I. Minerals

- Minerals are the ingredients needed to form the different types of rocks

- Rock

- Mineral

- Inorganic

- Crystalline

- Minerals form by three methods:
  1. **Crystallization** - a process of organizing ________________ to form crystalline solids
  2. **Recrystallization** - the cooling and hardening of ________________ or magma into minerals
  3. **Rearrangement** - the realignment of atoms in minerals under high ________________ and ________________

- Most rock forming minerals are silicates that result in a tetrahedron shape
  - Four-sided units of 4 ________________ and 1 ________________
Crystal structure or “_______________________________________________________” are responsible for the physical and chemical properties a mineral possesses.

Each mineral has a set of physical and chemical properties that can be used to identify the sample.

The methods we use to classify minerals are:

1. **Color** - a visual attribute of an object based on perception
   - One of the most obvious, but not the most reliable
   - Many of the 4000 known minerals share similar colors

2. **Streak** - __________________________________________________________________________________
   - Weathering changes the outside color, but streak gives the true color

3. **Luster** - __________________________________________________________________________________
   - Two types of luster:
     - Metallic Luster - shines like stainless steel
     - Nonmetallic Luster - earthy or dull shine

4. **Density** - __________________________________________________________________________________
   - Sample Problem: a student measures the mass of a mineral to be __________ g and calculates the volume to be __________ mL. What is the density?

Write the Formula:

Show All Work:

Answer:
The methods we will use are (continued):

5. **Hardness** -

Mohs Hardness Scale is used to classify hardness

<table>
<thead>
<tr>
<th>Hardness</th>
<th>Mineral</th>
<th>Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Talc</td>
<td>Finger nail scratches easily</td>
</tr>
<tr>
<td>2</td>
<td>Gypsum</td>
<td>Finger nail scratches</td>
</tr>
<tr>
<td>3</td>
<td>Calcite</td>
<td>Copper penny scratches</td>
</tr>
<tr>
<td>4</td>
<td>Fluorite</td>
<td>Steel knife scratches easily</td>
</tr>
<tr>
<td>5</td>
<td>Apatite</td>
<td>Steel knife scratches</td>
</tr>
<tr>
<td>6</td>
<td>Feldspar</td>
<td>Steel knife will not scratch</td>
</tr>
<tr>
<td>7</td>
<td>Quartz</td>
<td>Will scratch glass and steel</td>
</tr>
<tr>
<td>8</td>
<td>Topaz</td>
<td>Harder than any common mineral</td>
</tr>
<tr>
<td>9</td>
<td>Corundum</td>
<td>Scratches topaz</td>
</tr>
<tr>
<td>10</td>
<td>Diamond</td>
<td>Hardest mineral</td>
</tr>
</tbody>
</table>

6. **Cleavage** -

Mohs Hardness Scale is used to classify hardness

7. **Fracture** -

Tends to lack preferred zones of weakness

8. **Acid Test** -

Calcite and Dolomite both react with acid
II. Igneous Rocks

- **Igneous Rocks**

- **Methods to classify igneous rocks:**
  1. **Environment of Formation**

- **Magma**

- **Plutonic**

- **Intrusive**

- **Lava**

- **Volcanic**

- **Extrusive**
2. **Color** - ________________________________

3. **Composition** - a mixture of materials that make up an igneous rock
   - **Felsic** - ________________________________
   - **Mafic** - ________________________________

4. **Texture** - ________________________________
   - **Vesicular** - ________________________________
   - **Porphyritic** - ________________________________

5. **Crystal Size** - ________________________________
   - Crystal size is an important factor to determine the environment of formation
     - The _______________ the cooling time the _______________ the crystal size
       (coarse or very coarse)
     - The _______________ the cooling time the _______________ the crystal size
       (glassy or fine)

---

![Fine Grained](image1.png)  
![Coarse Grained](image2.png)

Leigh-Manuell - 5
**Class Notes: Minerals and Rocks**

**Scheme for Igneous Rock Identification**

<table>
<thead>
<tr>
<th>ENVIRONMENT OF FORMATION</th>
<th>EXTRUSIVE (Volcanic)</th>
<th>INTRUSIVE (Plutonic)</th>
<th>CRYS TAL SIZE</th>
<th>TEXTURE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Obsidian (usually appears black)</td>
<td>Basaltic glass</td>
<td>less than 1 mm</td>
<td>Glassy</td>
</tr>
<tr>
<td></td>
<td>Pumice</td>
<td>Scoria</td>
<td>1 mm or larger</td>
<td>Non-vesicular</td>
</tr>
<tr>
<td></td>
<td>Vesicular rhyolite</td>
<td>Vesicular andesite</td>
<td>Vesicular basalt</td>
<td>Vesicular (gas pockets)</td>
</tr>
<tr>
<td></td>
<td>Rhyolite</td>
<td>Andesite</td>
<td>Basalt</td>
<td>Fine</td>
</tr>
<tr>
<td></td>
<td>Granite</td>
<td>Diorite</td>
<td>Diabase</td>
<td>Coarse</td>
</tr>
<tr>
<td></td>
<td>Pegmatite</td>
<td></td>
<td>Gabbro</td>
<td>Non-vesicular</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Peridotite</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Dunitite</td>
<td></td>
</tr>
</tbody>
</table>

**CHARACTERISTICS**

- LIGHTER: COLOR
- LOWER: DENSITY
- FELSIC (rich in Si, Al)

- 100% Potassium feldspar (pink to white)
- 75% Quartz (clear to white)
- 50% Plagioclase feldspar (white to gray)
- 25% Pyroxene (green)
- 0% Biotite (black)
- 100% Olivine (green)

**MINERAL COMPOSITION**

- (relative by volume)

- 0% to 25% Amphibole (black)
- 25% to 50% Biotite (black)
- 50% to 75% Pyroxene (green)
- 75% to 100% Olivine (green)
III. Sedimentary Rocks

- Sedimentary Rocks -

- Lithification -

- Methods to classify sedimentary rocks:

  1. Texture -

     - Texture is the main factor in sedimentary rock identification
       - Clastic -

     - Crystalline -

     - Bioclastic -

     Bioclastic
     Contains Shell Fragments
Methods to classify sedimentary rocks (continued):

2. **Formation** -

   - Most sedimentary rocks form under large bodies of water by the following:
     - **Cementation** -
       - Occurs as water between sediments dissolves and the remaining materials hold the clasts together
     - **Compaction** -
       - Usually results in a decrease in pore space and sediments become more tightly packed
     - **Chemical Action** -

3. **Characteristics** -

   - Form at or near Earth’s surface where weathering can break down rocks into pieces
   - Forms in horizontal layers
   - May contain fossils

---

*Horizontal Layers*

*Fossils*
# Scheme for Sedimentary Rock Identification

<table>
<thead>
<tr>
<th>TEXTURE</th>
<th>GRAIN SIZE</th>
<th>COMPOSITION</th>
<th>COMMENTS</th>
<th>ROCK NAME</th>
<th>MAP SYMBOL</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>INORGANIC LAND-DERIVED SEDIMENTARY ROCKS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clastic (fragmental)</td>
<td>Pebbles, cobbles,</td>
<td>Mostly quartz, feldspar, and clay minerals; may contain fragments of other rocks and minerals</td>
<td>Mostly quartz, feldspar, and clay minerals; may contain fragments of other rocks and minerals</td>
<td>Conglomerate</td>
<td>![Conglomerate Symbol]</td>
</tr>
<tr>
<td></td>
<td>and/or boulders</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>embedded in sand,</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>silt, and/or clay</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sand (0.006 to 0.2 cm)</td>
<td>Fine to coarse</td>
<td>Fine to coarse</td>
<td>Fine to coarse</td>
<td>Sandstone</td>
<td>![Sandstone Symbol]</td>
</tr>
<tr>
<td>Silt (0.0004 to 0.006 cm)</td>
<td>Very fine grain</td>
<td>Very fine grain</td>
<td>Very fine grain</td>
<td>Siltstone</td>
<td>![Siltstone Symbol]</td>
</tr>
<tr>
<td>Clay (less than 0.0004 cm)</td>
<td>Compact; may split easily</td>
<td>Compact; may split easily</td>
<td>Compact; may split easily</td>
<td>Shale</td>
<td>![Shale Symbol]</td>
</tr>
<tr>
<td><strong>CHEMICALLY AND/OR ORGANICALLY FORMED SEDIMENTARY ROCKS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crystalline</td>
<td>Fine to coarse</td>
<td>Halite</td>
<td>Crystals from chemical precipitates and evaporites</td>
<td>Rock salt</td>
<td>![Rock salt Symbol]</td>
</tr>
<tr>
<td></td>
<td>crystals</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gypsum</td>
<td></td>
<td>Rock gypsum</td>
<td>![Rock gypsum Symbol]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dolomite</td>
<td></td>
<td>Dolostone</td>
<td>![Dolostone Symbol]</td>
</tr>
<tr>
<td>Crystalline or bioclastic</td>
<td>Microscopic to</td>
<td>Calcite</td>
<td>Precipitates of biologic origin or cemented shell fragments</td>
<td>Limestone</td>
<td>![Limestone Symbol]</td>
</tr>
<tr>
<td></td>
<td>very coarse</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bioclastic</td>
<td></td>
<td>Carbon</td>
<td>Compacted plant remains</td>
<td>Bituminous coal</td>
<td>![Bituminous coal Symbol]</td>
</tr>
</tbody>
</table>
IV. Metamorphic Rocks

- **Metamorphic Rocks** - 

- **Parent Rock** - 

- **Heat**
  - Rock expands when heated causing the atoms to break apart and move freely
  - As temperature decreases atoms join with other atoms to form different compounds
  - The result is a structural and chemical change

- **Pressure**
  - Under extreme pressure at great depths inside the Earth, atoms bonds are broken and re-arranged into a denser and more compact structure

- **Methods to classify metamorphic rocks:**
  1. **Texture** - the general appearance of the rock
  - **Foliation** - 
  - **Banding** - 
  - **Non-foliated** - 

---

![Foliated](Foliated.png)  ![Banding](Banding.png)  ![Non-foliated](Non-foliated.png)

Foliated  Banding  Non-foliated
Methods to classify metamorphic rocks (continued):

2. Grain Size -

3. Composition -

4. Type of Metamorphism -

- Regional Metamorphism -
- Most metamorphic rocks form regionally under a mountain or deep inside the Earth
- Contact Metamorphism -

Scheme for Metamorphic Rock Identification

<table>
<thead>
<tr>
<th>TEXTURE</th>
<th>GRAIN SIZE</th>
<th>COMPOSITION</th>
<th>TYPE OF METAMORPHISM</th>
<th>COMMENTS</th>
<th>ROCK NAME</th>
<th>MAP SYMBOL</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOLIATED</td>
<td>Fine</td>
<td>Quartz</td>
<td>Regional (Heat and pressure increases)</td>
<td>Low-grade metamorphism of shale</td>
<td>Slate</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fine to medium</td>
<td>Mica</td>
<td></td>
<td>Foliation surfaces shiny from microscopic mica crystals</td>
<td>Phyllite</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Medium to coarse</td>
<td>Feldspar</td>
<td></td>
<td>Platy mica crystals visible from metamorphism of clay or feldspars</td>
<td>Schist</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Amphibole</td>
<td></td>
<td>High-grade metamorphism; mineral types segregated into bands</td>
<td>Gneiss</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fine</td>
<td>Carbon</td>
<td>Regional</td>
<td>Metamorphism of bituminous coal</td>
<td>Anthracite coal</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fine</td>
<td>Various minerals</td>
<td>Contact (heat)</td>
<td>Various rocks changed by heat from nearby magma/lava</td>
<td>Hornfels</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fine to coarse</td>
<td>Quartz</td>
<td>Regional or contact</td>
<td>Metamorphism of quartz sandstone</td>
<td>Quartzite</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Coarse</td>
<td>Various minerals</td>
<td>Pebbles may be distorted or stretched</td>
<td>Metamorphism of limestone or dolostone</td>
<td>Marble</td>
<td></td>
</tr>
</tbody>
</table>
V. Rock Cycle

- Rock Cycle - ____________________________________________________________
  - Any rock type can change into another rock type
  - Therefore any rock could contain materials that were one part of another rock
- Igneous Rock - __________________________________________________________
- Sedimentary Rock - ______________________________________________________
- Metamorphic Rock - ______________________________________________________
- **Driving Forces** - the processes that create uplift, weathering, erosion, pressure, and melting to form the different rock types
  - _________________________________________________________________
  - _________________________________________________________________
  - _________________________________________________________________

---

**Rock Cycle in Earth’s Crust**

![Rock Cycle Diagram](image)

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