



COOKIE CHEMISTRY

Confectionary science! Learn about sugar crystal solubility and viscosity as you create your ideal cookie icing.

MATERIALS:

- 3 bowls for mixing
- 2 cups powdered sugar
- Measuring cup
- Measuring spoons
- 3 spoons for mixing
- Sugar cookies (or something to frost)
- 2.5 tablespoons water

TEKS:

SCI 4.6 B: The student is expected to investigate and compare a variety of mixtures, including solutions that are composed of liquids in liquids and solids in liquids.

SCI 5.6 C: The student is expected to compare the properties of substances before and after they are combined into a solution and demonstrate that matter is conserved in solutions.

HOW TO:

1. Take out three bowls and add one cup of powdered sugar to each bowl.
2. Add $\frac{1}{2}$ tablespoon of water to one bowl, 1 tablespoon of water to the second bowl, and 3 tablespoons of water to the third bowl. Use a spoon to thoroughly mix the water in each bowl with the powdered sugar.
3. Now it's time to observe! Note how the icing looks and feels. Scoop up a spoonful of each and let it fall back into the bowl. Does the icing drip slowly or quickly? Does it hold its shape?
4. Which of the three icings you created would you want to use to ice your cookies? Test them out and see which has the best icing results!



STEM EXPLANATION:

You made powdered sugar icing using only two ingredients! How did such a large amount of powdered sugar turn into such a small amount of icing? You might notice that powdered sugar doesn't weigh very much, and that is because it contains a lot of air! Powdered sugar is made up of tiny sugar crystals, and there are air pockets between the crystals. These powdered sugar crystals dissolve in water, which causes the crystals to break down into individual molecules that are much smaller than the crystals.

Some icings are thin and some are thick, and this property of icing is called its **viscosity**. Icing that is highly viscous is thick and flows very slowly while icing with low viscosity is thin and flows much faster. You can change an icing's viscosity by adjusting the ratio of powdered sugar to water! You might notice that smaller amounts of water resulted in thicker, or more viscous, icing. This happens because there's a limit to how much sugar will dissolve in water. Once the water is full of sugar molecules, all that extra sugar doesn't dissolve, making the icing thicker.

Now that you have this extra icing knowledge, think about how you might tweak your icing recipe to make it the best addition to a variety of desserts. What ratio of powdered sugar to water would you use for cinnamon rolls? How about brownies? Would you want to add any colors or special flavorings to your icing recipe? Or use a liquid like milk or orange juice instead of water? How might that affect the viscosity?

CAREER: MECHANICAL ENGINEER

Mechanical engineers create machines and tools that move and work, like cars, robots, and engines.



MEET JANIS LOUIE!

Janis Louie is a Professor of Chemistry and Associate Dean at the University of Utah and an internationally recognized researcher in catalysis. She is a gymnastics and martial arts instructor, a nationally ranked fitness competitor, and an inspirational educator. Janis earned her Ph.D. in Chemistry from Yale University and runs a Martial Arts Studio with her husband and 9-year-old triplets.



Learn more about Janis!

RESOURCES

<https://foodcrumbles.com/the-science-of-powdered-sugar-glace-icing/>
www.ifthencollection.org/