

Kitchen Chemistry

5th Grade

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References:

<http://www.reachoutmichigan.org/funexperiments/quick/trainingrm/milkglue.html>

a recipe for changing milk into curds and whey.

Fields, Debbie. Mrs. Fields I Love Chocolate! Cookbook: 100 Easy & Irresistible Recipes. Reed Business Information incorporated, 1994.

(Caramel from recipe for Mother Lode Brownies).

Benchmarks:

SLC 8: Propose and/or evaluate an investigation of simple physical and/or chemical changes.

CPS Benchmark: A) Students will identify physical and chemical changes and compare their properties.

Objectives:

Students will identify melting and freezing as physical changes. Students will identify cooking, burning, and baking as chemical changes. Students will state that they can identify chemical changes by the following: formation of new substances, formation of substances with different properties, irreversibility of change. Vocabulary: combustion, reaction, phase change.

Materials:

- Hot plate
- Small frying pan
- Candy mold
- Butter
- Shallow dish of ice water
- Egg
- Clear bowl to observe egg
- Bread and burnt toast
- Vinegar or lemon juice
- Water
- 2 balloons
- Baking soda
- 2 20 oz soda bottles
- ¼ cup sugar
- Tablespoon

- Clear cooking dish.
- Wax paper

Preparation: Burn a piece of toast so that the carbon formed is easily visible. Melt several tablespoons of butter and pour them into the candy molds. Keep the candy mold sitting in the shallow dish of ice water so the butter is not too soft to begin with. Have the hot plate with the small frying pan on it warm at the beginning of class, but be sure students do not go near it lest they burn themselves.

Initial Demonstration:

Pick up one of the piece of molded butter and show it to the students. Ask them to tell you about what you are holding. If they do not guess that it is butter, tell them that it is. Write the physical properties of the butter on the board. (Hard, solid, cold, yellow, having a certain shape). Put two or three pieces of the butter in the frying pan, and ask the students what is happening to the butter. Ask them why this change is happening. Remind them that heat energy is called “thermal energy.” Ask them if this is a chemical change or a physical change.

Target Observations:

- The butter is hard and has a certain shape. These are indications that it is a solid.
- It is also yellow and probably cold from the ice water.
- The butter melts when it is heated (Thermal energy is added to it). Its new properties are that it is hot, liquid, and clearish.

Target Model:

- Heat (thermal energy) can cause a phase change.
- Some students may believe this is a physical change while others may believe it is chemical.

Procedure:

Pour butter back into one or two of the molds. Leave a little on the pan. Make sure the mold is in the ice water so that the butter can solidify. Crack an egg into a small clear bowl for the students. Ask the students to describe the properties of the egg (not the shell). (It is liquid, part is clear, part is white, part is yellow orange, it is cold). Write these properties on the board. Pour the egg into the frying pan and have the students observe the changes taking place. Why are these changes taking place (thermal energy again!)? Slide the egg onto a dish so it can cool. Is cooking an egg a chemical change or a physical change?

Have the students compare the before and after butter and the before and after egg. They should notice that the butter is now back in the same form that it was at the

beginning of the lesson. We changed some the physical properties when we melted it, but we have now returned it to its original form. The change was reversible and nothing new was formed. This is a physical change. The egg, even when it returns to room temperature, has changed completely. It is a solid now, and cannot be made liquid again. A new substance (still egg, but now cooked egg) was formed, and its properties are different. This is a chemical change.

Target Revised Model:

- **Physical changes:** changes in size, shape, color, or state of matter.
- The properties of the substance don't change no new substances are formed
- Often (but not always) the changes are easily reversible.*

- **Chemical change:** a new chemical substance is formed
- New substance has different properties than original substances
- May require heat to change
- Difficult or impossible to reverse
- Can include physical changes (change in color, shape, size, or state of matter).[#]

* Remind students of a simple example of tearing paper. Obviously this is a physical change, as we still have paper, but we cannot reverse this one!
[#] Simple (observable) chemical changes include physical changes. Some chemical changes do not, but these are not part of the 5th grade curriculum.

These should be recorded in the students' notebooks after setting up the following procedure:

Procedure:

Add $\frac{1}{4}$ cup of sugar to a beaker or glass measuring cup. Add 1 tablespoon of water. (Do not add too much water, or the sugar will take a long time to caramelize later). Ask the students what will happen as you stir and warm the mixture. (The sugar will dissolve). Is this a physical change or a chemical change? Set the beaker on the hot plate to warm. Stir with a spoon occasionally to dissolve.

Have the students identify each of the following as chemical or physical changes:

Keep an eye on your sugar water. When it is clear, hold it up for the students to see. There have been no color changes. Take a little and dribble it on wax paper. When it dries, there will be sugar left, showing that this process is reversible. This may not happen during class time, so you can have a volunteer taste the syrup to show that the sugar is still there, it has not disappeared.

- 1) Hold up a density bottle. Ask the students what they observe. Have a volunteer shake the bottle. Ask the students how the liquids have changed, if the process is reversible, if a new substance was formed. (Physical change)

- 2) Hold up a piece of bread and piece of burnt toast. Ask the students what they observe. How can they tell a new substance was formed? (Does burnt toast taste the same as bread?) Can we turn the toast back into bread? (Chemical change)
- 3) Once the sugar is dissolved, increase the heat and allow the sugar to caramelize. You do not need to stir, **just let the syrup heat while you do the next demo.** The color change from clear to brown is an indication of a chemical change. Caramel cannot be easily turned back into sugar. Once you have shown the students the darker color and emphasized that the color change indicates a new substance was formed, add one of your butter molds. (Careful, it will boil rapidly!) This will make clean-up easier.
- Do NOT** let the caramel cool in the beaker! You will want to clean up the caramel right away so that it doesn't harden in your beaker. If the students would like to try some, dribble it onto wax paper and let the students each have a piece. It will be like hard candy. Softer caramel is made by adding cream. If you do not want the students to have the sugar, pour it out right away and rinse out the caramel before it hardens. If it does become hard, you will need to soak the beaker in warm water.
- 4) Hold up a box of baking soda or baking powder. Ask the students if they know what these are used for. (Other than “cooking” they probably won't know). Pour a spoon full or two of baking soda into each balloon. Pour the vinegar or lemon juice into the soda bottle until it is about 1/3 full. (This way the students know what you are using and it's not a mystery). Also fill a soda bottle 1/3 full of water. Without dumping the baking soda into the vinegar or water, attach one balloon to the mouth of each bottle. Ask the students to predict what will happen. Tip the balloons so the baking soda falls into each bottle. The water bottle shouldn't do much except dissolve if you swirl it. (Physical change) The vinegar bottle should fizz and bubble and Carbon dioxide should fill the balloon. (Chemical change)

Extensions:

Ask students what they would find in the bottles if they let all the liquid evaporate. In the water bottle, there were no chemical changes, so there should be baking soda left over. In the vinegar bottle there should be very little, if any baking soda. A salt was formed, so there will be solid, but it will have different properties than the baking soda.

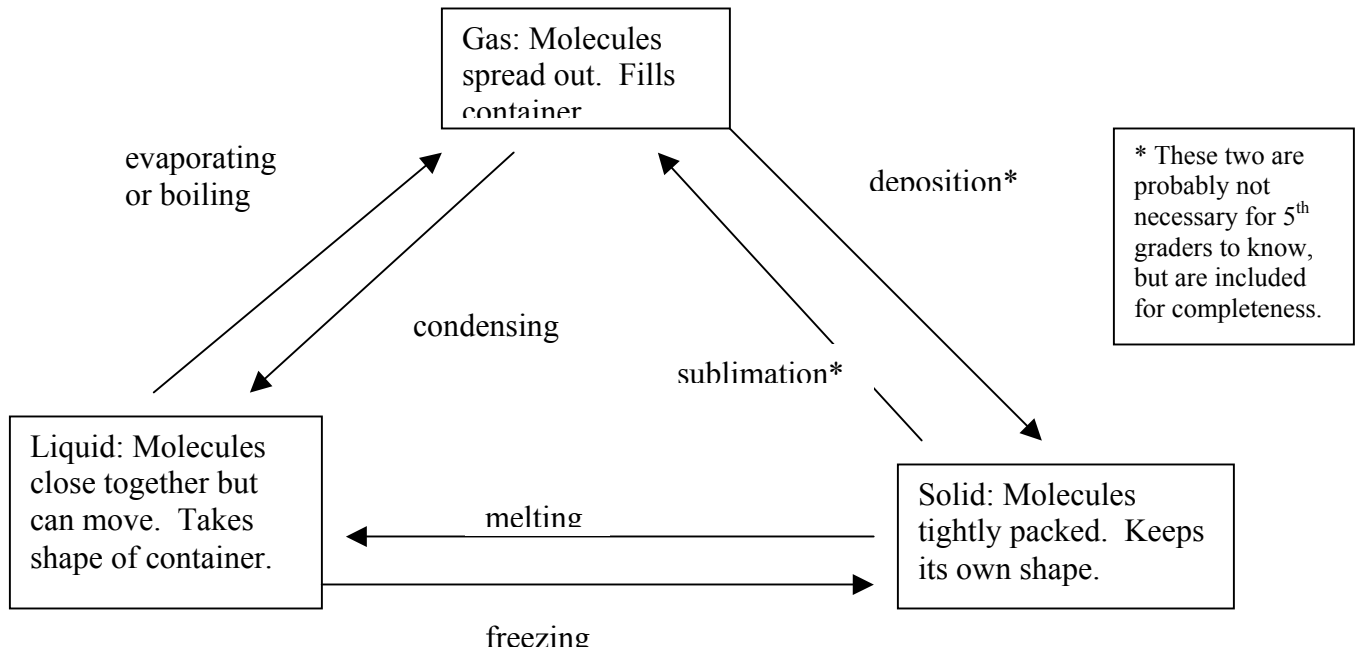
Baking soda is a “leavening” agent. The CO₂ it creates makes bubbles in batter so that bread, pancakes, and muffins are light and fluffy instead of flat and dense. See if you students can figure this out.

Target Revised Model:

- Cooking usually involves chemical changes for food.
- When food cooks, new substances are formed

Summary:

Students should put in their notes the examples above. “Kitchen” questions come up on the proficiency test quite a bit, so students should know that as a general rule, cooking or baking generally involves a chemical change as the food ingredients combine to form the new food. Frequently these changes require the input of heat, and can be observed by color, state of matter, or other property changes. Changes in states of matter only (dissolving, melting, freezing, cooling, heating cool water to warm water) are physical changes only and do not involve chemical changes. If the students do not have the phase changes in their notes already, they should include a chart similar to the one below. (Note: The state of mater of a material refers to all of its properties: its temperature, volume, color, etc. in addition to the phase. Changes from solid to liquid and so on are more properly referred to as phase changes).



Chemical and Physical Changes

Physical Changes: <hr/> <hr/> <hr/> <hr/> <hr/> example:	Chemical Changes: <hr/> <hr/> <hr/> <hr/> <hr/> example:
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For each of the following, describe the changes. Tell whether it is a physical change only or also includes a chemical change. What are the key points that tell you it is a physical or chemical change?

1) Mixing oil and water

Changes:

Physical or Chemical change? (circle one)

Key points:

2) Turning bread into toast

Changes:

Physical or Chemical change? (circle one)

Key points:

3) Mixing baking soda and water

Changes:

Physical or Chemical change? (circle one)

Key points:

4) Mixing baking soda and lemon juice

Changes:

Physical or Chemical change? (circle one)

Key points:

5) Mixing sugar and water

Changes:

Physical or Chemical change? (circle one)

Key points:

6) Making caramel from sugar water

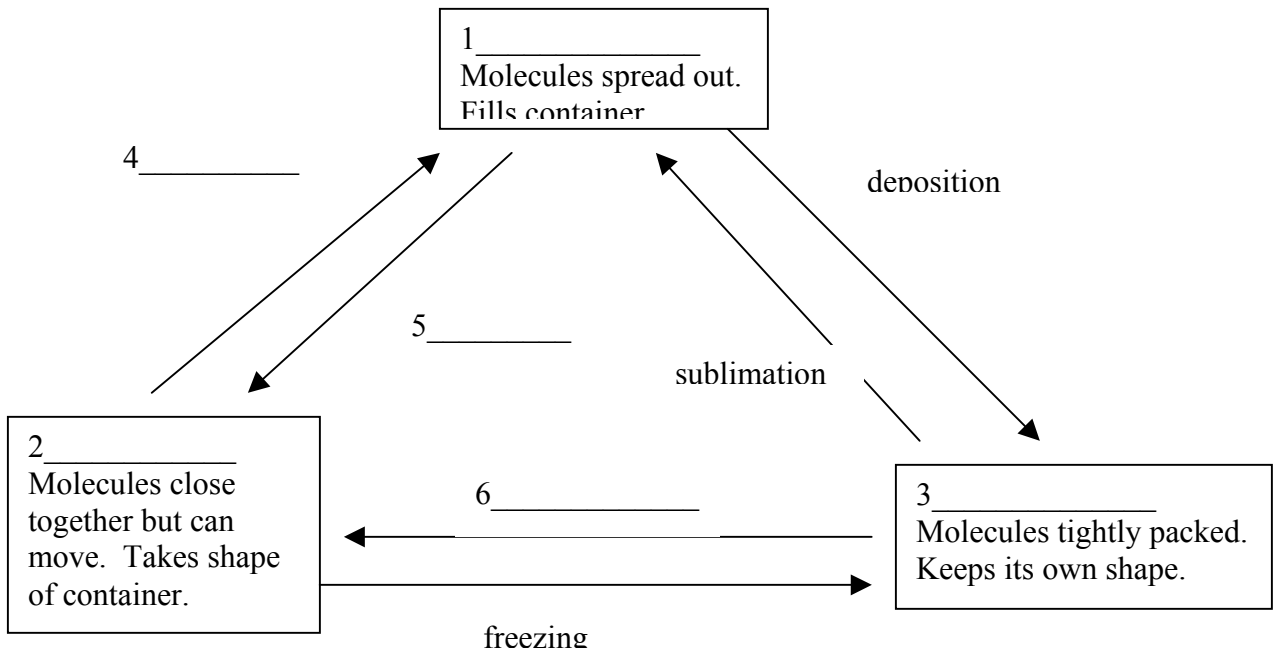
Changes:

Physical or Chemical change? (circle one)

Key points:

Phase Changes:

Fill in the chart below with the words: condensing, evaporating, gas, liquid, melting, and solid.



Chemical and Physical Changes

Physical Changes:

change in shape, size or color

change in state of matter

change in state of matter

no new substance is formed

easily reversible

example: melting butter

Chemical Changes:

new substance is formed

substance has new properties

often requires heat

difficult to reverse

includes physical changes

example: cooking egg

For each of the following, describe the changes. Tell whether it is a physical change only or also includes a chemical change. What are the key points that tell you it is a physical or chemical change?

1) Mixing oil and water

Changes:

Liquid looks cloudy. Oil slowly separates out and floats on top.

Physical or Chemical change? (circle one)

Key points:

No new substance formed, reversible

2) Turning bread into toast

Changes:

Bread is dark brown or black. Tastes different.

Physical or Chemical change? (circle one)

Key points:

Black stuff is new. Not reversible.

3) Mixing baking soda and water

Changes:

Water looks cloudy. Some of the powder seems to disappear.

Physical or Chemical change? (circle one)

Key points:

No new substance was formed, solid changed it's state

4) Mixing baking soda and lemon juice

Changes:

Balloon expands and fills with gas. A lot of the solid seems to disappear

Physical or Chemical change? (circle one)

Key points:

New substance (gas) is formed, it has different properties. Not reversible.

5) Mixing sugar and water

Changes:

Solid dissolves, changes state. Water becomes thicker.

Physical or Chemical change? (circle one)

Key points:

No new substance formed. Reversible.

6) Making caramel from sugar water

Changes:

Clear liquid turns brown and stiff

Physical or Chemical change? (circle one)

Key points:

New substance formed (can tell by color change), not reversible

