Kitchen Chemistry
5th Grade

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References: (Checked 1/2005)

- http://www.reachoutmichigan.org/funexperiments/quick/trainingrm/milkglue.html *(not working as of 1/2005, check out http://www.reachoutmichican.org for further updates)*
- 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 recognize melting and freezing as physical changes. They will recognize cooking, burning, and baking as chemical changes. Students will be able to 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:

- butter
- candy mold or ice cube tray
- shallow dish of ice water
- hot plate
- small frying pan
- egg
- clear bowl to observe egg
- plate
- beaker or glass measuring cup
- ¼ cup sugar
- tablespoon of water
- bread and burnt toast
- density bottle (colored water & oil)
- 2 balloons
- baking soda
- vinegar or lemon juice
- 2 20 oz soda bottles
- wax paper

Preparation:

At home:

Burn a piece of toast so that the carbon formed is easily visible. Melt several tablespoons of butter and pour them into candy molds or an ice cube tray. Refrigerate.

Before class:

Put the candy molds in a shallow dish of ice water to keep the butter solid. Place the small frying pan on the hot plate and let both warm up.

Initial Demonstration:

Pick up one of the pieces of molded butter and show it to the students. Ask them to describe it. (Hard, solid, cold, yellow, having a certain shape). Remove a couple more pieces and put them into the frying pan. Ask the students to describe what is happing to the butter. Why are these changes occurring? Because heat, or "thermal energy," is being added. Is this a chemical change or a physical change? (Take ideas, but don't give away the answer!)

Target Observations:

- The butter is hard and has a certain shape. This indicates that it is a solid.
- It is also yellow and 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 transparent/clear-ish in color.

Target Model:

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

Procedure:

Pour most of the butter back into the mold but leave a little in the pan. Return the mold to the ice water so that the butter can re-solidify. Crack an egg into a small clear bowl and ask the students to describe its properties. Pour the egg into the frying pan and have the students observe the changes taking place. Why are these changes occurring? (Thermal energy again!) Slide the egg onto a dish so it can cool. Is cooking an egg a chemical change or a physical change? (Again, take ideas but don't give away the answer!)

Have the students compare the before and after butter and the before and after egg. They should notice that the butter has returned to the same form that it had at the beginning of the lesson. The changes that occurred when it was melted have reversed and nothing new was formed. This is a physical change. The egg, however, has changed for good. 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.

Set up the next demo. Add ¼ 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 too long to caramelize later). Ask the students what they think 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.

Target Observations:

- The egg changed its shape.
- The butter became a solid again.
- The egg turned solid.
- The egg won't turn back into a liquid.
- The cooked egg is a new substance.

Target Revised Model: (added to students' notes)

Physical changes:

- changes in size, shape, color, or state of matter
- No new substances are formed
- Often, but not always, the changes are easily reversible*

Chemical changes: a new chemical substance is formed

- The new substance has different properties than the original substance
- May require heat to change
- Difficult or impossible to reverse
- Include physical changes#

* 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.

Procedure:

Have the students identify each of the following as a chemical or physical change. They should take notes in their journals to keep for future reference.

1) Keep an eye on your sugar water. When it is clear, hold it up for the students to see. Take a little and dribble it on wax paper. When it dries, there will be sugar left, proving that this process is reversible. This may not happen during class time, in which case you can have a volunteer taste the syrup to show that the sugar is still there.

2) Hold up a density bottle. Ask the students what they observe. Have a volunteer shake the bottle. How have the liquids changed? Is the process reversible? Has a new substance been formed? (Physical change)

3) Hold up a piece of bread and a 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)

4) If you have completed demo #1, 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 will change from clear to brown, indicating a chemical change. Caramel cannot easily be 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 a piece of butter. (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). Pour the remainder out right away and rinse the beaker thoroughly.

5) Hold up a box of baking soda or baking powder. Ask the students if they know what these are used for. Pour a spoon full or two of baking soda into each balloon. Pour vinegar or lemon juice into a soda bottle until it is about 1/3 full. Fill another 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 when the baking soda is mixed in. 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, however, 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 has been no chemical change, so baking soda should be left over. In the vinegar bottle, however, there should be very little, if any, baking soda. Instead a salt will be found, but it will have different properties than the baking soda. Baking soda is a "leavening" agent. The CO_2 it creates makes bubbles in batter so that bread, pancakes, and muffins are light and fluffy instead of flat and dense. See if your students can figure this out.

Target Observations:

- The sugar water evaporated and left sugar crystals behind.
- The density bottles mixed up all the stuff, but the stuff separated.
- The burnt toast smells bad, tastes funny, and can never be made back into soft bread.
- The burnt sugar turns into something brown and gooey- a new substance (caramel).
- The baking soda and vinegar mixture involves a chemical change- a gas that wasn't there before is produced.
- The baking soda and water mixture doesn't seem to do anything.

Target Revised Model:

- The water in the sugar water evaporated- this is a change in the state of matter (phase), so it is a physical change.
- The density bottle mixture changed shape, but was still the same stuff.
- The burnt toast involved a new substance, and is a chemical change.
- Making caramel from sugar is a chemical change.

Summary:

"Kitchen" questions come up on the proficiency test quite a bit so students should know that as a general rule cooking or baking involves a chemical change (food ingredients combine to form new foods). Frequently, these changes require the input of heat and can be observed by color, state of matter, or other property changes. (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 in states of matter are physical changes only.)