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

2.196 Troy oz. 
Gold

586,218 lbs. 
Coal

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/carbonate/calcite/images/4assorted.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 Fracture</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>Metallic Luster</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>
</tr>
<tr>
<td></td>
<td>2.5</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>5.5-6.5</td>
<td>✓</td>
<td>black to silver</td>
<td>black streak, magnetic</td>
<td>ore of iron, steel</td>
<td>Fe₃O₄</td>
<td>Magnetite</td>
</tr>
<tr>
<td></td>
<td>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>Nonmetallic Luster</td>
<td>5.5-6.5 or 1</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>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>
</tr>
<tr>
<td></td>
<td>2</td>
<td>✓</td>
<td>yellow to amber</td>
<td>white-yellow streak, sulfuric acid</td>
<td>plaster of paris, drywall</td>
<td>CaSO₄·H₂O</td>
<td>Selenite gypsum</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>✓</td>
<td>white to pink or gray</td>
<td>easily scratched by fingernail</td>
<td>paint, roofing</td>
<td>K₄Si₃O₉(OH)₂</td>
<td>Muscovite gypsum</td>
</tr>
<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>KAl₃Si₃O₁₀(OH)₂</td>
<td>Halite</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>Biotite mica</td>
</tr>
<tr>
<td></td>
<td>2.5-3</td>
<td>✓</td>
<td>black to dark brown</td>
<td>flexible in thin sheets</td>
<td>construction materials</td>
<td>K(Mg,Fe₃)₂Al₃Si₃O₁₀(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>
</tr>
<tr>
<td></td>
<td>4</td>
<td>✓</td>
<td>colorless or variable</td>
<td>when powdered</td>
<td>building stones</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</td>
<td>(Ca,Na)(Mg,Fe,Al)(Si,Al)O₆</td>
<td>Pyroxene (commonly augite)</td>
</tr>
<tr>
<td></td>
<td>5.5</td>
<td>✓</td>
<td>black to dark green</td>
<td>cleaves at 58° and 124°</td>
<td>mineral collections, jewelry</td>
<td>Na₂CaMg₃O₇(OH)₂</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>KAl₃Si₃O₁₀</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>CaMg₃Si₃O₁₀</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>Fe₃Mg₃SiO₆</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>Fe₂Mg₂SiO₄</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
• Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes. [Clarification Statement: Emphasis is on how these resources are limited and typically non-renewable, and how their distributions are significantly changing as a result of removal by humans. Examples of uneven distributions of resources as a result of past processes include but are not limited to petroleum (locations of the burial of organic marine sediments and subsequent geologic traps), metal ores (locations of past volcanic and hydrothermal activity associated with subduction zones), and soil (locations of active weathering and/or deposition of rock).]
NGSS Connections MS-ESS- 3.3

- **Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.** *[Clarification Statement: Examples of the design process include examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating solutions that could reduce that impact. Examples of human impacts can include water usage (such as the withdrawal of water from streams and aquifers or the construction of dams and levees), land usage (such as urban development, agriculture, or the removal of wetlands), and pollution (such as of the air, water, or land).]*
Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems. [Clarification Statement: Examples of evidence include grade-appropriate databases on human populations and the rates of consumption of food and natural resources (such as freshwater, mineral, and energy). Examples of impacts can include changes to the appearance, composition, and structure of Earth’s systems as well as the rates at which they change. The consequences of increases in human populations and consumption of natural resources are described by science, but science does not make the decisions for the actions society takes.]
• Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity. [Clarification Statement: Examples of key natural resources include access to fresh water (such as rivers, lakes, and groundwater), regions of fertile soils such as river deltas, and high concentrations of minerals and fossil fuels. Examples of natural hazards can be from interior processes (such as volcanic eruptions and earthquakes), surface processes (such as tsunamis, mass wasting and soil erosion), and severe weather (such as hurricanes, floods, and droughts). Examples of the results of changes in climate that can affect populations or drive mass migrations include changes to sea level, regional patterns of temperature and precipitation, and the types of crops and livestock that can be raised.]
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
NGSS Connections