Lesson Objectives:
   Students will be able to demonstrate how minerals are formed and compare different minerals and crystals.

Materials:
Provided:  
   Gem and mineral samples (see appendix)  
   Crystal formation diagrams  
   Common mineral and gem charts  

Not Provided:  
   Sugar/salt  
   Food coloring  
   Water  
   Beakers/bowls  
   Sticks  
   Cotton string  
   Hot water  
   Optional: hand lenses and microscopes  

Curriculum Benchmarks:
K.3S.2 Make observations about the natural world  
1.1P.1 Compare and contrast physical properties and composition of objects.  
1.1E.1 Examine characteristics and physical properties of Earth materials.  
2.3S.2 Make predictions about living and non-living things and events in the environment based on observed patterns.

Activity:

Hook:  
   1. Split the class into pairs. Assign each pair a mineral or crystal from the kit, and ask them to write down anything they notice. Good questions include:  
      a. Can you see the crystal structure with your eye? If so, how big is it?  
      b. What color or colors is your mineral?  

Lesson:  
   1. Explain to the students how minerals form beneath the surface of the Earth’s crust. Displays crystal formation diagrams. After your students have explored their mineral, have them try to compare minerals as a class. Ways you could do this are:  
      a. Divide minerals into those that have crystals too small to see, minerals with some visible crystals, and minerals that are one large crystal. Which do you think took the longest to form?
b. Divide minerals into colors- grays and blacks, whites, and bright colors. What do you think might have caused the different colors?
c. Does your mineral have a pattern, or is it a solid color? How might this have happened? Certain minerals will have molecules separate out in the crystallization process, resulting in a patterned look verses a uniform look.

Grow a Crystal:
Now it is time for students to grow their own crystals. Follow the instructions provided, making sure there is enough materials for however many crystals you want to make.

1. Before class, mix a ratio of 3 cups sugar to 1 cup hot (almost boiling water) until the sugar is dissolved. Try not to cook the sugar mixture, as this makes hard candy. Mixture makes about 2 cups of liquid.
2. During class, split the mixture up into bowls or jars. You can do a couple bowls, as a class, or students can pair up, or each student can get their own bowl.
3. If using food coloring, have students put a single drop of the color of their choosing in the bowl, then stir. The food coloring can be thought of as the impurities in crystals that give them certain colors.
4. To make a crystal, tie a piece of cotton string around a stick or pencil, dip the string in the syrup mixture, and then roll the string in sugar. Rest the stick across the bowl or jar so that the tip of the string is well within the syrup at the bottom.
5. Put the growing crystals somewhere where they will not be disturbed. Let them grow for at least 3 days (7 days is better).
6. Show the students how taking out the string in 3 days will result in different sized crystals than those pulled out at 6, 9, or even 12 days.

Closure:
After students show off their crystals, have students informally discuss how growing crystals in a classroom might compare to crystals growing in the earth. Variables to bring up might be temperature, pressure, and time.

Extensions:
• Ask students to bring in any crystals they might have to show the class
• You can also make a salt crystal geode with an eggshell and salt-water. Take the same idea of saturating the hot water with as much salt as possible, then pour the salt water mixture over the eggshell, add any coloring you want, and let sit for a couple days. Thunder eggs, a type of geode, are the state rock for Oregon.
## Appendix: Minerals and Rocks

<table>
<thead>
<tr>
<th>Number</th>
<th>Mineral/Gem</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Magnetite*</td>
<td>Cubic crystal, black. Magnetic.</td>
</tr>
<tr>
<td>2</td>
<td>Gypsum*</td>
<td>Monoclinic crystal, found near hot springs.</td>
</tr>
<tr>
<td>3</td>
<td>Calcite*</td>
<td>Hexagonal crystal tends to be white.</td>
</tr>
<tr>
<td>4</td>
<td>Hematite*</td>
<td>From iron, tends to be rust red.</td>
</tr>
<tr>
<td>5</td>
<td>Sulfur*</td>
<td>Lemon yellow. Forms around hot springs and volcanoes</td>
</tr>
<tr>
<td>6</td>
<td>Muscovite*</td>
<td>Monoclinic crystal. See-through.</td>
</tr>
<tr>
<td>7</td>
<td>Chalcedony- Quartz*</td>
<td>Quartz crystals too small to see. Most petrified wood is chalcedony.</td>
</tr>
<tr>
<td>8</td>
<td>Sapphire*</td>
<td>Hexagonal crystal, blue or purplish color.</td>
</tr>
<tr>
<td>9</td>
<td>Granite</td>
<td>Rock- made up of quartz, feldspar, mica and hornblende</td>
</tr>
<tr>
<td>10</td>
<td>Obsidian</td>
<td>Glassy texture. Usually made up of silica</td>
</tr>
<tr>
<td>11</td>
<td>Rhyolite</td>
<td>Banded, formed from light weight lava cooling</td>
</tr>
<tr>
<td>12</td>
<td>Slate</td>
<td>Clay minerals that have pressed together.</td>
</tr>
<tr>
<td>13</td>
<td>Gneiss</td>
<td>Banded, same make up as granite.</td>
</tr>
<tr>
<td>14</td>
<td>Conglomerate</td>
<td>Have pebbles cemented together by sedimentary rock</td>
</tr>
<tr>
<td>15</td>
<td>Sandstone</td>
<td>Sand grains that have cemented together</td>
</tr>
<tr>
<td>16</td>
<td>Shale</td>
<td>Clay rock. Fossils are common in shale.</td>
</tr>
<tr>
<td>17</td>
<td>Amethyst*</td>
<td>Quartz crystal with an imperfection that turns it a light lavender color</td>
</tr>
<tr>
<td>18</td>
<td>Garnet*</td>
<td>Cubic or rhombic crystals that are mostly red though can be green.</td>
</tr>
</tbody>
</table>

*Mineral
Background information:
Minerals are:
- inorganic (not from living things)
- naturally occurring
- solid
- have a crystalline structure (can be too small to see with the naked eye)
- have a specific chemical makeup (can be thought of like a recipe)

Crystals form when a liquid (often water) has been saturated with particles and then the liquid starts to evaporate. This forces the particles closer and closer together until they start to form crystal structures. If the water evaporates quickly, there will be many small crystals. If the water evaporates slowly, there will be fewer crystals, but they will be bigger. Temperature and pressure can also influence how the crystals form. The lower the temperature and pressure, the more likely a crystal is to form. A great example of this is snow— at higher temperatures, water is a liquid, but if it gets too cold, it forms a crystal structure and becomes ice or snow.

Different minerals form different types of crystal structures. For example, sapphires, which are a type of corundum, form a six sided crystal, whereas muscovite and mica form very thin sheets. Minerals that form large and beautiful crystals are often called gemstones, and are used by people as jewelry.