, 2001)
- Chris Pellant, *Smithsonian Handbooks: Rocks and Minerals* (DK, 2002)
- Prinz, Harlow, & Peters, *Simon & Schuster's Guide to Rocks and Minerals* (1978)

Dr. Rider's Guide to Pet Rocks

Igneous rocks

Solidified from hot liquid materials.

May have flow marks, gas bubbles, or crystals (if cooled slowly).






<p>Granite Particles of black, white, pink, clear Hard, foundation of continents Used for counters, monuments Called rhyolite if uniformly mixed</p> 	<p>Pumice Gray, floats in water (trapped air) Hardened volcanic foam Used for sanding</p> 	<p>Obsidian Shiny black and sharp (careful!) Volcanic glass Used for arrowheads</p> 	<p>Basalt Black, dense, may have bubbles Volcanic lava that cooled Forms the sea floor Called gabbro if separate crystals</p> 	<p>Peridotite Greenish, dense Forms mantle of earth Source of peridot (olivine) gems</p> 
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Sedimentary rocks

Deposited as sediments and hardened.

May crumble easily,

contain visible chunks or fossils, or have flat deposited layers.



<p>Conglomerate Round pebbles glued together Looks like concrete Components >2 mm Called breccia if pebbles are sharp</p> 	<p>Sandstone Grains of sand glued together Components 0.1-2 mm</p> 	<p>Shale Mud that hardens to rock Components <0.1 mm May contain fossils More organic matter → darker</p> 	<p>Coal Black, burns—used for fuel Compressed decayed plants Bituminous coal is dull & crumbly Anthracite coal is glossy & harder</p> 	<p>Limestone Rough, fizzes in vinegar Compressed little seashells Used for chalk, buildings</p> 
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Metamorphic rocks

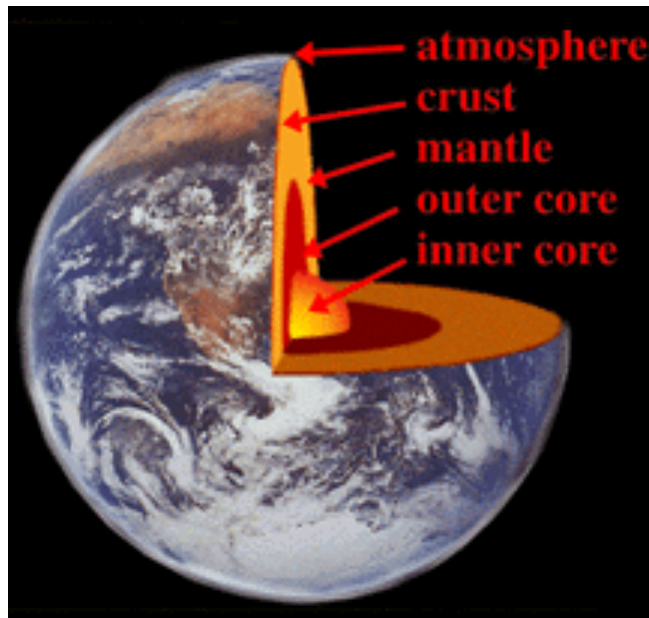
Other rocks changed by pressure or heat (but not melting).

Stronger

& denser than sedimentary rocks; may have wavy layers from pressure.

<p>Gneiss ("Nice") Layers of black, white, pink, clear Formed from granite Used for buildings</p> 	<p>Quartzite Dense glassy sand Formed from sandstone Used for buildings</p> 	<p>Slate Dense black/gray/green, fine layers Formed from shale Used for blackboards, tile</p> 	<p>Schist Grayish with glittery, wavy layers Formed from slate + more pressure Used for buildings</p> 	<p>Marble Dense, polished, fizzes in vinegar Formed from limestone Used for countertops, tile</p> 
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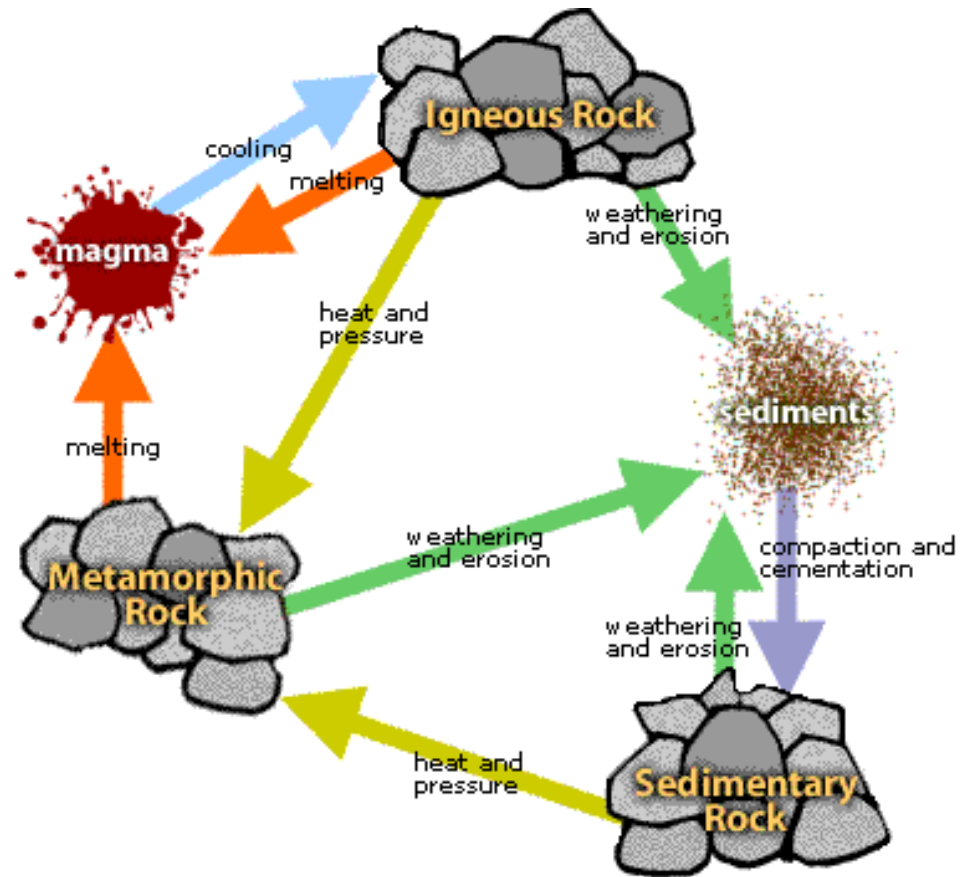
Structure of the Earth



Increasing density of rock

- Continental crust: Granite, etc.
- Oceanic crust: Basalt/gabbro
- Mantle: Peridotite, etc.
- Outer core: Liquid iron + nickel
- Inner core: Solid iron + nickel

Rock cycle



Minerals vs. Rocks

Minerals are fairly pure chemical substances, like sulfur, gold, quartz (silicon dioxide), etc.

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