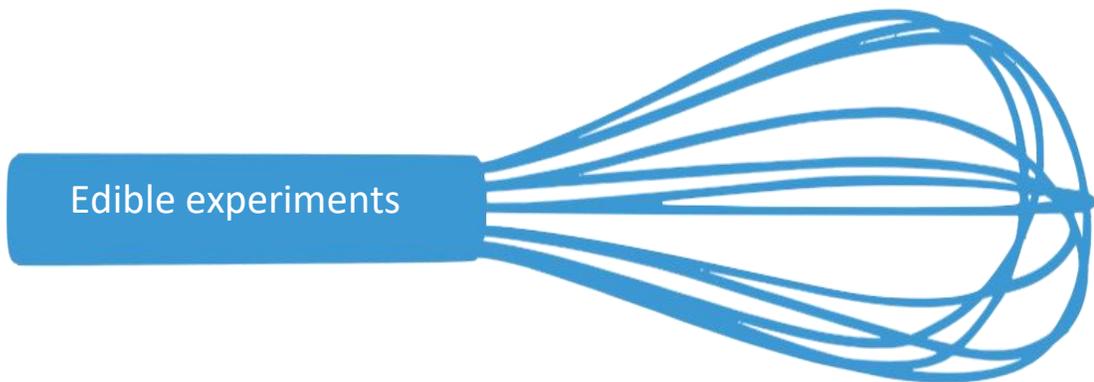


Chemistry in the Kitchen



TABLESPOON CONVERSIONS



TABLESPOON



TEASPOON



CUP

Tablespoons to one cup, half cup, quarter cup and more.



=



3 TEASPOONS = 1 TABLESPOON



=



1 TABLESPOON = 1/16 CUP



=



2 TABLESPOONS + 2 TEASPOONS = 1/6 CUP



=



2 TABLESPOONS = 1/8 CUP



=



4 TABLESPOONS = 1/4 CUP



=



5 TABLESPOONS + 1 TEASPOON = 1/3 CUP



=



6 TABLESPOONS = 3/8 CUP



=



8 TABLESPOONS = 1/2 CUP



=



10 TABLESPOONS + 2 TEASPOONS = 2/3 CUP



=



12 TABLESPOONS = 3/4 CUP



=



16 TABLESPOONS = 1 CUP

Butter recipe

recipe

homemade butter

Ingredients

1 PINT SIZED 16 OZ MASON JAR

1 CUP HEAVY CREAM 38% FAT CONTENT

COLD WATER

METHOD

1. Pour heavy cream into the mason jar, filling it half-way full. Screw the lid on.
2. Shake mason jar for approximately 5-7 minutes. After the first 2 minutes you'll have whipped cream. Keep shaking until you hear that a lump has formed inside, and shake an additional 30-60 seconds after that.
3. Remove the solids from the jar. The remaining liquid is buttermilk. You can save that for other recipes, or discard it.
4. Place the solids into a small bowl. Pour cold water over the butter and use your hands to squish it into a ball. Discard water and repeat rinsing 2 times more.
5. At this point you have butter. You can add in things like salt, honey, and herbs to create flavored butters, or serve in its pure form as is.

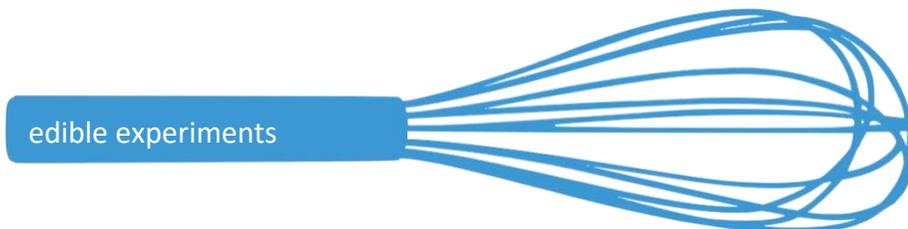
Where's the science?

Heavy cream has a good deal of fat in it. That's why it can make such delicious items. By shaking the cream, the fat molecules begin to separate from the liquid. The more the cream is shaken the more these fat molecules clump together forming a solid which is the butter.

Weigh the amount of heavy whipping cream that you start with and then weigh the amount of butter that you end with. *How much of the cream turned into butter?*

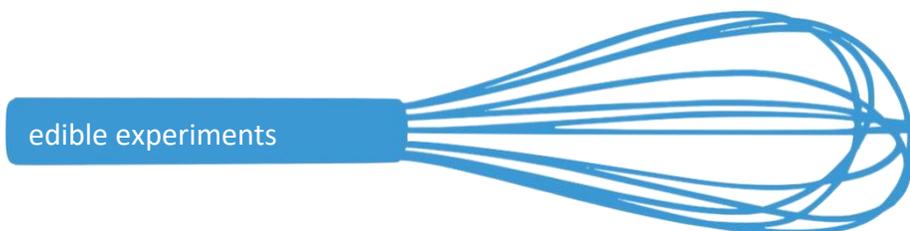
References and where you can go to learn more!

edible experiments



Butter recipe

<https://thestayathomechef.com/how-to-make-homemade-butter-in-a-mason-jar/>



Chewing gum recipe

Ingredients for classic bubble gum

3/4 cup powdered sugar- each person in group will put 1/4 cup of powdered onto their place mat

1/3 cup base gum pellets

2 tablespoons corn syrup

1-2 drops of flavoring of your choice

Recipe

Instructions for classic bubble gum- for each group

1. Place powdered sugar onto a piece of waxed paper creating a well.
2. Place 1/3 cup of gum pellets into a small, microwaveable container.
3. Add in corn syrup.
4. Microwave the mixture in 10 second intervals, stirring in-between, until it is fully melted.
5. CAUTION HOT! Make a well in the center of the powdered sugar (like you do when you make homemade pasta), and pour the hot gum mixture into it.
6. CAUTION HOT! Work the powdered sugar into the gum mixture by stirring the mixture with the wooden stick to avoid burning your hands. Keep working the powdered sugar into the mixture, using more if necessary until



Chewing gum recipe

it will no longer absorb any more sugar. You can switch to needing with your hands as the mixture cools.

7. Adding the flavorings is tricky, you don't want to overdo it but using a dropper put into the gum.
8. Knead the gum around till it becomes nice a loose like taffy, if it sticks to your hands too much add more powdered sugar.
9. Then, break the gum into small pieces and wrap it in rectangles of waxed paper, twisting the ends to seal and keep the gum fresh.

Ingredients for beeswax gum- for each group

1/2 cup powdered sugar- each person in group will put 1/4 cup of powdered onto their place mat

1/4 cup beeswax (food grade)

1 1/2 tablespoons honey

2 drops of flavoring of your choice

Recipe

Instructions for beeswax gum

1. Melt the wax. Place the wax in a double boiler. Put the double boiler on the stove and turn the burner to medium high. Melt the wax until it is soft and gooey. Alternately, add boiling water to the slow cooker, until it comes half-way up the exterior of the jars filled with wax. Allow the jars to “cook”

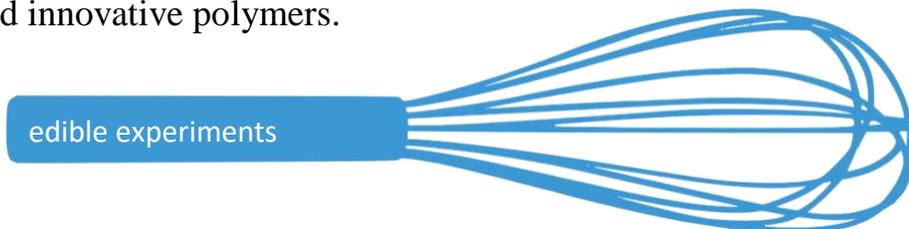
Chewing gum recipe

for 30-45 minutes, covered. After 30-45 minutes, the wax should begin melting.

2. Add the honey. Place the honey in the pot and stir it into the melted wax. You can substitute corn syrup for honey if you prefer.
3. Add flavorings. Beeswax gum goes well with peppermint flavoring. You could also try cinnamon, or lemon. Squeeze about five drops of flavoring into the pot with the melted wax and honey, and stir well.
4. Add the sugar. Stir powdered sugar into the melted gum base. The mixture should begin to thicken a bit.
5. Taste the gum mixture and add more flavorings or powdered sugar if you'd like to increase the flavor or sweetness.
6. Pour the gum base into molds. Use candy molds, an ice cube tray, or other small molds for the gum.
7. Pour an equal amount of the gum base into each mold. Place the molds in the refrigerator to give the gum time to harden, then pop out the pieces when you're ready to chew them.

Where's the science?

In many ways, chewing gum is a perfect example of modern chemistry at work. We see miracles of polymers in our everyday lives, from plastic bottles to innovative packaging designs. Have you ever considered all the wonderful science behind such a fun food product like chewing gum? The story of chewing gum is long and interesting, starting with simple forest products all the way through to modern and innovative polymers.



Chewing gum recipe

Modern chewing gum begins with a “gum base.” Back in the 1860’s, when the first commercial product was available, gum base was made of “chicle,” a natural latex from trees native to Central America, and the namesake for Chiclets. The Aztecs and Mayans chewed this traditional gum long before it was made into commercial chewing gum. Only a few manufacturers still produce chewing gum using chicle. For most manufactures, “gum base” is created using various synthetic rubber that has proven to be cheaper to produce, easier to manufacture and even more effective as a base for chewing gum products.

Why doesn’t gum dissolve when you chew it?

The rubbers used as gum base are not soluble in water. The formulations used by modern manufacturers are suited to stick around (see what we did there?) a long time in saliva. Some formulations are not even digestible if swallowed and will reemerge as a solid piece. (uh, yuck!) There are enzymes, such as amylase, that can cause gum to break down. Certain foods like peanuts that are stuck to your teeth can cause the same effect. There is even a medical term called Gum Disintegration Syndrome that is given to people whose saliva is incompatible with chewing gum for one reason or another.

References and where you can go to learn more!

<https://www.rachaelray.com/2014/03/07/how-to-make-bubble-gum/>

<https://www.wikihow.com/Make-Chewing-Gum>

<https://www.polymersolutions.com/blog/chewing-gum/>

Chocolate chip cookie recipe

recipe

1/2 cups and 1 tablespoon all-purpose flour

1/4 teaspoon baking soda

1/4 teaspoon salt

1/4 cup butter, softened

3 tablespoons granulated sugar

3 tablespoons packed brown sugar

1/4 teaspoon vanilla extract

1/2 large eggs

1/2 cups (12-oz. pkg.) NESTLÉ® TOLL HOUSE® Semi- Sweet Chocolate Morsels

How to Make It

Step 1 PREHEAT oven to 375° F.

Step 2 COMBINE flour, baking soda and salt in small bowl. Beat butter, granulated sugar, brown sugar and vanilla extract in large mixer bowl until creamy. Add eggs, one at a time, beating well after each addition. Gradually beat in flour mixture. Stir in morsels. Drop by rounded tablespoon onto ungreased baking sheets.

Step 3 BAKE for 9 to 11 minutes or until golden brown. Cool on baking sheets for 2 minutes; remove to wire racks to cool completely.

VARIATIONS:

- A) Use Bread Flour instead of all-purpose flour.
- B) Use Crisco Shortening instead of butter.
- C) Use Brown Sugar in place of granulated (so 2x brown sugar).

Chocolate chip cookie recipe

Where's the science?

When you bake a cookie, here's what's going on, step-by-step.

The dough spreads: As the butter warms, it slackens. The cookie dough begins to turn more liquid and gradually spreads out.

The edges set: As the cookie spreads, the edges thin out. This, coupled with the fact that they are fully exposed to the heat of the oven and are constantly reaching hotter areas of the baking pan, causes them to begin to set long before the center of the cookie does.

The cookie rises: As the butter melts and the cookie's structure loosens, this frees up water, which in turn dissolves baking soda. This baking soda is then able to react with the acidic components of brown sugar, creating gases that cause the cookies to rise up and develop a more open interior structure.

Egg proteins and starches set: Once they get hot enough, egg proteins and hydrated starches will begin to set in structure, finalizing the shape and size of the finished cookie.

Sugar caramelizes: At its hottest areas—the edges and the underbelly in direct contact with the baking dish—sugar granules melt together, turning liquid before starting to caramelize and brown, producing rich, sweet flavors.

The Maillard reaction occurs: Proteins in the flour and the eggs brown along with the sugar in a process called the Maillard reaction—the same reaction responsible for giving your hamburger or bread a brown crust. It produces nutty, savory, toasted flavors.

The cookie cools. Once it comes out of the oven, the process isn't over yet. Remember that liquefied sugar? Well as the cookie cools, that liquid sugar hardens up, which can give the

Chocolate chip cookie recipe

cookie an extra-crisp, toffee-like texture around the edges. Meanwhile, the air inside cools, which causes the cookie to deflate slightly, though when fully baked, the structure lent by eggs and flour will help it retain some of its rise.

It's a simple technique that hides more complicated processes underneath. So how do you decipher what's going on? My first course of action was to test out these basic ingredients one at a time in order to determine how they affect the final outcome.

Butter

Cookie Fact: More Butter = Wider Spread and More Tenderness

Because of shortening's different melting qualities (and the fact that it has no water content), shortening-based cookies come out softer but denser than those made with butter.

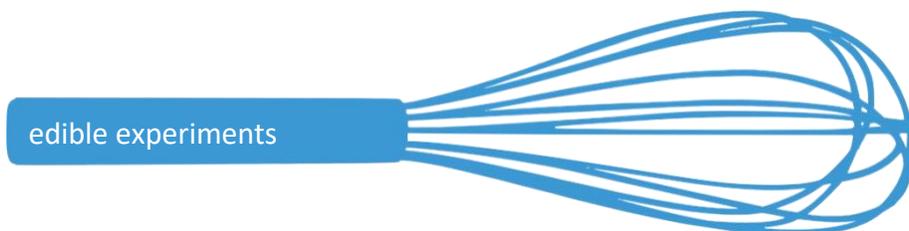
Cookie Fact: Butter Gives the Most Flavor

Butter is essential for flavor. Substituting butter with a less flavorful fat like shortening, lard, or margarine yielded sub-par cookies. Butter is about 80 to 83% butterfat, 15% water, and 3 to 5% milk protein. These proteins brown as the cookie bakes, adding nuttiness and butterscotch notes to the final flavor of cookies.

Flour

The main differences in flour varieties comes down to protein content. Cake flour contains a relatively low amount, which leads to less gluten formation. Cookies made with all cake flour will be very soft, almost mushy, even when you've cooked them to what would normally be a beyond-crisp stage. All-bread-flour cookies, on the other hand, come out ultra-chewy. Alton Brown has a recipe called The Chewy which utilizes this effect.

Cookie Fact: More Bread Flour = Chewier Cookies, More Cake Flour = Softer Cookies



Chocolate chip cookie recipe

Sugar

There's more to sugar than just sweetness! The type of sugar you use and its method of incorporation can have a profound effect on the finished cookies. **White sugar** is crystallized sucrose, a disaccharide consisting of a fructose molecule and a glucose molecule linked together. It is mildly hygroscopic (that is, it likes to retain moisture), and relatively neutral in pH.

Brown sugar is *mostly* crystallized sucrose, but also contains a good amount of glucose and fructose, along with trace minerals that give it its flavor and a slightly acidic pH. Glucose and fructose are far more hygroscopic than sucrose.

Check out what happens if you bake cookies that are made 100% with white sugar or brown sugar:

You can clearly see the difference in spread. This happens because the baking soda in my cookie recipe is a powdered base, and needs some form of acid to react with in order to create the bubbles that leaven the cookie. Slightly acidic brown sugar causes cookies to rise higher when baking, which limits their spread. You end up with a cakier end result. White sugar, on the other hand, adds no leavening power, so you end up with a cookie that spreads wide. Because white sugar-based cookies more readily give up moisture, they also end up crispier.

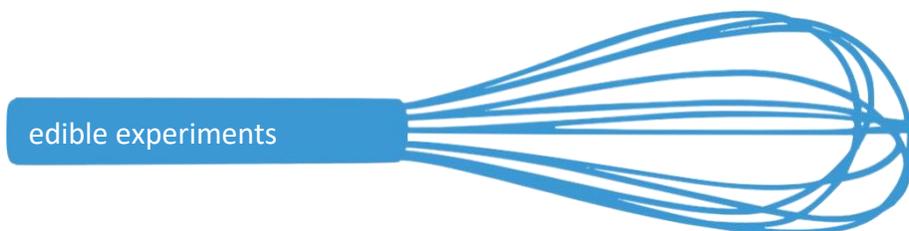
Cookie Fact: White Sugar = Thin and Crisp, Brown Sugar = Tall and Moist

References and where you can go to learn more!

<https://sweets.serious-eats.com/2013/12/the-food-lab-the-best-chocolate-chip-cookies.html>

<https://www.npr.org/sections/thesalt/2014/09/04/345530660/the-science-behind-baking-your-ideal-chocolate-chip-cookie>

<https://www.allrecipes.com/recipe/174864/original-nestle-toll-house-chocolate-chip-cookies/>



Dehydrated fruit

recipe

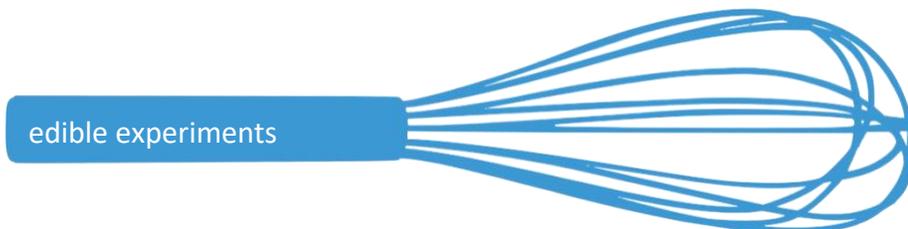
Dehydrated apples

1. Wash, peel and core apples.
2. Slice apples thinly and evenly (1/4 inch), use a mandolin if possible.
3. Place rings on dehydrator trays leaving a little space around each slice for air circulation.
4. Dehydrate at 135°F (57°C) for 6 to 8 hours.
5. Check apples for any moisture on outside and inside. The slices should feel dry and leathery without any tackiness. Rip a slice in half to see if there is any moisture on the inside - it should look like dry dense sponge.
6. Allow to cool several hours before storing in an airtight bag or container.
7. Store in a dry, cool, dark place for several months (if you don't eat them all!)

Dehydrated grapes

METHOD

1. Wash the fruit thoroughly using an [all natural produce wash](#). Drying is optional, since they'll dry in the dehydrator anyway. Although working with dry fruit is easier and less messier than working with wet fruit.
2. If the grapes have seeds, halve the grapes and remove the seeds. It is not necessary to slice whole, unseeded grapes.
3. Lay the clean fruit on the dehydrator trays in a single layer. It's okay if some of the fruit touches.
4. Set the temperature to 135 degrees, the "fruit" setting on most dehydrators.
5. Allow to dehydrate for 24-48 hours.
6. Grapes are raisins when you squeeze them gently and there is very little "squish" left. Taste as you go since this may be a learned test of doneness.
7. Yield: 2 pounds of grapes yields approximately two 16 oz glass jars of raisins, depending on the grapes used.



Dehydrated fruit

Where's the science?

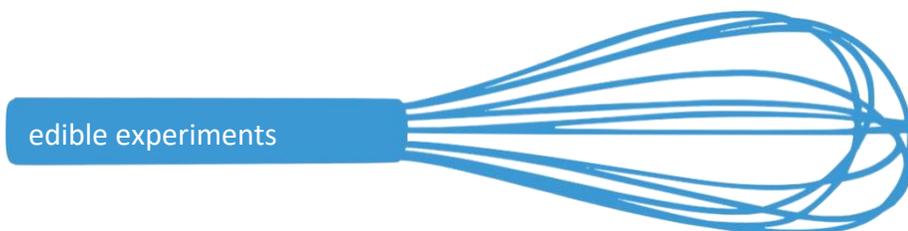
Food dehydration is one of the oldest unit operations used by the food processing industry. Food dehydration is a process of reducing moisture of food to low levels for improved shelf life by adding one or more forms of energy to the food. However, it does not include removal of moisture from food by mechanical pressing or concentration of liquid foods. Most commonly, heat is added to the food by hot air, which also carries the moisture away from the food. The process of food dehydration involves simultaneous transfer of mass and heat within the food and the medium used to transfer energy to the food. In food dehydration methods that supply energy to the food using media other than hot air, air or some other gas may be required to move moisture away from the food.

References and where you can go to learn more!

<https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/foods>

<https://dontwastethecrumbs.com/2013/08/how-to-dehydrate-fruit-basic-food-preservation/>

<https://www.thespruceeats.com/how-to-make-dehydrated-apples-1327578>



Gummy bear recipe

Recipe

Ingredients for basic gummy bear candy

1 ½ packets of knox gelatin

1 ½ tablespoons of flavored jello powder

¼ cup room temp water

Instructions for basic gummy bear candy

1. Place all ingredients into microwave safe bowl.
2. Stir to form a smooth paste.
3. Place bowl into the microwave and heat for approx. 1 minute or until mixture starts to boil.
4. Remove and let any foam subside.
5. Use dropper to put liquid into molds. CAUTION HOT LIQUID!!!
6. Allow the molds to sit for about 30 minutes then place in refrigerator to harden (approx. 1 hour).
7. Remove and enjoy.

Recipe

Ingredients for vegan gummy bears

1/2 cup fruit juice

1 tablespoon agar powder

1 tablespoon honey

Gummy bear recipe

Instructions for vegan gummy bears

Step 1

In a small sauce pan, whisk juice and agar together and let sit for about 5 minutes before heating.

Step 2

Heat the liquid over medium heat, whisking frequently. When it starts to thicken, add sweetener (if you're using) and stir. Let the mixture simmer for a few minutes until it thickens to the consistency of paint, stirring constantly.

Step 3

Move the liquid into a measuring cup with a spout and then pour into your molds.

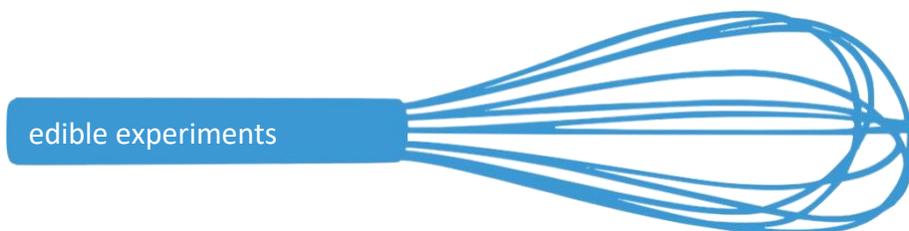
Step 4

Let the molds cool at room temperature for 5 minutes, then place in the freezer for 20-30 minutes (larger gummies will need closer to 30 minutes). Then pop 'em out and keep refrigerated in an airtight container for up to 2 weeks.

Where's the science?

Gelatin is the basis of what makes a gummy bear a gummy bear, but we first start with sugar, corn syrup and water.

We have to use water to help the sugar dissolve, but then heat the mixture to about 240 degrees to boil off the excess until the mixture is only about 12 percent water.



Gummy bear recipe

We then add gelatin and dissolve it into the mixture. Gelatin comes from the hooves and skin of pigs or cows and is basically collagen broken into smaller molecules.

Think of a tough or grisly meat steak— that's collagen. When you add heat, like putting meat in a crockpot for an extended period of time, the collagen breaks down and is easier to eat.

In the same way, we dissolve the gelatin into the sugar and corn syrup mixture for gummy candies. We then add color, flavor and a little bit of acid.

To make the gummy bear shape, we press a form of the bear shape into a tray of corn starch. The corn starch has a little more oil in it than you would find at the grocery store, so it holds its shape when we press the bear form into it.

We then fill the holes with the liquid candy mixture and let them dry overnight. The gelatin will cool, and the corn starch takes more moisture out of the candy to get it to its final gummy state.

One interesting property of gelatin is that it's thermoreversible, meaning that heat can turn it back into a liquid. If you put a gummy bear in the microwave, you'd see this in action and the gummy would turn liquid. When it cools down again, it resets back into a squishy gel.

This is based on the chemical nature of the gelatin molecule. You can go back and forth a number of times before the gelatin loses its elastic properties.

Our Vegan Gummies contain Agar Agar Powder

Agar-agar, sometimes referred to as China grass, kanten, or just agar, is a gelatinous polysaccharide derived from red algae. Agar is used to gel many food

Gummy bear recipe

products, such as puddings, desserts, jelly candy, soups, sauces, and more. It is a popular vegetarian alternative to gelatin. Vegetarians and vegans do not use gelatin because it is made from animal bones, skin, and connective tissue.

Characteristics of Agar

Agar is a prized ingredient for more reasons than just being vegetarian. Unlike gelatin, which melts at around body temperature, agar will stay solid at warmer temperatures. In fact, agar solidifies at temperatures below 122 F (50 C), which means that refrigeration is not required to set an agar gel.

Agar is also a much more powerful gelling agent than gelatin. One teaspoon of agar will give as much thickening power as 8 teaspoons of gelatin. It is important to note that although both agar and gelatin will solidify liquids, the resulting textures are slightly different.

Agar will not impart any color, flavor, or odor to the food to which it is added.

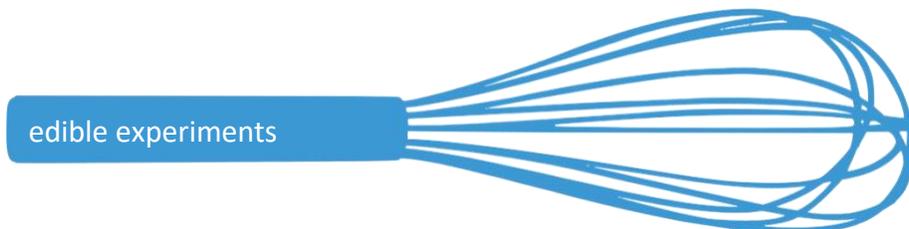
References and where you can go to learn more!

<https://www.mybluprint.com/article/make-diy-gummy-bears-in-4-simple-steps>

<http://www.chymist.com/Gummy%20Candy.pdf>

<https://morgridge.org/blue-sky/how-are-gummy-bears-made/>

<https://www.thespruceeats.com/what-is-agar-agar-1328461>



pancake recipe

- ½ Cups All Purpose Flour
- 1 Tablespoons White Sugar
- 1 Teaspoons Baking Powder
- 0.5 Teaspoons Salt
- 1/2 egg Used egg beaters you can use a food scale to determine 1/2 an egg.
- ½ Cups Milk
- 1 Tablespoons Veg Oil

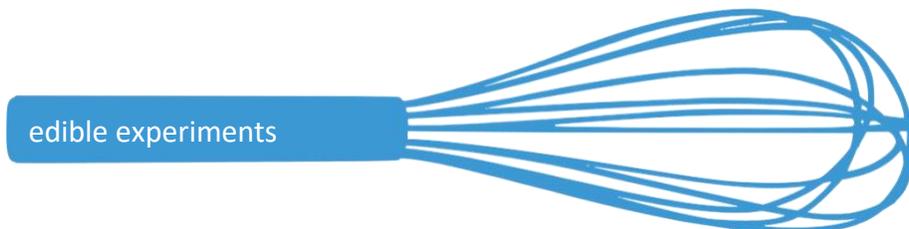
Recipe

1. In a large bowl, mix flour, sugar, baking powder and salt. Make a well in the center, and pour in milk, egg and oil. Mix until smooth.
2. Heat a lightly oiled griddle or frying pan over medium high heat. Pour or scoop the batter onto the griddle, using approximately 1/4 cup for each pancake.

Brown on both sides and serve hot.

VARIATIONS:

- A) Use Bread Flour instead of all-purpose flour.
- B) Don't add baking powder.
- C) Use ½ Cup plain yogurt.



pancake recipe

Where's the science?

Fluffiness Begins With Bubbles

Producing these air pockets requires, first, the formation of bubbles in the batter, and second, the solidification of those bubbles.

The formation of the bubbles is caused by the release of gas, which in turn is caused by the fact that you added [baking powder](#) to your batter. Baking powder is a chemical leavening agent that, when activated, produces CO₂ gas. It's this gas that forms the bubbles.

Activating the baking powder happens in two stages. The first occurs when the ingredients are mixed. The chemicals in the baking powder react when combined with liquid, which triggers an initial release of gas. This first release happens slowly.

A second, bigger burst of gas occurs when the batter is heated. Heat produces a quick burst of bubbles, and that's what really gives pancakes their fluffiness. The higher the heat, the more powerful is the release of gas. (These separate reactions are why baking powder is referred to as "double-acting.")

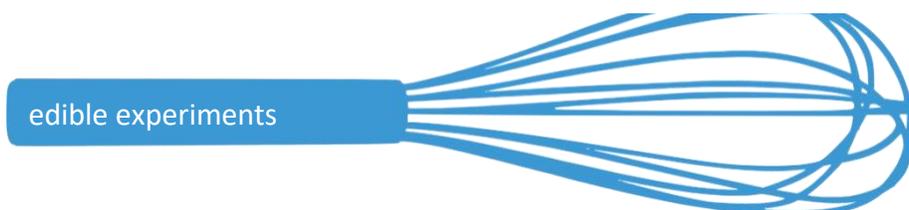
Now, the bubbles form because of [the gluten in the flour](#) you used to make the batter. Glutens are long strands of protein molecules. And as these molecules develop, they become elastic. If you've ever seen the way bread dough stretches, that's the elasticity we're talking about.

In pancake batter, the elasticity of the gluten is what allows the bubbles to form. Like balloons that stretch and expand as they're inflated, so do the little pockets of dough. (This is why you can't make fluffy pancakes with gluten-free flour.)

The Next Step: Heating the Batter

The heat (aka "cooking") is also what brings about the solidification of the bubbles.

When a dollop of batter hits a hot griddle or surface of a skillet, it heats up quickly, which because of the second reaction of your baking powder, quickly forms bubbles in the batter.



pancake recipe

Simultaneously, in less time than it takes for the bubbles to pop, the liquid in the batter cooks away in the form of steam, the proteins in the egg coagulate, and those CO₂ bubbles solidify into a network of air pockets. This airy interior is what gives a pancake its fluffiness.

Your griddle needs to be hot enough to cause the baking powder to activate quickly, which produces large bubbles and thus more fluffiness. Furthermore, a hot griddle ensures that the batter cooks quickly so that the air pockets hold their shape instead of collapsing. This is important. Too low of heat will slow the creation of the bubbles, and also the solidification of the bubbles. In most cases, your target temperature should be 375 F.

Additional Fluffiness Factors

Sugar: Sugar binds with the water in the batter and slows the development of the gluten. That means pancakes with a tablespoon of sugar will be softer, less rubbery, less elastic. Sugar will also aid in browning and give you those crispy edges that no pancake can do without. For best results, dissolve the sugar with the beaten egg.

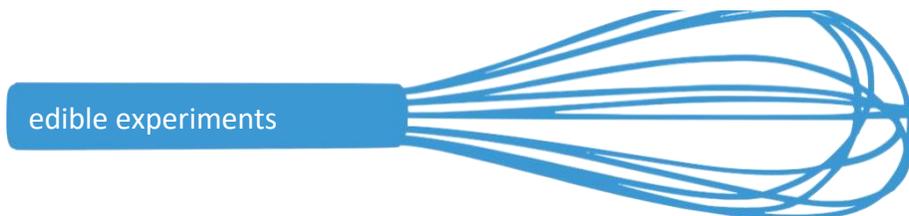
Salt: Salt also slows the development of the gluten, but it also produces a firmer dough.

Fat: Fat shortens the strands of gluten, causing it to be less elastic. For example, think how crumbly shortbread cookies are. Therefore, substituting cream for milk, say, would lead to a denser, less fluffy pancake.

Viscosity: This is another word for how thick your batter is. If your only liquid is milk, or just milk and egg, your batter will be relatively thin. Thin batter will spread out on the griddle, giving you thin pancakes. Thus thin batter is not compatible with fluffy pancakes. For fluffiness to exist, there must be thickness.

You can produce a thick batter by using less liquid. But in this case, thick will merely lead to heavy, leaden pancakes. The corollary to this is that using more flour will also give you thicker batter, but again, not in a good way. This can happen by accident, though, if you measure your flour incorrectly. (You should [weigh your flour, not scoop it.](#))

On the other hand, if you substitute a thick liquid for a thinner one (or for part of the thinner one), you are on your way to making a thicker batter, but one that will still rise and set.



pancake recipe

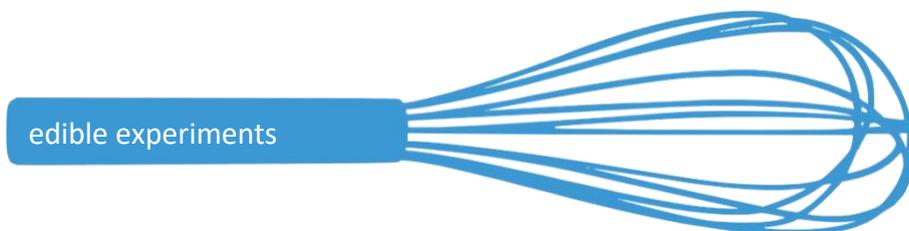
Example: If a pancake recipe calls for 1 cup of milk, substituting 1/2 cup of plain yogurt for half the milk will produce a thicker batter and a fluffier pancake. The acidity of the yogurt will also boost the chemical reaction of the baking powder, producing still more fluffiness. (The same will happen if you substitute [buttermilk](#) for some or all of the milk.)

Be aware that thicker batter will take longer to cook, so you'll want to lower the heat of your griddle about 25 degrees to prevent them from burning.

References and where you can go to learn more!

<https://www.thespruceeats.com/the-science-behind-making-fluffy-pancakes-4155859>

<https://sciencemadefun.net/blog/celebrate-your-pancakes-with-a-side-of-science/>



Rock candy

recipe

Ingredients: 3 cups of white sugar and 1 cup of water.

Directions: this recipe can be made on the stove top or in the microwave. This is the microwave version

1. Wet stick and roll in a dish of sugar. Let this dry before you put it in the solution (this gives the crystals something to grow on).
2. Pour 3 cups of granulated cane sugar into the large microwave safe container.
3. Add 1 cup of water to the sugar. Use a large spoon to thoroughly mix the solution together.
4. ADULTS NEED TO HELP FROM HERE ON OUT!!! CAUTION HOT LIQUIDS!!! Put the container in the microwave and heat for 2 minutes.
5. Remove and place on stable surface and stir again to dissolve more of the sugar.
6. Continue repeating these steps until all of the sugar is dissolved (there can be no crystals left).
7. Add powdered drink mix if desired.
8. Pour the colored solution into a smaller glass container (jelly jar).
9. Lower the stick into the jar, clip with clothespin cover with wax paper and let sit undisturbed for a week.

Where's the science?

• Why does the string need to be soaked and then dried?

The string will provide the surface on which the crystals will grow. As water evaporates from the string, small crystals of sugar will encrust the string. These tiny *seed crystals* provide starting points for larger crystals.

Future growth will be concentrated around these points.

Rock candy

- **What makes the crystals grow?**

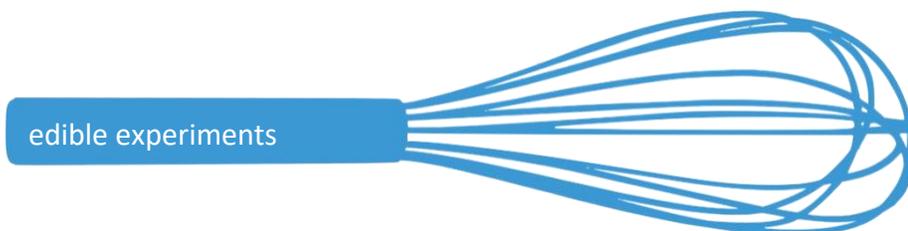
Two different methods will contribute to the growth of the crystals on the string. You have created a *supersaturated* solution by first heating a *saturated* sugar solution (a solution in which no more sugar can dissolve at a particular temperature) and then allowing it to cool. A supersaturated solution is unstable—it contains more *solute* (in this case, sugar) than can stay in a liquid form—so the sugar will come out of solution, forming what's called a *precipitate*. This method is called *precipitation*.

The other is *evaporation*—as time passes, the water will evaporate slowly from the solution. As the water evaporates, the solution becomes more saturated and sugar molecules will continue to come out of the solution and collect on the seed crystals on the string. The rock candy crystals grow molecule by molecule. Your finished rock candy will be made up of about a quadrillion (1,000,000,000,000,000) molecules attached to the string.

References and where you can go to learn more!

<https://www.exploratorium.edu/cooking/candy/rock-pop.html>

<https://www.stevespanglerscience.com/lab/experiments/homemade-rock-candy/>



Saltwater Taffy recipe

Recipe

Ingredients for saltwater taffy for each group

- 1 Cups Sugar
- 1 Tablespoons Cornstarch
- ½ Cups Corn Syrup
- 6 Tablespoons Water
- 1 Tablespoons Butter
- 0.5 Teaspoons Salt
- 0.5 Teaspoons Flavoring
- 1 Food Coloring

1. Mix together sugar and cornstarch in the saucepan.
2. Use a wooden spoon to stir in the corn syrup, glycerin, water, butter, and salt. Place the saucepan over medium heat and stir until the sugar dissolves.
3. Continue stirring until mixture begins to boil, then let cook, undisturbed, until it reaches about 270° F or the soft-crack stage. Wash down the sides of the pan with a pastry brush dipped in warm water while the syrup cooks.
4. Remove the saucepan from the heat and add food coloring and flavoring. Stir gently, then pour onto a greased marble slab or into a shallow greased cookie sheet to cool.
5. When the taffy is cool enough to handle, grease your hands with oil or butter and pull the taffy until it's light in color and has a satiny gloss. You can have a friend help with this step, which should take about 10 minutes.
6. Roll the pulled taffy into a long rope, about 1/2 inch in diameter, and cut it with greased scissors or a butter knife into 1-inch-long pieces. Let the pieces sit for about half an hour before wrapping them in wax paper or plastic wrap and twisting the ends of the wrapper.



Saltwater Taffy recipe

Where's the science?

Why do I add cornstarch?

The addition of cornstarch (called *cornflour* in British recipes) helps give the taffy a smooth texture.

Why do I add corn syrup?

Corn syrup acts as an "interfering agent" in this and many other candy recipes. It contains long chains of glucose molecules that tend to keep the sucrose molecules in the taffy syrup from crystallizing.

In this taffy recipe, the butter also acts as an "interfering agent"—the milk proteins in the butter interfere with crystal formation as well.

What is glycerin?

Glycerin is a sweet, slippery, colorless liquid that's made from fats and oils and is most often a by-product of the soapmaking process. It's used in many soaps and cosmetic products, cake icing, as a lubricant, and to make nitroglycerin—an ingredient in dynamite! (Note: glycerin itself is not an explosive substance, so it's safe to use in your kitchen!) In this taffy recipe, glycerin helps give the candy a soft, creamy consistency.

Glycerin can be found in many drugstores, as well as some supermarkets and craft stores in the baking supplies section, or in cake-decorating stores. Be sure to purchase food-grade glycerin.

Why do I need to stop stirring after the syrup begins to boil?

At this point, you have dissolved the crystal structure of the sugar. Stirring or other agitation is one of the many factors that can encourage the fructose and glucose molecules in your syrup to rejoin and form sucrose—crystals of table sugar.

Why do I wash down the sides of the pan?

The sugar crystals are dissolved at this point in the process. But a single *seed crystal* of sugar clinging to the side of the pan might fall in and encourage recrystallization.

Why do you pull taffy?

The final important step in making taffy is pulling it: Stretching it out and folding it in half, then stretching and folding again, over and over, until you may reach the point of exhaustion. Good exercise—but what does it do for the candy? As it turns out, pulling taffy *aerates* it, or incorporates many tiny air bubbles throughout the candy. This makes it lighter and chewier. Taffy isn't the only candy out there that gets pulled this way. We saw molten



Saltwater Taffy recipe

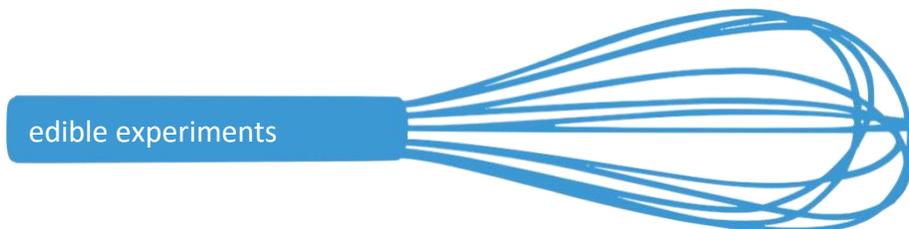
lollipop pulled by a machine at a local lollipop factory. In this case, the air bubbles added by pulling were to make the candy less rock hard and more brittle.

Is there salt water in saltwater taffy?

Actually, no. There is salt—and water—in saltwater taffy. But it isn't made with ocean water, despite the fact that it's so widely available at seaside vacation spots.

References and where you can go to learn more!

<https://www.exploratorium.edu/cooking/candy/recipe-taffy.html#>





Ice Cream

It's easy to make ice cream in a bag!

Activity Guide

Try This!

1. For each portion, put 1-2 cups of ice in a gallon bag with $\frac{1}{4}$ cup of salt.
2. Pour sugar, milk and vanilla into the small bag and seal.
3. Place the small bag inside the large bag and seal.
4. Shake for 10-15 minutes.
5. Remove the small bag and rinse the salt water off, or wipe it with a paper towel.
6. Open and enjoy! Add chocolate syrup if you wish.



What's Going On?

Salt lowers the freezing temperature of water, which cools the cream and sugar mixture enough to allow tiny crystals of ice to grow. With a little shaking, the result is an emulsion of liquid cream, tiny crystals of ice, and air bubbles...also known as ice cream.

Heat always flows from an area of higher temperature to an area of lower temperature. So, heat is transferred from the milk mixture to the ice and salt mixture in the outer bag. If only ice is used in the outer bag, the milk mixture would become cold as the ice melted, but would not actually freeze. Adding salt to the ice lowers the freezing point and allows the milk mixture to freeze.

Learning Objective

- Salt lowers the freezing point of water, allowing us to make ice cream out of cream and sugar.

Materials

For each portion:

- 1-2 cups ice
- 2-3 teaspoons sugar, or 2 sugar packets
- ½ cup half and half
- ¼ teaspoon vanilla extract
- ¼ cup rock salt
- 1 pint or quart size zip or slider freezer weight bag
- 1 gallon size zip or slider freezer weight bag (slider is best)

For the group:

- Small cups and plastic spoons for serving ice cream
- Measuring cups and spoons
- Paper towels
- Sheet plastic or newspaper to protect working surface
- Chocolate syrup (optional)
- Large container to hold discarded ice and salt

Tootsie rolls

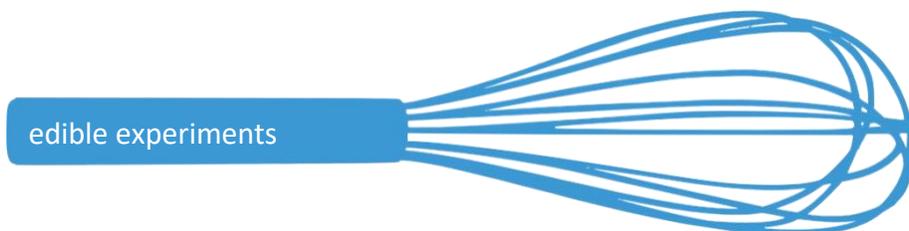
Spruce Eats Tootsie Roll EACH GROUP

Ingredients

- Chopped Unsweetened Chocolate .5 ounces
- 2 Tablespoons Corn Syrup
- 1.5 Teaspoons Softened Butter
- 0.25 Teaspoons Vanilla
- ½ Cups Powdered Sugar

Steps to Make It

1. Gather ingredients.
2. Melt the chocolate in a large microwave-safe bowl.
3. Once the chocolate is melted and smooth, stir in the corn syrup and the butter, stirring until the butter is melted. Stir in the powdered milk and vanilla extract.
4. Add ¼ cup of the powdered sugar and stir until it is incorporated. Once that sugar is mixed in, add 1 cup more of powdered sugar and stir to mix. At this point, the dough will start getting stiff and it might be difficult to stir more powdered sugar into the candy.
5. Dust your work surface with powdered sugar, and knead the candy until it is smooth. If it is still very soft, knead in more



Tootsie rolls

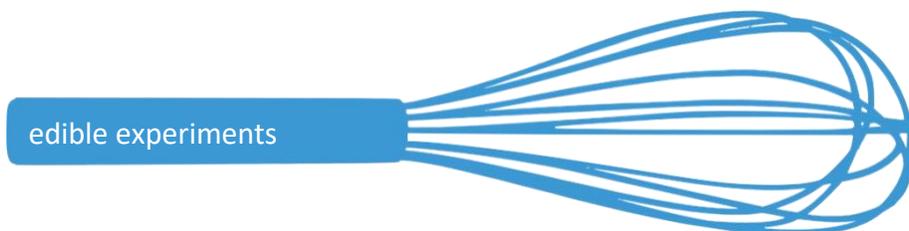
powdered sugar until it is firm but not dry or crumbly. You might need more powdered sugar adding one tablespoon at a time to.

6. Once the candy is smooth and a perfect firm but supple texture, break off a small bit and roll it into a long, thin rope. Using a sharp knife, cut it in to small pieces and place them on a baking sheet. Repeat until you have formed all of the tootsie roll dough into small pieces.
7. Refrigerate the tray of tootsie rolls for about 1 hour, or until they firm up.
8. Serve and enjoy!

References and where you can go to learn more!

<https://www.thespruceeats.com/tootsie-rolls-521225>

<http://www.chymist.com/Tootsie%20Rolls.pdf>



Tootsie rolls

No Cook Tootsie Roll EACH GROUP

- 1 Tablespoons Unsweetened Cocoa
- ¼ Cups Powdered Sugar
- 1 Tablespoons Dry Milk
- 1 Tablespoons Cup Corn Syrup
- 1.5 Teaspoons Melted Butter

Procedure

1. Sift together the cocoa powder, confectioner's sugar, dry milk powder, and salt into a medium sized bowl (1 to 2 quarts). Set this aside.
2. Measure the corn syrup. Add the butter to the corn syrup and mix well to combine as completely as possible.
3. Pour the corn syrup mixture into the dry ingredients. Mix well. It will take a couple of minutes of mixing until all the ingredients are combined. It may look like there is not sufficient liquid for everything to mix, but DO NOT add any additional liquid.
4. Once everything is combined, scrape the mixture out onto a plastic or glass cutting board. Knead the mixture until it is uniform and smooth. If it is too soft, you can add small amounts of confectioner's sugar.
5. Separate the dough into small chunks. Roll each chunk into a rope about 1 cm (about ½ inch) in diameter. Using a knife, cut the rope into pieces about 2.5 cm (1 inch) long.
6. Place the cut pieces onto a baking sheet. Place the sheet and the Tootsie Rolls into the refrigerator or a cool place to set up for about an hour.

Tootsie rolls

7. Wrap the Tootsie Rolls in wax paper.

Where's the science?

Tootsie Rolls® are not a fudge or a caramel, but somewhere in between.

Commercial Tootsie Rolls are made with sugar, corn syrup, soybean oil, condensed skim milk, cocoa, whey (the liquid remaining from milk used to make cheese – it may be in the form of whey powder), lecithin (an emulsifier), and artificial and natural flavors. This mixture requires some cooking to combine all the ingredients.

This recipe does not require any heating or cooking other than melting the butter.

Powdered sugar (confectioner's sugar) is used to eliminate cooking which would be needed to dissolve the crystals of granulated sugar. Sugar crystals would give a coarse mouth feel.

Commercial Tootsie Rolls contain about 3 g of fat per 40 g serving size. Since the ingredients in this recipe are fat-free, the function of the butter is to add a small amount of fat to the mixture. The fat helps in emulsifying the ingredients, contributes to the flavor and mouth feel, and adds some gloss to the finished product.

The dry materials need to be sifted to remove any lumps and insure complete mixing. Sifting also separates the powder which makes it take longer to hydrate it when mixing.

