Answer Key: Determining a Chemical or Physical Change

Background
Matter can undergo both Physical and Chemical Changes.

Examples of these changes include:

<table>
<thead>
<tr>
<th>Physical Changes</th>
<th>Chemical Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Changing the size of an object</td>
<td>Burning/Combustion</td>
</tr>
<tr>
<td>Phase Changes</td>
<td>Mixing acid and base</td>
</tr>
<tr>
<td>Dissolving substances (salt into water)</td>
<td>Digesting food</td>
</tr>
<tr>
<td>Changing the color of an object with</td>
<td>Cooking meat</td>
</tr>
<tr>
<td>a dye/marker</td>
<td>Baking bread</td>
</tr>
<tr>
<td>Breaking an object into pieces</td>
<td>Oxidation of metals</td>
</tr>
</tbody>
</table>

Prelab Questions
1. In what case would heating a substance cause a physical change to occur? Explain how you would know. Answers will vary. Example: Phase change – melting, or vaporization.

2. In what case would heating a substance cause a chemical change to occur? For each example, explain how you would know. Answers will vary. Example: baking/cooking.

Purpose
To determine if a physical change or chemical change occurs as you heat copper(II) sulfate pentahydrate crystals in a test tube.

Hypothesis
I think heating Copper(II) Sulfate Pentahydrate crystals will:

- Produce a physical change OR Produce a chemical change (circle your choice)
- Because (explain why):

Materials
- Copper(II) Sulfate Pentahydrate
- Scoopula
- Test Tube Rack
- Test Tube
- Test tube holder
- Bunsen Burner
- Striker/Matches

Procedure
1. Place one or two crystals of Copper(II) Sulfate Pentahydrate in the bottom of a clean, dry test tube.
2. Observe the crystals and record the color and appearance in the data table provided.
3. Heat the crystals gently with a low flame while inclining the test tube on its side. *Your teacher will demonstrate this set-up.*
4. Record your observations of the crystals and the inside of the test tube while heating it.
5. Heat the whole test tube until no more changes occur.
6. Make a detailed observation of the remaining substance in the test tube.
7. After the test tube has cooled, add 2 drops of water to the crystals and observe any changes that occur.

### Data

<table>
<thead>
<tr>
<th>Process</th>
<th>Observations of crystals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prior to heating</td>
<td>Crystals are blue in color and opaque. Observations may vary, but could include crystal shapes, and sizes.</td>
</tr>
<tr>
<td>During heating</td>
<td>Crystal is going from a deep blue color to a light blue color. I notice that there is some water droplets around the mouth of the test tube</td>
</tr>
<tr>
<td>After heating has ended</td>
<td>Crystals are a very light blue to white color and look as though they may have a white coating on them.</td>
</tr>
<tr>
<td>Addition of water</td>
<td>After adding a few drops of water, you should notice that the crystals will begin to take on a blueish color again. This depends on the amount of time you let the water sit on the crystals.</td>
</tr>
</tbody>
</table>

### Conclusion

Did the heating of the Copper(II) Sulfate Pentahydrate crystals produce a chemical or physical change? Give evidence for your conclusion:

- Conclusions should vary but should confirm or refute their original hypothesis.
- The conclusion should be that there was a physical change, which can be easily reversed, but may also argue that since the water was driven off, that may constitute a change in the chemical formula hence a chemical change.
- More detail: This is an example of a physical change. Copper (II) Sulfate Pentahydrate is a blue solid, but when heated you evaporate the water from the sample and are left with an anhydrous compound. There is little to no water present and the crystal turns white. After cooling, the white crystals absorb water from the surrounding air and become the pentahydrate again. Or, if you add water, the material will also convert to the pentahydrate form. Since there are not bonds broken or formed in the CuSO₄, it is defined as a physical change.
Post-lab Questions

1. Do you think that the amount of crystals would have an effect on what took place? WHY?
The amount of crystals would not affect the results of this experiment. More crystals would just take longer to drive off the water.

2. What was the major change in the crystals that you observed? The major change of the crystal was color. I noticed that the color changed as the water was driven out of the crystal. When water was added back into the test tube, the crystal began to change back to the blueish original color.

3. What do you think is the reason for the crystals changing colors (as a result of the heating)? Due to the evaporation of water. As water is heated, it evaporates quickly. This changed the color from blue (containing water) to white (water evaporated).

4. Discuss how your conclusion addressed your hypothesis? Did you change your mind after adding water to the crystals in your test tube? Answers will vary, but students should see that this is a physical change caused by the evaporation of water from the hydrate. This process is reversible.

5. What does it mean to have “dehydrated” milk (or other food) and how does this relate to the crystals in our lab activity? Dehydrated means without water. The crystals in our lab were originally hydrated (contained water in the crystal lattice) and were dehydrated after heating.

6. What is something new you learned when completing this activity? Answers will vary.