The Chemistry of Cooking

Who doesn't love food? It's fun to make, it's fun to eat, it's fun to …study? That's right! There is a lot of science that goes into the everyday foods that you love.

Your task is to choose ONE of the attached edible projects. As you carry out the recipe, take pictures of each step and paste them into a slideshow. For each picture, write about all of the chemistry that we can see taking place. For example:

- Are you using sugar or salt as an ingredient? Those are both compounds! Tell us what elements those compounds are made up of.
- Are you stirring things together into a mechanical mixture, or have you created a solution?
- What physical changes are taking place?
- Are any chemical changes taking place?
- Make note of any other chemistry-related terminology (words) we've discussed over the past few months.

You may need to do some extra research to complete this task - please refer to your notes, but also don't hesitate to use Google!

*** A note to parents: This is meant to be a fun, hands-on activity - not a burden! If you do not have the proper ingredients, tools, or time, PLEASE don't worry too much. Make substitutions or modifications if possible, and otherwise let me know via email that your student will not be able to complete the project (without any penalty, of course).

Crystal Candy

If you've ever been to a candy store, there's a good chance that you've seen what looks like colored crystal-like candy on a wooden stick. This is rock candy, and it's not made from the rocks that you'd find in nature. Rock candy is made from crystallized sugar that forms in water. Anyone who has sugar, water, and a stovetop at home can easily make rock candy. Luckily, we've got some directions below so you can make them. Be sure to have an adult present for this candy-making experiment as you'll be dealing with hot liquids!

What you'll need:

- A wooden skewer OR a clean wooden chopstick
- A clothespin
- 1 cup of water
- 2-3 cups of sugar
- Optional: food coloring
- A tall narrow glass jar
- A pot for boiling water
- An adult to help you

What you'll do:

1. Position your clothespin on the wooden skewer so that when you place it into the tall glass jar and it hangs down, there's about 1 inch (2.5 cm) of space between the skewer and the bottom of the glass.
2. Now place the clothes pin and skewer aside and find your helpful adult for the next steps that involve hot water.
3. Pour the cup of water into the pot and bring it to a boil on the stove top.
4. If you decide to use food coloring, add it to your pot and stir. The more you use, the darker your rock candy will be.
5. Pour about ¼ cup of sugar into the boiling water. Stir until dissolved.
6. Repeat step 5 until no more sugar will dissolve in the water. This part will take some time and patience, so it is important not to give up too soon.
7. Once no more sugar will dissolve, remove the pot from the heat and allow it to cool for at least 20 minutes.
8. While the water is cooling, dip half of your skewer in the sugar solution and roll it into some dry sugar. These are going to be your seed crystals and they will help jump start crystal growth. Let the skewer dry completely so the sugar crystals don't fall off when you go to place it in the tall glass.
9. The adult can now carefully pour the cooled off sugar solution into the tall glass almost to the top.
10. Place the skewer into the tall glass. Use the clothespin to ensure that it is hanging straight down the middle and not touching the sides.

Allow the tall glass to fully cool off before placing it in a safe place where it will not be disturbed.
Be patient and wait. Sugar crystals should grow and appear over the next 3-7 days.

The Science Behind Rock Candy: What Actually Happened During the Candy-Making Process?

When you make rock candy, sugar is added to hot water until a saturated solution is created. This is where sugar, called the solute, can no longer be dissolved into the water, called the solvent.

A supersaturated solution formed once the saturated sugar and water solution cooled down. This simply means that there is more of the dissolved solute (sugar) than could be dissolved by the solvent (water). This is a perfect environment for sugar crystals to grow.
Sugar will leave its liquid form and become a solid, growing on an item such as a wooden skewer. This method is called precipitation and when sugar does this, it is called a precipitate. As time passes during the 3-7 days of waiting for the rock candy to grow, the water will also evaporate (leave the solution and disperse into the air). With water leaving, the solution becomes even more saturated. The sugar molecules will continue to arrange themselves in an orderly fashion on the skewer and grow larger and larger until we can see cube-like crystals. This crystallization process is called nucleation. Your finished product will contain about a quadrillion (1,000,000,000,000,000) sugar molecules that have grown and attached themselves to the skewer! These molecules will be tasty, so enjoy!

Irresistible Ice Cream

Have you ever made homemade ice cream? It can be a lot of fun, and you end up with a tasty frozen treat! A lot of interesting chemistry is actually needed to make ice cream. For example, think about how you start out with refrigerated (or even room-temperature) ingredients and then need to cool them down to turn them into ice cream. How do the ingredients change during this process? How important do you think they get cooled to a certain temperature? In this science activity you'll make your own ice cream (in a bag!) and explore the best way to chill the ingredients to make them become a delicious reward!

To make ice cream, the ingredients—typically milk (or half and half), sugar and vanilla extract—need to be cooled down. One way to do this is by using salt. If you live in a cold climate, you may have seen trucks spreading salt and sand on the streets in the wintertime to prevent roads from getting slick after snow or ice. Why is this? The salt lowers the temperature at which water freezes, so with salt ice will melt even when the temperature is below the normal freezing point of water.

Technically, the temperature that the salt lowers is called the freezing point. When a freezing point is lowered, such as by adding salt to water, the process is called freezing-point depression. As we'll see in this activity, freezing-point depression is not unique to solutions made of water and salt; it also happens with other solutions. (A solution is made when a substance, such as salt, is dissolved and becomes a solute. The medium into which it is dissolved is a solvent—typically a liquid, like water.)

Materials

- Measuring spoons
- Measuring cup
- Sugar
- Half and half (Alternatively, milk or heavy whipping cream may be used.)
- Vanilla extract
- Salt (Different types of salts, such as table salt or rock salt, should work but may give slightly different results.)
- Two small, sealable bags such as pint-size or sandwich-size Ziplocs
- Two gallon-size sealable bags
- Eight cups of ice cubes
- Oven mitts or a small towel
- Timer or clock

Preparation

In each small bag, place one tablespoon of sugar, one half cup of half and half (or milk or heavy whipping cream) and one quarter teaspoon of vanilla extract. Seal up each bag after adding the ingredients. Keep the bags in the refrigerator until you are ready to continue on to the procedure.

Procedure

Add four cups of ice cubes to one of the large, gallon-size bags. Then add one half cup of salt to the bag. What do you think the salt will do?
Put one of the small bags you prepared into the large bag with the ice cubes. Be sure both bags are sealed shut.

Put on oven mitts or wrap the bag in a small towel and then shake the bag for five minutes. Feel the smaller bag every couple of minutes while you shake it and take a peek at it. What happens to the ingredients over time? When five minutes are up, how do the ingredients look? What about the ice cubes—how do they change over time and how do they look by the end?

Now add four cups of ice cubes to the other large, gallon-sized bag, but this time do not add any salt to it. What do you think will happen without using salt?

Put the other small bag you prepared into this large bag. Be sure both bags are sealed.

Put on oven mitts or wrap the bag in a small towel and then shake the bag for five minutes, as you did before. Again, feel the smaller bag every couple of minutes while you shake it, and take a peek at it. What happens to the ingredients over time now? When five minutes are up, how do they look now compared with last time? What about the ice cubes—did they change in the same way?

You can also compare how cold the different ice cube bags feel. Does one feel much colder than the other?

The Chemistry of Cookies

*** you could swap this for a cake recipe as well!

This recipe makes 18 cookies.

TIME: 30 minutes

SAFETY:

Don't leave the oven unattended when baking. Use oven mitts when taking things out of the oven. Let the cookies cool for a few minutes before you eat them.

WHAT YOU NEED:

Ingredients:

- 1 1/2 cups (200g) all purpose flour
- 1/2 cup (80g) white sugar
- 1/2 cup (80g) brown sugar
- 2/3 cup (160g) butter at room temperature
- 1½ tsp (6g) salt
- 1/2 tsp (3g) baking soda
- 2 tsp (10g) vanilla
- 1 large egg
- 1 cup (150g) chocolate chips

Tools:

- Oven
- Oven mitts
- 2 large mixing bowls
- Measuring cups
- Measuring spoons
- Baking sheet
- Mixer or a fork '
- Wooden spoon (or a strong mixing spoon)
- Parchment paper or silicone mat (optional)

WHAT YOU DO:

- Preheat the oven to 350°F (180°C).
- Measure the butter and beat it with the mixer (or a fork) until it's creamy.
- Add both brown and white sugars, and beat the mixture until it's light and fluffy.
- Mix in the vanilla and the egg, then turn the mixer to high or get your fork ready. Beat the dough vigorously.
- In a separate bowl, mix together the dry ingredients.

• Slowly add the dry ingredients to the wet. Use the wooden spoon to mix, but be careful not to over-mix. Stop when you can no longer see the flour.
• Stir in the chocolate chips.
• Line the baking sheet with parchment paper or a silicone mat. Drop tablespoon-sized balls of cookie dough onto it. Bake for 12 to 15 minutes — or until the cookies start to get brown around the edges.

WHY THIS MATTERS:

The physical and chemical properties of a compound determine its function in our daily lives. Consider the baking sheets that you baked your cookies on: are they made from aluminum, steel or silicone? How do the properties of those materials compare, and why would they then be good (or not) for baking on? A silicone rubber baking sheet, for instance, is a synthetic polymer made from silicon and oxygen. Silicone has low thermal conductivity, which means it transfers heat at a lower rate than some other materials — great if you want your cookies to bake evenly and without scorched bottoms. But understanding a material's properties is important for more than baking. It is central to the field of materials science, which involves creating new materials and applying already-discovered substances in novel ways.