Minerals

- Natural
- Solid
- Inorganic
- Definite chemical composition
- Crystal structure due to internal arrangement of atoms

http://www.minerals.net/gemstone/index.htm
Every American Born Will Need...

- 1.841 lbs. Copper
- 21,476 lbs. Clays
- 32,061 lbs. Salt
- 997 lbs. Zinc
- 1.64 million lbs Stone, Sand, & Gravel
- 81,585 gallons Petroleum
- 68,110 lbs. Cement
- 23,700 lbs. Phosphate
- 5,599 lbs. Aluminum
- 1,074 lbs. Lead
- 45,176 lbs. Iron Ore
- +57,448 lbs. Other Minerals & Metals
- 5.9 million cu. ft. of natural gas

3.7 million pounds of minerals, metals, and fuels in his/her lifetime

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http://www.mii.org/
General Facts about Minerals

• More 3,000 have been identified
• A few are “native elements” -- made of only one element, such as sulfur, gold, copper, and graphite (carbon)
• Most are compounds, especially the silicate group (Si, O).
• Other important groups are oxides, carbonates, and sulfides.
Less than a dozen commonly form most of the rocks

- Quartz
- Feldspar (group)
- Muscovite (white mica)
- Biotite (black mica)
- Calcite
- Pyroxene
- Olivine
- Amphibole (group)
- Magnetite, limonite, and other iron oxides
- Pyrite
Common uses include:

- Aluminum -- packaging, transport, building
- Beryllium -- gemstones, fluorescent lights
- Copper -- electric cables, wires, switches
- Feldspar -- glass and ceramics
- Iron -- buildings, automobiles, magnets
- Calcite -- toothpaste, construction

http://www.mii.org/commonminerals.php
Minerals are identified by their key characteristics

- hardness
- crystal shape (form)
- luster
- color
- streak
- cleavage/fracture
- density (specific gravity)
- special properties
  -- reaction to acid
  -- fluorescence
  -- salty taste
  -- magnetism
Mineral Hardness

- Ability to scratch another mineral
- Mohs scale from 1 (talc) to 10 (diamond)
- Quartz (most common mineral and most dust particles) is 7

Crystal Shape (Form)

- External structure due to internal arrangement of the atoms
- Six basic groups of shapes, with about three dozen variations

http://www.minerals.net/mineral/carbonat/aragonit/aragoni1.htm
Luster

- Describes how light reflects off the surface
- Main categories are “metallic” and “non-metallic”
- Non-metallic includes “dull,” “glassy,” “waxy,” “pearly,” and others

http://www.minerals.net/mineral/sulfides/pyrite/pyrite2.htm
Color

- results from ability to absorb some wavelengths and reflect others
- some minerals have characteristics colors
- others vary due to chemical differences or impurities (atoms mixed inside the main elements)

http://www.minerals.net/mineral/carbonat/calcite/images/4assortd.htm
Streak

- Color of the powder when rubbed on a "streak plate" (unglazed porcelain)
- May be same as hand-specimen or different
- Some paint is based on powdered minerals (streaks).

http://www.minerals.net/mineral/oxides/hematite/hematit6.htm
Mineral cleavage/fracture

- Some minerals split along flat surfaces when struck hard--this is called mineral cleavage.
- Other minerals break unevenly along rough or curved surfaces--this is called fracture.
- A few minerals show both cleavage and fracture.
Density (Specific Gravity)

- All minerals have density (mass / volume), but some are very dense.
- Examples include galena, magnetite, and gold.
- Specific Gravity means the density of the mineral compared with the density of water.

http://www.minerals.net/mineral/elements/gold/gold1.htm
Special Characteristics--
the "Acid Test"

Carbonates react with dilute HCl and other acids by fizzing or bubbling (releasing CO$_2$ gas)
Special Characteristics--
Fluorescence

• Some minerals will glow when placed under short-wave or long-wave ultraviolet rays

• Franklin and Ogdensburg NJ are famous for their fluorescent minerals

http://www.sterlinghill.org/Tour%20information.htm
Special Characteristics--Salty Taste

- DO NOT TASTE MOST MINERALS!
- Halite is the exception--it will taste salty

Special Characteristics--Magnetism

- Many iron minerals will produce an invisible magnetic force field
- “Lodestone” was used by Vikings more than 1,000 years ago as compasses

http://www.minerals.net/mineral/oxides/magnetit/magneti4.htm
## Properties of Common Minerals

<table>
<thead>
<tr>
<th>Luster</th>
<th>Hardness</th>
<th>Cleavage</th>
<th>Common Colors</th>
<th>Distinguishing Characteristics</th>
<th>Use(s)</th>
<th>Composition*</th>
<th>Mineral Name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1-2</td>
<td>✓</td>
<td>silver to gray</td>
<td>black streak, greasy feel</td>
<td>pencil lead, lubricants</td>
<td>C</td>
<td>Graphite</td>
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<tr>
<td>Metallic Luster</td>
<td></td>
<td>✓</td>
<td>metallic silver</td>
<td>gray-black streak, cubic cleavage, density = 7.8 g/cm³</td>
<td>ore of lead, batteries</td>
<td>PbS</td>
<td>Galena</td>
</tr>
<tr>
<td></td>
<td>2.5</td>
<td>✓</td>
<td>black to silver</td>
<td>black streak, magnetic</td>
<td>ore of iron, steel</td>
<td>Fe₂O₃</td>
<td>Magnetite</td>
</tr>
<tr>
<td></td>
<td>5.5–6.5</td>
<td>✓</td>
<td>brassy yellow</td>
<td>green-black streak, (fool’s gold)</td>
<td>ore of sulfur</td>
<td>FeS₂</td>
<td>Pyrite</td>
</tr>
<tr>
<td></td>
<td>6.5</td>
<td>✓</td>
<td>metallic silver or earthy red</td>
<td>red-brown streak</td>
<td>ore of iron, jewelry</td>
<td>Fe₂O₃</td>
<td>Hematite</td>
</tr>
<tr>
<td></td>
<td>5.5–6.5 or 1</td>
<td>✓</td>
<td>white to green</td>
<td>greasy feel</td>
<td>ceramics, paper</td>
<td>Mg₃Si₂O₅(OH)₂</td>
<td>Talc</td>
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<tr>
<td></td>
<td>2</td>
<td>✓</td>
<td>yellow to amber</td>
<td>white-yellow streak</td>
<td>sulfuric acid</td>
<td>S</td>
<td>Sulfur</td>
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<tr>
<td></td>
<td>2</td>
<td>✓</td>
<td>white to pink or gray</td>
<td>easily scratched by fingernail</td>
<td>plaster of paris, drywall</td>
<td>CaSO₄·2H₂O</td>
<td>Selenite gypsum</td>
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<tr>
<td></td>
<td>2–2.5</td>
<td>✓</td>
<td>colorless to yellow</td>
<td>flexible in thin sheets</td>
<td>paint, roofing</td>
<td>Na₂SO₄·2H₂O</td>
<td>Muscovite mica</td>
</tr>
<tr>
<td></td>
<td>2.5</td>
<td>✓</td>
<td>colorless to white</td>
<td>cubic cleavage, salty taste</td>
<td>food additive, melts ice</td>
<td>NaCl</td>
<td>Halite</td>
</tr>
<tr>
<td></td>
<td>2.5–3</td>
<td>✓</td>
<td>black to dark brown</td>
<td>cubic cleavage in thin sheets</td>
<td>construction materials</td>
<td>K(Mg,Fe₃⁺,Al)₃(Si₃O₈)(OH)₂</td>
<td>Biotite mica</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>✓</td>
<td>colorless or variable</td>
<td>bubbles with acid, rhombohedral cleavage</td>
<td>cement, lime</td>
<td>CaCO₃</td>
<td>Calcite</td>
</tr>
<tr>
<td></td>
<td>3.5</td>
<td>✓</td>
<td>colorless or variable</td>
<td>bubbles with powder</td>
<td>building stones</td>
<td>CaMg(CO₃)₂</td>
<td>Dolomite</td>
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<tr>
<td></td>
<td>4</td>
<td>✓</td>
<td>colorless or variable</td>
<td>cleaves in 4 directions</td>
<td>hydrofluoric acid</td>
<td>CaF₂</td>
<td>Fluorite</td>
</tr>
<tr>
<td></td>
<td>5–6</td>
<td>✓</td>
<td>black to dark green</td>
<td>cleaves in 2 directions at 90°</td>
<td>mineral collections, jewelry (Ca,Na)Mg₂Fe₀.₃Al(SiAl)O₈</td>
<td>Pyroan (commonly augite)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5.5</td>
<td>✓</td>
<td>black to dark green</td>
<td>cleaves at 56° and 124°</td>
<td>mineral collections, jewelry</td>
<td>CaNa₂Mg₆Al₃Ti₃₂Si₂O₈</td>
<td>Amphibole (commonly hornblende)</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>✓</td>
<td>white to pink</td>
<td>cleaves in 2 directions at 90°</td>
<td>ceramics, glass</td>
<td>KAl₂Si₂O₆</td>
<td>Potassium feldspar (commonly orthoclase)</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>✓</td>
<td>white to gray</td>
<td>cleaves in 2 directions, striations visible</td>
<td>ceramics, glass</td>
<td>Ca(Al₂Si₂O₆)</td>
<td>Plagioclase feldspar</td>
</tr>
<tr>
<td></td>
<td>6.5</td>
<td>✓</td>
<td>green to gray or brown</td>
<td>commonly light green and granular</td>
<td>furnace bricks, jewelry</td>
<td>Fe₂Mg₂Si₄O₁₁</td>
<td>Olivine</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>✓</td>
<td>colorless or variable</td>
<td>glassy luster, may form hexagonal crystals</td>
<td>glass, jewelry, electronics</td>
<td>SiO₂</td>
<td>Quartz</td>
</tr>
<tr>
<td></td>
<td>6.5–7.5</td>
<td>✓</td>
<td>dark red to green</td>
<td>often seen as red glassy grains in NYS metamorphic rocks</td>
<td>jewelry (NYS gem), abrasives</td>
<td>Fe₂Mg₂Si₄O₁₁</td>
<td>Garnet</td>
</tr>
</tbody>
</table>

*Chemical symbols:  
Al = aluminum  
Cl = chlorine  
H = hydrogen  
Na = sodium  
S = sulfur  
C = carbon  
F = fluorine  
K = potassium  
O = oxygen  
Si = silicon  
Ca = calcium  
Fe = iron  
Mg = magnesium  
Pb = lead  
Ti = titanium

✓ = dominant form of breakage
Useful Web Sites

- http://www.mineralseducationcoalition.org/
- www.galleries.com/Minerals
- State Mineral information: http://minerals.usgs.gov/minerals/pubs/state/
- Other USGS educational resources: http://education.usgs.gov/secondary.html