

## Cloverbud Investigators: Career Detectives



# Lollipop Mania



The science of sugar!

March

**Background:** Lollipops are a sweet little treat that have been around for many years, but there have been a number of changes made to what we call a “Lollipop” through the years. In this investigation, we will discuss the history of the Lollipop and how it has changed over the years.

Historical accounts record that the first sweet treat on a stick happened thousands of years ago, when prehistoric man collected honey on sticks from beehives. Archeologists have found records that indicate that early Chinese and Egyptians also collected honey, which they used as a preservative for fruit and nuts. They too would attach a stick to the sweet combination of honey, fruit and nuts to make it easier to eat. As time passed, honey became limited and harder to find and sugar was not yet being widely produced. This absence of a sweet element almost prevented the future of the lollipop.

Later, in the seventh, century the sugar production had increased, trade was becoming more plentiful, and with it came the birth of the commercial lollipop. One major difference between the old English "lolly pop" and the more modern versions of today, is that in the old recipes the candy was soft, rather than hard. It was an American candy maker named George Smith, who first created what we now consider the modern version of the lollipop in 1908. According to him, he named his new candy after his favorite racehorse, “Lolly Pop”. During the years that followed, many companies made improvements to the lollipop production process. The invention of automated machines gave companies the ability to make up to 2,400 sticks per hour. Today, lollipops are molded into hundreds of shapes and made from countless recipes and flavors.

**So how do they make the lollipops?** To answer that question, we are going to dig deeper into Dum Dum lollipops, made right here in Ohio by the Spangler Candy Company.

The recipe for Dum Dum lollipops contains a mixture of sugar, corn syrup and water. The mixture is added to a pre-cooker, which starts the cooking process. It is then pumped into a vacuum cooker, which removes all moisture from the candy. The next step mixes in the color and the flavor into the batch. Finally two acids are added to the mixture; citric acid is added to reduce the sweetness and make the flavors stronger while malic acid enhances the flavor of non-citrus flavors. Once mixed together, the mixture is put into a batch roller which rolls the candy into rope form. The press then cuts the rope into small pieces to form the lollipop head and the stick is then inserted. After the candy is formed it is cooled, wrapped, bagged, and stored until they are shipped to a retailer.

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In today's investigation, we are going to become food scientists. Working with different flavor combinations, to create an almost endless list of new lollipops. Our assignment is to test and re-test different flavor combinations to come up with a brand new flavor of lollipop.

**Local Career Connections:** Careers to discuss

- Food Scientist, Biochemist, Flavor Chemist, Food Engineer, Sales, Food Production, Farming, Grocery Stores, Restaurants, Food Safety Inspector, Food Toxicologist, Public Health Official, Quality Assurance Director, Market Researcher, Packing Specialist, Plant Manager, Chef.



**March's Mystery:** Can we create our own lollipop flavor?

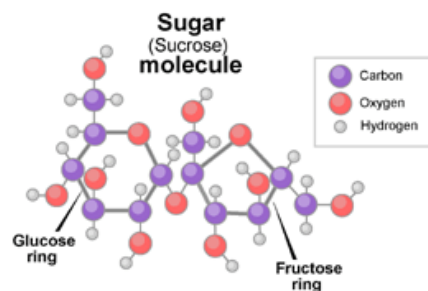
### ***Supplies:***

- ♣ Flavored Lollipops (Dum-Dums)
- ♣ Pipettes
- ♣ Small Rinse Cups
- ♣ Warm Water
- ♣ Paper Towels
- ♣ Small Plastic Containers



### **Science Behind Lollipop Mania:**

Sugars are natural substances found in most plants. Plants like sugar beets and sugarcane contain high amounts of sugar and are grown for sugar production. The chemical name for sugar is sucrose. Sucrose is a molecule of 12 carbon atoms, 22 hydrogen atoms, and 11 oxygen atoms. Sucrose is a carbohydrate and in the case of sucrose it is made up of two simple sugars, fructose and glucose. The chemical bond of these two simple sugars gives sugar its block or cube like shape.



### **What to Do:**

**Step 1:** With the wrappers still on the lollipops, sort the lollipops by the flavors on the wrappers.

**Step 2:** Pour hot water into enough cups to have one for each flavor.

**Step 3:** Un-wrap lollipops and place 5-10 (depending on group size) lollipops in their corresponding cup of hot water.

**Step 4:** Once lollipops have dissolved, remove the sticks. Use a pipette to carefully draw up the liquid and place in a small testing cup.

**Step 5:** Taste each of the flavors. Take note of what you liked and did not like about each flavor.

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**Step 6:** Experiment by mixing flavors to come up with a new flavor and a new name for the flavor. For example, three pipettes of peach and one pipette of blue raspberry equals Blue Peachy Raspberry.

**Step 7:** Discuss the different combinations and how you came up with their combinations.

**Go Over Findings:**

Did all of the flavors you mixed together taste good? Why or why not?

What is the main ingredient of a lollipop? (Sugars)

What ingredient was the first lollipop from? (Hint: it's made by bees)

What career should you investigate if you like working with creating new food flavors?

**Optional activity questions:**

If we wanted to dissolve more sugar into water than it will normally hold, what do we have to do?

What is the point where the water stops dissolving the sugar called? (Saturation point)

What shape is a sucrose (white sugar) crystal? (Cube)

New Flavor Name	Flavor #1	Flavor #2	Flavor #3	Comments

Which Flavor combination did you like best?

**\*Optional activity: Have students to examine sugar under a microscope to see its structure.**

Sugar is a main component in the making of a lollipop, but there is actually a great deal of chemistry and scientific testing involved. The scientist must develop, test, and re-design experiments to come up with the correct ratio of ingredients, the right flavor, color and texture for their products. In order to make a lollipop, you must first understand the chemical reactions of a sugar molecule when heated. Sugar crystals will naturally dissolve in water, up to a point. This is the *point of saturation*. One example of this concept that the investigators can relate to is making Kool-Aid. Ask the students if they have ever tried to add more sugar to a pitcher of Kool-Aid than the recipe calls for. What happened to the extra sugar? The excess sugar will remain on the bottom of the pitcher. Stirring will allow some additional sugar to dissolve but the liquid will still become saturated.



**What to do: In three small clear glasses, allow students to try to dissolve as much sugar in water as they can with the following instructions:**

- Fill all three glasses with the same amount of water.
- In glass #1 slowly add measured teaspoons of sugar (no stirring or shaking of the glass) and record how much sugar dissolves.
- In glass #2 slowly add measured teaspoons of sugar and stir the liquid between teaspoons and record how much sugar dissolves.
- In glass #3 heat the water in a microwave until it boils. Caution: use pot holders or protective mitts, to remove from the microwave. Then add measured teaspoons of sugar and stir the liquid between teaspoons and record how much sugar dissolves.

Ask: Which glass held the most sugar? Why?

The reason the hot water could hold more sugar is that the saturation point is dependent on temperature. The higher the liquid's temperature, the greater the amount of sugar that can be held in the solution.

Candy makers use this fact when making a batch of lollipops. By cooking the sugar water solution at an extremely high temperature, they can add more sugar and create a “supersaturated” liquid, that when cooled will harden. The problem they face is that supersaturated liquids are unstable and the sucrose (sugar) in the solution will try to recrystallize. For some candies like fudge, the crystalline texture is fine but for lollipops we want a non-crystalline product. To solve this problem, food scientists discovered that if they use different types of sugar, for example, adding a simple sugar like fructose (corn syrup) in just the right ratio to the sucrose (white sugar), they can prevent the sucrose (white sugar) from re-crystallizing. The reason this works, is because the simple sugars have a different molecular structure and block the sucrose from being able to form. Kind of like if you were building with different size blocks, it becomes harder to make a cube shape, which is the shape of the sucrose (white sugar) crystals.

**Investigate, Create, & Take: Investigators can take with them:**

**Make a homemade Lollipop:** using a Hardtack recipe. Investigators can design their own label and packaging.

*RECIPE TIP:* When making hard candy, it is important to use a flavoring that is highly concentrated. Candy oils are designed to withstand exposure to high heat without losing flavor.

## INGREDIENTS

2 cups granulated sugar (sucrose)

2/3 cup light corn syrup (fructose)



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$\frac{3}{4}$  cup water

1 small bottle (1 teaspoon) of candy oil any flavor (LorAnn candy oils recommended)

Liquid food coloring any color

Spray cooking oil (PAM is recommended)

Powdered sugar - if not using candy molds

Scissors that have been sprayed with cooking oil

Candy thermometer that has a hard crack indicator

Heavy cooking pan that heats evenly

Heavy cookie sheet - if not using candy molds

\*Hard candy molds (optional) – Molds need to be approved for hard candy to prevent melting of the plastic mold.

\*Sucker bags, sticks & twist ties (optional)

## DIRECTIONS

Lightly spray a cookie sheet. We recommend placing a towel under the cooking sheet to prevent heat damage to wood or countertop surfaces under the pan.

(If using molds, lightly spray cavities of clean, dry candy molds with cooking spray. Insert sucker sticks into molds.)

1. In a heavy (good quality) 2-quart kettle or large saucepan, mix together sugar, corn syrup and water. Stir over medium heat until sugar dissolves and the liquid become clear.
2. Insert candy thermometer, making certain it does not touch the bottom of the pan. Bring mixture to a boil without stirring.
3. Continue to cook the syrup, without stirring, until the temperature reaches 300° F (hard crack on some candy thermometers).
4. Remove from heat precisely at 300° F (hard crack stage).
5. Add desired food coloring and stir.
6. Add flavoring and stir. **USE CAUTION WHEN ADDING FLAVORING TO AVOID RISING STEAM.**
7. Carefully pour syrup into prepared molds or onto the prepared sprayed cookie sheet. If using molds, make sure the sticks are securely covered by syrup to ensure they stick into the lollipop.
8. If NOT using candy molds - pour the hot candy onto a heat-resistant oiled cookie sheet. (Use caution to protect wood surfaces or counter tops under the cookie sheet with a large bath towel.) When the candy is slightly cooled, it can be cut with well-oiled scissors into small 1-1.5" pillow-shaped pieces (caution the candy is very hot and should be cut and handled first by an adult). Cut small pieces by rolling the candy mixture in your hands to form ribbons or snake like shape. (At

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this point the candy should be cool enough for children to cut.) Then cut with scissors into one inch pieces.

9. If making candies, toss the small one inch pieces into a bowl of powdered sugar and allow candy to finish cooling. Once cooled shake off excess powdered sugar using a colander and store in zip lock bags.

10. If making lollipops, do not use powdered sugar but roll pieces into small ball shapes, insert sticks and place on wax paper to cool. Once cooled, place in sucker bags and secure with twist ties.

Do not refrigerate.

### **Sources:**

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<http://www.exploratorium.edu/cooking/candy/sugar.html>

*The Food Network "Unwrapped": Dum Dums Lollipops*, <https://www.youtube.com/watch?v=xUpGTvPrCG8>

*How Dum Dums Are Made*, <https://www.youtube.com/watch?v=1liZKlRmtqQ>

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