EXPERIMENT MANUAL

Tasty Labs

# SUPER DUPER Bubble Gum Lab

**WARNING**. Only for use by children 6 years of age or older with continuous adult supervision and assistance. Adult supervision required at all times. Use of a microwave or stove is required. Hot mixtures and stove tops can cause severe burns.

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## Safety information

Warning! Not suitable for children under 6 years. For use under adult supervision. Read the instructions before use, follow them and keep them for reference.
Keep small children and animals away from experiments. Keep the experimental set out of reach of children under 6 years old.
Warning. Not suitable for children under 3 years. Choking hazard — small parts may be swallowed or inhaled.
Keep the packaging and instructions as they contain important information.
The gum pieces should be wrapped in wax paper wrappers or plastic wrap before labeling them with the stickers.

## First aid information

Should an accident happen while experimenting, please heed the following recommendations.

**1. In case of burns:** Wash affected area with plenty of water for at least 10 minutes.
**2. In case of doubt or larger burns,** seek medical advice without delay.
3. **In case of injury (e.g. cuts)** always seek medical advice.

## Safety rules

Read this before starting any experiments.

1. Read these instructions before use, follow them and keep them for reference.
2. Keep young children and animals away from the work area and stove at all times.
3. Store this kit out of reach of children under 6 years of age.
4. Clean all equipment after use. Clean all pots and utensils with hot water and soap.
5. Do not use any equipment which has not been supplied with the set or recommended in the instructions for use.
6. Never work alone. An adult should always be present. Pay attention to the information provided with each experiment.
7. Pay special attention to the quantity specifications and the sequence of the individual steps. Only perform experiments that are described in this instruction manual.
8. Clean the work surface carefully after you are finished and always wash your hands thoroughly — before and after you work.
9. If you are allergic to certain foods you must avoid sweets that contain such ingredients. Therefore, always begin by checking the list of ingredients. If you are diabetic, you must only eat the amount of sugar allowed by your diet plan.

# Advice for parents and supervising adults

This experiment kit is not suitable for children under 6 years. It must be used with an adult at all times. The kit provides a fun introduction to physical science topics through bubble gum making activities and experiments.

The work of a candy maker is fun and exciting, but it is not always easy. This is why we would like to thoroughly inform you of safety precautions, so that you can guide your child with advice and help. You must supervise and assist him or her with all of the activities in this kit, but especially when using the stove, microwave, and working with hot ingredients. This also applies to the use of sharp knives and other kitchen utensils (e.g. breakable glasses).

Take a look through this instruction manual and pay particular attention to the:

→ Safety information and rules (inside front cover),
→ Safety notes that accompany each experiment (marked with an exclamation point symbol ), and
→ First aid in case of accidents (inside back cover).

Discuss the experiments and the individual work steps with your child before beginning. Use only the recommended ingredients.

Candy making requires several different talents and skills. It can be affected by the weather, temperature, and the specific equipment used. Don't get discouraged if a particular step does not work out as expected. Having some experiments "fail" is an important part of science.

Select the steps that appear suitable for your child and supervise him or her during the melting, cutting, packaging, and storage of the bubble gum. Your own bubble gum might not keep as long as commercially available bubble gum, which generally is not required by law to be labeled with an expiration date. Write the production date on the packaging.

Tell your child to read these instructions, safety rules, and first aid information; to follow them; to keep them for reference; and to perform only those experiments that are described in the manual.

Pick an area in the kitchen that can tolerate spills and stains. When working with hot pots, have a trivet and pot holders available, and make your child aware of the danger of burns.

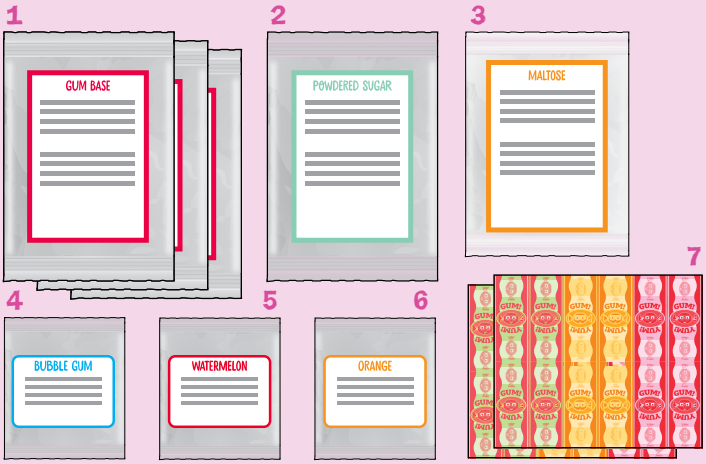
Make sure that you wrap the gum pieces completely in wax paper wrappers before labeling them with the stickers or storing them.

If your child has to stay away from certain sweets or avoid some ingredients (for example because of an allergy), you will have to alter the recipe or not use it. Always check the contents of purchased ingredients.

We hope you and your young gum maker have lots of fun with this kit!

***NOTE!*** *The additionally required items are highlighted in italic script in the individual experiments. Before starting the experiments, carefully read through everything that will be required and make sure to have all the materials ready.*

# KIT CONTENTS




1 | Gum base (in 3 packets, Net Wt. 70 g/2.47 oz)
2 | Powdered sugar (Net Wt. 70 g/2.47 oz)
3 | Maltose (Net Wt. 100 g/3.53 oz)
4 | Bubble gum flavor (Net Wt. 5 g/0.18 oz)
5 | Watermelon flavor (Net Wt. 5 g/0.18 oz)
6 | Orange flavor (Net Wt. 5 g/0.18 oz)
7 | Sticker sheets for gum (2)

For the ingredient list, see the side of the box.

TO MAKE THE GUM, YOU WILL ALSO NEED: *Cup, water, scissors, tablespoon, adhesive tape, fork, spoon, cutting board or flat work surface, microwave-safe container (disposable plastic cup or bowl recommended), knife, wax paper, ruler*
FOR SOME EXPERIMENTS, YOU WILL ALSO NEED: *Two glass jars or drinking glasses, tissue paper or paper towels, kitchen scale, clean rubber band*
KITCHEN EQUIPMENT: *You will need a microwave (or stove), sink, and a regularly equipped kitchen. Read through each experiment to make sure you have everything you need for the experiment.*

## Hey Bubble Gum-gineers!


Want to make delicious bubble gum in different flavors and learn some physical science while you're at it? Then let's get started! After you've made your gum pieces, you can wrap them up and decorate them with sticker labels. Then you can give them to your family and friends!

PART 1

# MAKE YOUR OWN BUBBLE GUM

## Mixing the gum

### You will need:

**Gum base, powdered sugar, maltose (a sweetener), flavor packet, stickers,** *cup, water, scissors, tablespoon, adhesive tape, fork, spoon, cutting board or flat work surface, microwave-safe container (disposable plastic cup or bowl recommended), knife, wax paper, ruler, microwave*

### Here's how:

1. Make sure an adult is present. An adult must supervise this activity, especially when hot substances and sharp knives are involved.

2. Soften the maltose by placing the packet into a cup (or bowl) of hot water. Handle the hot water carefully. Set aside.

3. Cut open one packet of gum base. Remove the solid piece of gum base from the packet and put it in a disposable, microwave-safe container.

**These instructions call for using one flavor packet at a time. If you want to experiment with mixing flavors, go for it!**

1

**Safety Note:** Caution! High temperatures. There is a risk of burns.

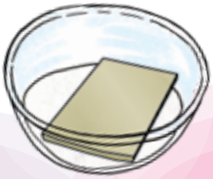
2

*Maltose packet*

*Note: It is normal for the maltose packet to have some sugar crystals formed in it.*

3

*1 packet of gum base*



*Microwave-safe container*

**IMPORTANT: Use a disposable plastic cup or bowl to avoid a sticky cleanup. Once hot, the sticky gum base will leave a residue that will be difficult to clean out of the container, so you will want to use a disposable container if you do not want to spend the time cleaning it.**

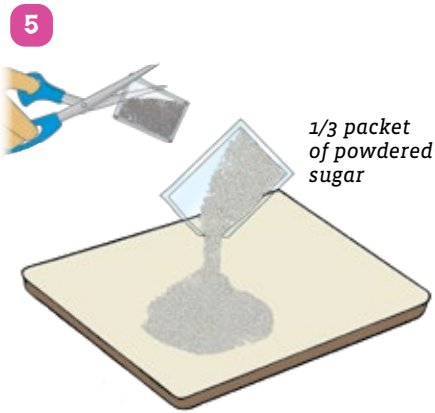
## Continued from page 3:

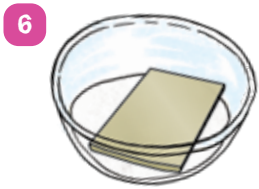
4 Cover the gum base with warm water and set it aside.

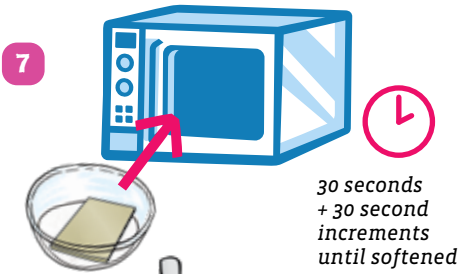
5 Cut the corner off of the powdered sugar packet to open it. Pour about a third of the packet (about 2 tablespoons) onto your work surface and form a small volcano-shaped mound with a depression about two inches wide in the middle. You should not be able see your work surface through the depression. Set aside the rest of the powdered sugar.

6 Drain the water from the soaked gum base. You can leave a small amount of water to help the gum base heat evenly when it's in the microwave.

7 Microwave the gum base for 30 seconds (or less) at a time. After each cooking interval, stir the mixture and check to see if the gum base has softened by pressing on it gently with the fork. Continue to microwave the gum base in short intervals until the gum base has softened into a thick, gooey liquid. Do not overheat the gum base or it may begin to smell burnt. Be careful when removing the container of heated gum base from the microwave — it will be very hot and sticky! Do not let the hot mixture get onto your skin, hair, or clothing.


## Continued from page 4:

8 Once the gum base is hot and gooey, drain any excess water into the sink.

9 Remove the softened maltose packet from the cup of hot water. Carefully cut open the packet with scissors at the corner. Squeeze about a third of the maltose into the hot gum base. If you prefer, you can measure this by filling up one heaping tablespoon. Set aside the rest of the maltose.

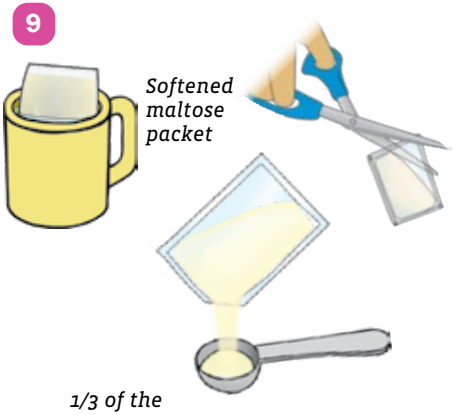
10 Add the maltose to the hot gum base. The maltose is very sticky, so you may need to use your finger or another spoon to scrape the maltose into the gum base. Don't worry if you cannot get all of the maltose out of the packet or off of the tablespoon; there is a little extra maltose included in the packet than is needed for the recipe, because it is impossible to get all of the maltose into the gum base due to how sticky the maltose is.

11 Cut open one of the flavor packets and add it to the warm mixture of gum base and maltose. Stir to mix it in.

8

*Melted gum base*

9



*Softened maltose packet*

*1/3 of the maltose packet (about 1 heaping tablespoon)*

10

11

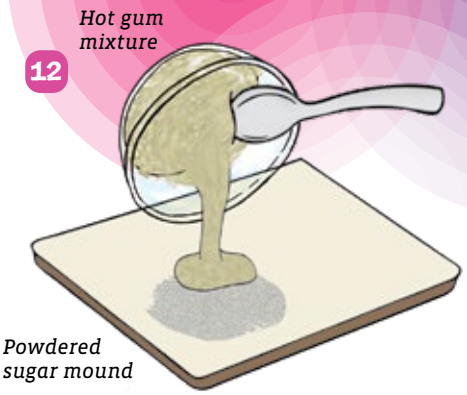
*1 flavor packet*

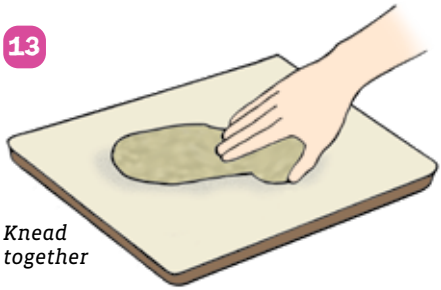
## Continued from page 5:

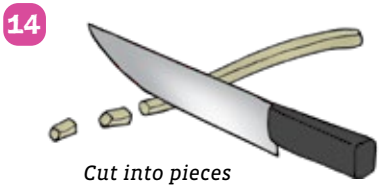
**12** Use utensils such as a fork and spoon to transfer the hot gum mixture onto the mound of sugar. While the gum mixture is still hot, move some of the excess sugar from the edge of the mound to cover it.

**13** As the gum mixture cools, it will begin to become firm. Before it cools completely, the powdered sugar must be kneaded into the gum mixture. This makes it taste sweet. An adult must help with this part. Remember that the gum mixture is very hot. You can start folding sugar into the gum mixture with a fork or spoon. Once the mixture has cooled slightly, you can begin to use your hands, but be very careful in case it is still hot. Knead the sugar into the gum mixture by repeatedly stretching and flattening the mixture out, sprinkling sugar across it, and then folding it back over, until most of the sugar is incorporated into the gum mixture, and it is no longer sticky to the touch.

**14** Use your hands to roll the gum mixture into a 6- to 8-inch-long cylinder, with a thickness of about half of an inch. The longer and thinner the cylinder, the smaller the pieces of gum will be. Use scissors or a knife (with an adult's help) to cut the gum into small pieces. Your gum is finished! The recipe yields about 10–30 pieces of gum each time depending on how you divide the pieces.




TIP: To clean the utensils and container after the experiment, use hot water to melt the gum base again.

**Now repeat the process to make the remaining flavors of gum. Continue to the next page for instructions on wrapping and labeling your gum.** → → →

## Wrapping the gum

### Here's how:

15 Count out the total number of pieces of gum you have made. Measure and cut out strips of wax paper for all of your gum. Each strip of wax paper should be about three inches wide and four inches long, or at least big enough to wrap each piece of gum easily.

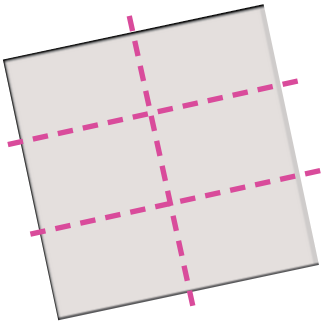
16 Place a piece of gum in the center of a piece of wax paper. Fold the wax paper over the piece of gum.

17 Gently twist the sides to enclose the gum.

18 Use a sticker from the sticker sheet to keep the wax paper wrapped around the gum and to decorate it.

19 Save a few pieces of gum for your experiments.

15



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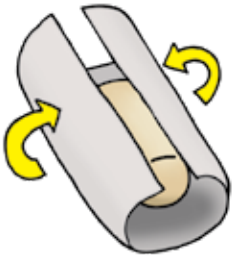

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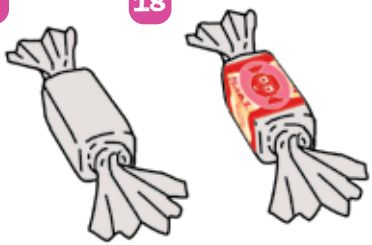


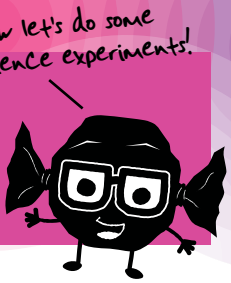
GEEK OUT!

## WHAT'S HAPPENING?

The gum base is a solid at room temperature. It is made of long molecular chains called polymers that are all intertwined like a bowl of noodles. When you heat up the gum base, you add energy to these molecules. With more energy, the molecules start to vibrate around more. This vibration allows the long chains to untangle from each other a little, and move around more freely. This is how the gum softens up and becomes fluid like a liquid. In this liquid state, it is easier to mix in the other ingredients that sweeten and flavor the gum. When the gum hardens again, the sweetener and flavoring is now mixed throughout the gum.

PART 2

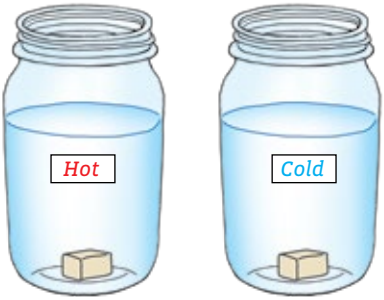
# EXPERIMENTS WITH GUM




**Safety Note:** Caution! High temperatures. There is a risk of burns.

Now that you have made your pieces of gum, let's do some science experiments with them.

## 1. Removing the flavor from the gum




### You will need:

**Two pieces of your gum,** *two glass jars or drinking glasses, water, paper, pen, tape*

### Here's how:

1. Fill one glass jar or drinking glass with hot water and one glass jar or drinking glass with cold water. Label the jars by writing "Hot" and "Cold" with the pen on strips of paper and taping them to the jars.
2. Place one piece of gum in each jar. Let the gum sit for about one day.
3. Remove the pieces of gum from their respective jars. Record your observations.

GEEK OUT!

### WHAT'S HAPPENING?

From your experiment, you found that leaving the gum in water removes the flavoring and sugar from the gum, leaving only the gum base. This is because the universe has a natural tendency to go from order to disorder. In physics, the measure of the degree of disorder within a system is called **entropy.** This is why after cleaning up your room, it gets messy again within a few days!

So, the sugar and flavor will spread out from inside the gum where there is a lot of flavoring (ordered) into the water where there is no sugar or flavoring (disordered). This process is called **diffusion.**

## 2. Weighing gum

Which do you think will weigh more: an unchewed piece of gum or a chewed piece of gum? Why?

### You will need:

**One or two pieces of gum (weighing about 5-8 grams total);** *piece of wax paper, tissue paper, or paper towel; digital kitchen scale or postage-stamp scale*

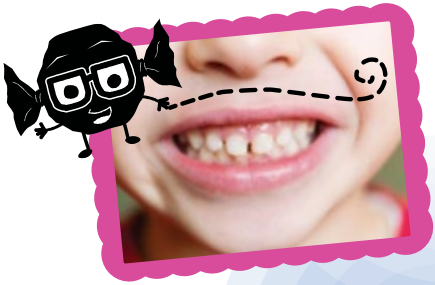
### Here's how:

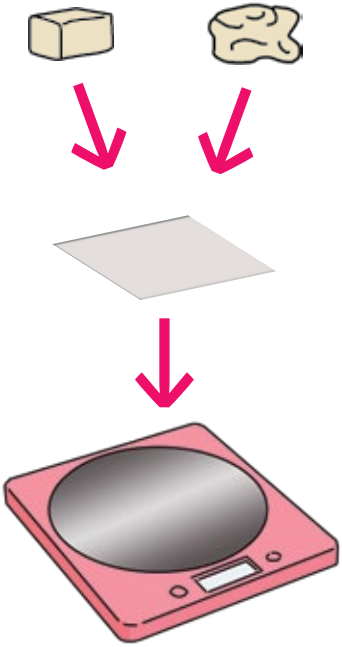
1. Turn on the scale. Place a piece of wax paper, tissue paper, or paper towel on the scale. Press the tare button to zero the scale so that it is ready to weigh the gum.

2. Place the gum on the scale. Record the weight of the unchewed gum on a piece of paper.

3. Chew the gum for about five minutes and then leave it to dry for a few minutes.

4. Weigh the gum again and record the weight of the chewed gum. What happened to the weight of the gum after you chewed it? Why?





GEEK OUT!

### WHAT'S HAPPENING?

As you found in the dissolving gum experiment, water pulls the sugar and flavoring out of the gum leaving only the gum base. Since saliva is 99.5% percent water, the same thing is happening here! The ability of water to remove the sugar and flavoring from gum is how you are able to taste the flavoring in gum.

## 3. Finding the volume of a piece of gum

### You will need:

**A piece of gum,** *glass jar or drinking glass, water, pen, tape*

### Here's how:

1. Fill the jar or glass with water. Use the tape and pen to mark the top of the water level. Look closely at the surface of the water. You will see it curves up slightly around the sides where it touches the jar. Place your mark at the bottom of the curve in the surface of the water (called the **meniscus).**

2. Drop a piece of gum into the jar. What happens to the water level?

3. Try adding more objects to the jar of water. Observe what happens to the water level when you add them.


GEEK OUT!

**WHAT'S HAPPENING?**

When you place the gum into the jar, the water level rises. The water is displaced by the gum, causing the water level to rise. The amount of water appears to increase, but really it is the same amount of water as before, only now it is pushed up by the gum. The amount that the water appears to increase is actually equal to the amount of space that the gum takes up. This amount is called the volume.

## 4. Rubber bands and bubble gum

### You will need:

*A clean rubber band (a thick flat rubber band works best)*

### Here's how:

1. Hold the rubber band flat on the top edge of your lips, and then stretch the rubber band. Repeat a few times. What do you notice?

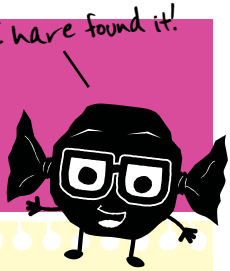
GEEK OUT!

**WHAT'S HAPPENING?**

When you stretch the rubber band, you can feel it heat up a little bit. Your lips are very sensitive to heat, so they can feel this small increase in heat. Heat is generated because the rubber band contains long molecules called **polymers,** which are all tangled up in a web like spaghetti — just like gum! When you stretch the rubber band, the molecules slide past each other and they generate heat as they do this. Bubble gum is a form of natural or synthetic rubber.

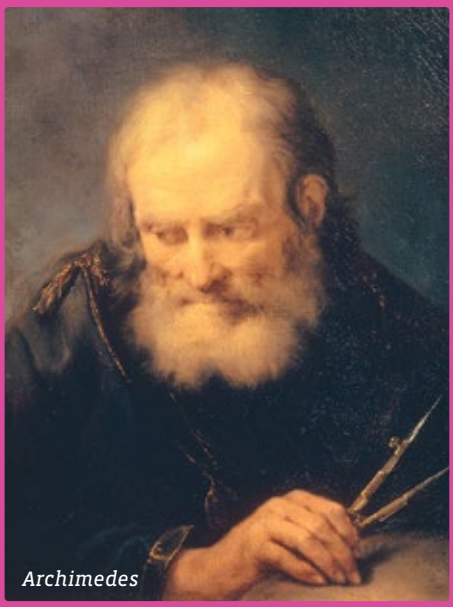
GEEK OUT!

# EUREKA!




A popular historical story tells us that the Ancient Greek scholar Archimedes was taking a bath and noticed that the deeper he sank into the bath, the higher the water level rose. He realized that he had discovered a way to measure the volume of an object. Archimedes was said to have been so excited by his discovery that he leapt out of his bathtub and ran through the streets of Syracuse yelling, "Eureka! Eureka!" which is Ancient Greek for "I have found it."

Archimedes then used this knowledge to find out if the crown of the king of Syracuse was pure gold. He did this by comparing the amount of water that was displaced by the crown and the amount of water that was displaced by a bar of pure gold that had the same weight as the crown. If the crown and the bar of gold were made from different materials, most likely they would have different **densities.** Two objects of the same weight but with different densities would have different volumes, and therefore displace different amounts of water. If a crown and a bar of pure gold have the same weight and the same volume, then they must have the same density. Eureka!



*Archimedes*

GEEK OUT!

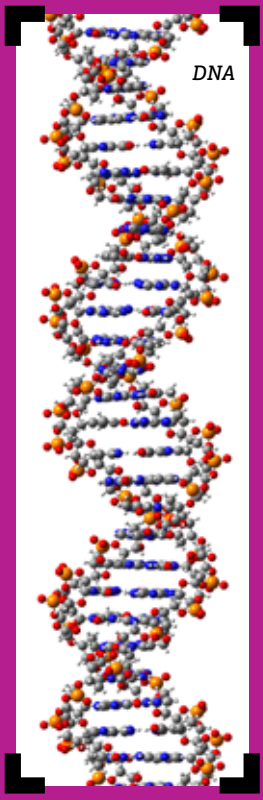
# ALL ABOUT POLYMERS

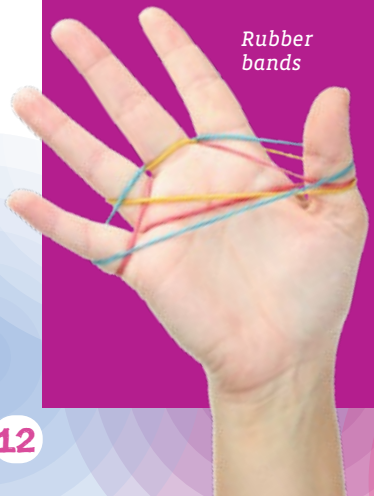

How are rubber tires, granulated sugar, and wool similar? They are all made up of **polymers!**

Polymers are long molecules that are made up of many repeating parts, like a chain with many chain links. Small changes in these repeating units, the links of the chain, are what create such different materials. This illustrates a common theme in chemistry: Small changes in a molecule's structure can result in big changes in the properties of a substance made up of that molecule.

There are two general types of polymers: natural polymers and synthetic polymers. A very important example of a natural polymer is deoxyribonucleic acid, or DNA. DNA stores all the biological information about a living thing. So, polymers are essential for living things!

Synthetic polymers are made by humans using natural raw materials including oil, coal, natural gas, minerals, and plants.


*DNA*


*Rubber bands*


*Industrial plastic granules in a factory*

GEEK OUT!

# NATURAL GUM FROM A TREE

Most bubble gum today is made from synthetic rubber, but some bubble gum is still made from natural rubber.

Natural bubble gum uses a gum base called **chicle,** which is harvested from trees in the *Manilkara* genus, including *Manilkara zapota* and *Manilkara chicle*. These trees are native to Central America and grow in tropical and sub-tropical climates.

The gum is harvested from these trees using zig-zag or diagonal gashes in the tree trunk, out of which liquid gum oozes. The dripping gum is collected in small bags or buckets. The sap is then boiled until it reaches the desired thickness.

Chicle is a natural gum which contains **polysaccharides,** which are molecules that are capable of increasing a solution's viscosity. They are used as thickening agents, gelling agents, emulsifying agents, and stabilizers.

*↑ Natural rubber is harvest from a tapped tree.*

*← A grove of tapped rubber trees.*

GEEK OUT!

# A BRIEF HISTORY OF BUBBLE GUM

- There is evidence that prehistoric humans chewed saps and waxes from plants.
- Toothmarks left in birch bark tar suggest people in Finland chewed gum 5,000 years ago.
- The ancient Aztec people in Central America made rubbery glues with natural chicle from trees.
- The ancient Greeks chewed gum made out of the resin from the mastic tree thousands of years ago.
- Native Americans chewed a type of gum made from the sap of spruce trees. European settlers picked up this practice in the 1800s.
- John B. Curtis created and marketed the first commercial chewing gum in 1848. It was called The State of Maine Pure Spruce Gum.
- In 1850, a sweetened form of paraffin wax was introduced. It soon became more popular than the spruce gum.
- An American named William F. Semple was the first person to patent chewing gum. His gum contained chalk and licorice root. But it wasn't a candy; it was designed to clean teeth and strengthen one's jaw!
- In the 1860s, John Colgan created the first flavored chewing gum. He made gum using extract from balsam trees and sugar. Later on, he made gum from chicle.
- By the early 1870s, chicle was widely used as a chewing gum base and the number of chewing gum products grew rapidly. Some of the first were Adams New York Chewing Gum (1871), Black Jack (1884), and Chiclets (1899).
- In the early 1900s, synthetic gum started replacing natural chicle.
- By the mid-1900s, gum manufacturers switched to a synthetic rubber made from butadiene because it lasted longer and was less expensive than natural chicle. Butadiene-based gum is still the most common type of gum made today.

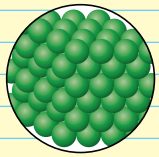

*Gum brands from the past several decades.*

GEEK OUT!

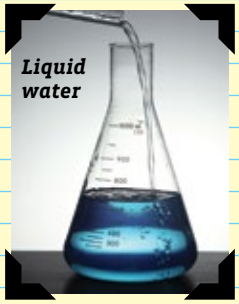
# THE PHASES OF MATTER


There are three **phases of matter:** solid, liquid, and gas. (There are actually others, like plasma and Bose-Einstein condensate, but they're much less common.) This means that pretty much all the stuff you see in the world can be characterized as being in either a solid, liquid, or gas phase.

The atoms of **solids** are packed together densely and have fixed positions in space relative to each other (like bricks in a wall), which makes solids rigid.

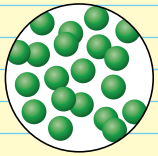


***Solid water (ice)***

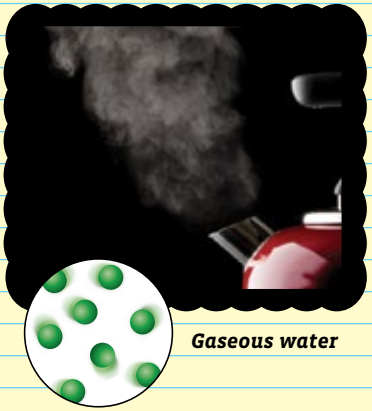


***Liquid water***

**Liquids** have atoms that are packed less densely than are those of solids, and while solids form a rigid shape, liquids move freely. But when liquids are poured into a container, they must conform to the shape of the container, except for possibly one surface (like the surface of water in a fish tank).



This is not the case for **gases,** which must conform to the shape of the container entirely (like water vapor in a fish tank, which would have no surface different from the walls of the tank). The atoms of gases are packed the least densely of all three phases, and are in relatively random motion. Gases have no definite shape or volume, can expand and contract greatly with changes in temperature and pressure, and spread easily to distribute themselves evenly throughout a container — hence their total conformity to the shapes of containers.



***Gaseous water***

GEEK OUT!

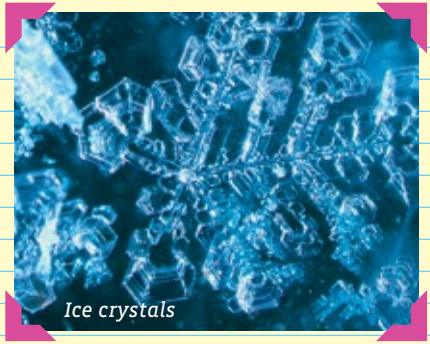
# HOW SWEET IT IS: SCIENCE

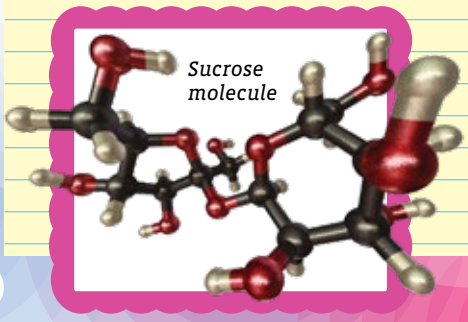

## CRYSTALLIZATION

A **solution** is a mixture of substances in which the particles of one substance are evenly mixed with the particles of the other substance. A solution consists of a **solute,** the substance that is dissolved, and a **solvent,** the substance that dissolves the solute.

When solutes fall out of solution, scientists say they **precipitate** out of the solution. This can happen when the amounts of solvent or solute change, or when the conditions such as pressure or temperature change.

When the solute precipitates out of solution, sometimes it will do so molecule by molecule, in a slow, orderly way. Because the molecules are all the same, they tend to fit together, or stack, in the same way, forming solid crystals with organized shapes. This process is called **crystallization.** Crystals can also form when molten items solidify or freeze.


*Ice crystals*


*Sucrose molecule*

### The Chemistry of Sugar Crystals

Common table sugar, or **sucrose,** is a molecule called a **carbohydrate** because it contains carbon, hydrogen, and oxygen atoms. The simplest carbohydrates are called monosaccharides, such as **fructose** and **glucose,** which are the building blocks of all other sugars and carbohydrates. Sucrose is actually made of a fructose molecule combined with a glucose molecule.

When put into water, sugar crystals will dissolve. The amount of sugar that will dissolve in water depends on the temperature of the water: the hotter the water, the more sugar can fit into it, to a point. A very hot solution that has a lot of sugar in it is called a supersaturated solution. These solutions are used in candy making.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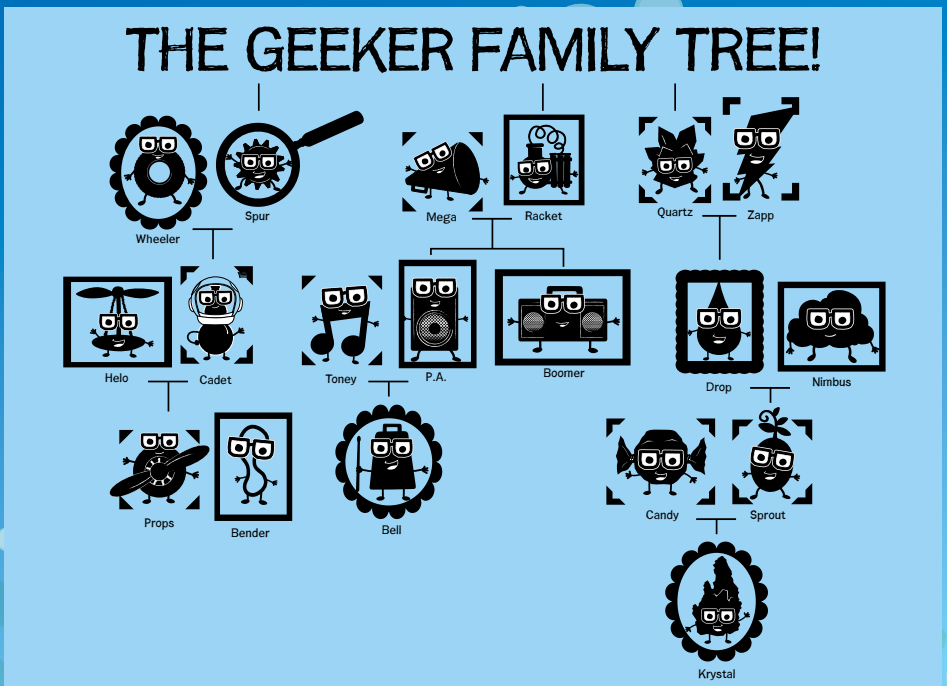




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