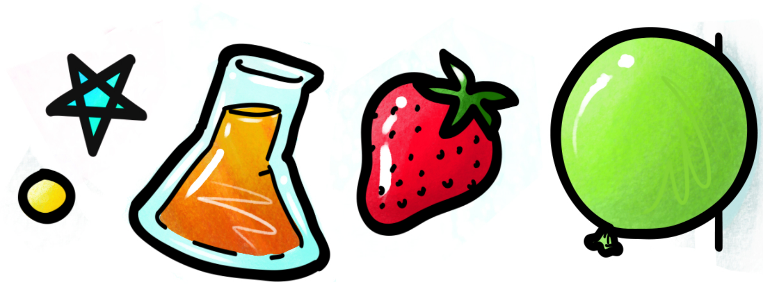
SCIENCE MOM

THE SCIENCE FAIR IS TOMORROW. HELP!

18 SIMPLE EXPERIMENTS TO TEACH THE SCIENTIFIC METHOD



Whether or not the science fair really is tomorrow, we know that sometimes you need a science project that takes minutes or hours rather than days or weeks!

In this book we've put together 18 simple science projects that are delightfully fun and will teach your student about the scientific method too.

Each project can be completed in one evening and has a guide with ideas for how to make it a true experiment and then communicate your results.

Enjoy!

— Science Mom

Special thanks to Emily Chen www.mchendraws.com for designing the cover of this ebook!

Questions or feedback? Contact us at jenny@science.mom

Find more activities and science courses at www.science.mom

SCIENCE MOM

TABLE OF CONTENTS

Experiments that involve water

- How many drops on a penny? 4
- Walking water 6
- Ink chromatography 8
- Pepper scatter 10
- Gravity-defying lid 12
- “Magic” screen 14
- String water bridge 16
- Thermocline cups 18

Experiments that involve static electricity

Note: these are best performed when the weather is cold. If it is hot and humid outside, it will be much more difficult to build up a static charge.

- Rolling a can 20
- Balloon on a wall 22
- Pepper vacuum 24
- Levitating orb 26
- Repelling balloons 28

Experiments with sound and food

- Chladni plate 30
- Rainbow milk 32
- Cabbage juice lemonade 34
- Sunbutter Cookies 36
- DNA extraction 38

HOW MANY DROPS ON A PENNY?

CREATE A SCIENCE EXPERIMENT FROM THIS FUN DEMONSTRATION!

Supplies

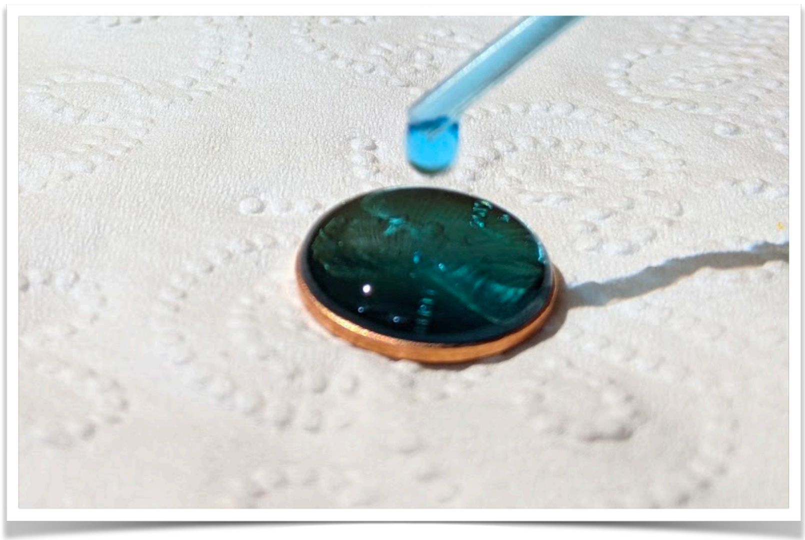
- Water
- Coins such as pennies, nickels, or dimes.
- A dropper or pipette, or a rag and the patience to add water drop by drop
- Optional items: salt, rubbing alcohol, soap, food coloring

Demonstration

Use the dropper or pipette to slowly add water to a dry and clean coin. Count the drops as you add them. An impressively large dome of water will form on the coin before the water spills off.

Explanation

Water has strong surface tension. The molecules on the surface are attracted to each other more strongly, and this is what causes the water on the penny to form a dome. The stronger the surface tension, the more drops you will be able to fit on top of the coin. Different liquids have different strengths of surface tension.

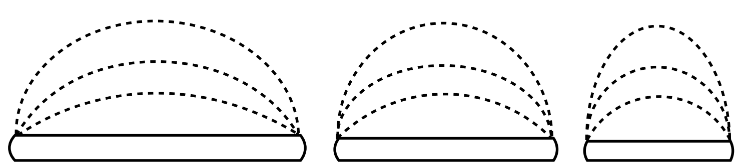


Turn it into an experiment

Great experiments begin with great questions. Read these questions first and think of ways you might answer them, then look at the next page for our experiment design suggestions. Follow one of those or make your own!

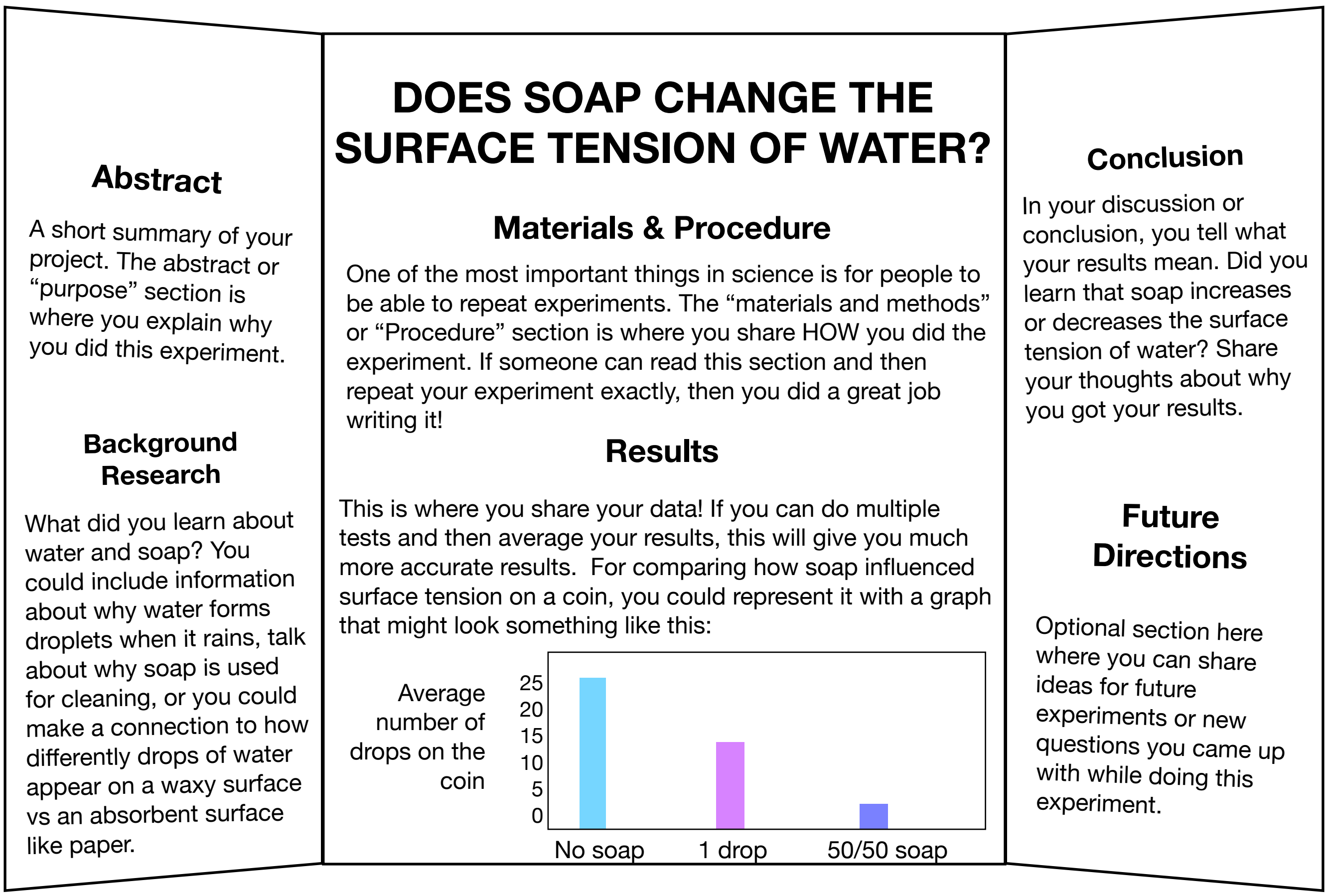
QUESTIONS:

- Does cold water make a larger dome on a coin than hot water?
- Does adding salt or sugar change the surface tension of water?
- What happens if you use oil instead of water?
- Does a dry coin work better than a wet coin?
- Does adding rubbing alcohol change the surface tension?
- What if you use differently-sized coins? Quarters vs dimes?



Does soap change the surface tension of water?

Get several identically-sized coins, such as pennies, a dropper or pipette, and three cups of water. If you don't have a dropper, you can use a wet rag and a great deal of patience to let water fall on the coin drop by drop. Start with plain water and be sure to count the number of drops that can fit on the coin before spilling off onto the table or counter. After recording the result, dry the coin (or use a new coin) and repeat it at least 3 times to get an average number of drops. Next, add one drop of soap to the second cup. Then, see how many drops of soapy water the coin can hold. Repeat this step at least 3 times to obtain an average. Finally, prepare a cup that is 50% soap and 50% water and try placing drops of this solution on the coin. Repeat at least 3 times. The **independent** variable (the thing you change) is the amount of soap in the water. The **dependent** variable (the thing you measure) is how many drops the coin can hold. If the coin holds more drops of liquid, then the liquid has a higher surface tension. Try it and see if soap changes the surface tension of water!



Do other liquids have surface tension like water?

You can investigate other liquids too! Rubbing alcohol, oil, and corn syrup all have different levels of surface tension and will behave very differently than water. Or, you can use them in the same way as the experiment above and add them to water to see what happens to the surface tension. For additional reading, look up "**surfactants**." Soap is a surfactant, but it's not the only one! Surfactants are an important ingredient in not only cleaning supplies, but any other situation where you want water to "stick" to something and get it wet.

"WALKING WATER"

CREATE A SCIENCE EXPERIMENT FROM THIS FUN DEMONSTRATION!

Supplies

- Clear cups (plastic or glass)
- Water
- Food coloring
- Paper Towels

Demonstration

Arrange the cups in a line with their rims just touching. Fill the first, third, fifth, and seventh cups with water. Put a few drops of red food coloring in the first, yellow in the third, blue in the fifth, and red in the seventh. Cut your paper towel sheets into half sheets and fold in half lengthwise twice. Place the end of one paper towel strip in the first cup, and the other end in the second empty cup. Place another paper towel strip in the second cup, and the other end in the third cup. Repeat for all of the cups. Watch the water "walk" across the cups, creating a rainbow effect in the process.

Variation 1: place the cups in a circle with water alternating with empty cups.

Variation 2: put a cup with water next to several empty cups. See how far the water can "walk."

(Explanation on next page)

Turn it into an experiment.

Great experiments begin with great questions. Read these questions first and think of ways you might answer them, then look at the next page for our experiment design suggestions. Follow one of those or make your own!

QUESTIONS:

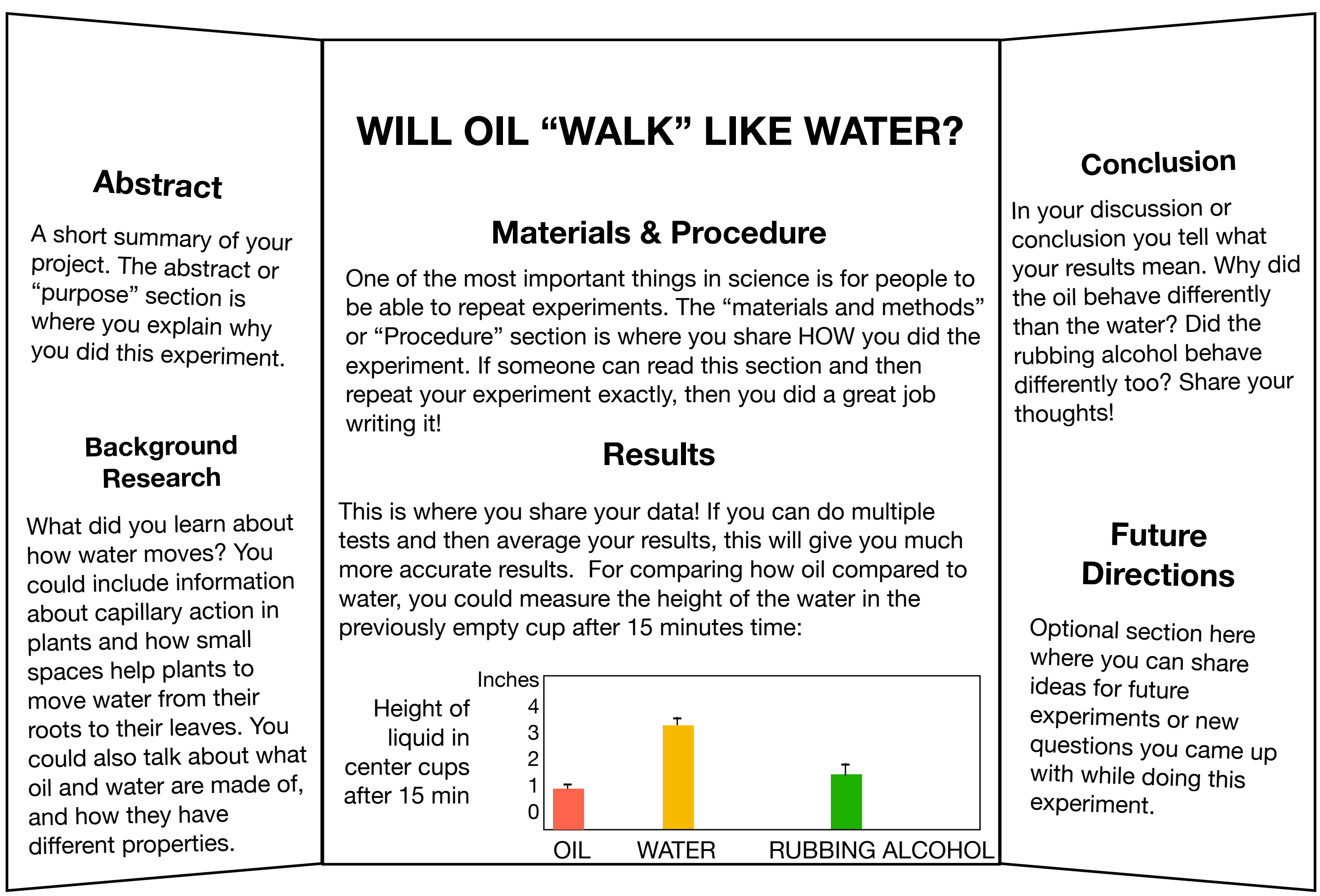
- What happens if you use different materials (like cotton cloth, string, wool yarn, or nylon)?
- What happens if you place the cups at different levels?
- What happens if you use different thicknesses of paper towels (unfolded, folded once, or folded twice)?
- What happens if you use longer strips of paper towel, or place the cups further apart from each other?
- What happens if you put water in the first cup, and leave all the other cups empty?
- Would this experiment work with oil or other liquids?

Explanation

Water moves up the paper towels because of a phenomenon called **capillary action.** Water molecules like to stick to each other (cohesion), and to other things (adhesion). When water molecules stick to surfaces better than they stick to each other (that is, when adhesion forces are stronger than cohesion) water will move upward along a surface until it's stopped by gravity. This process of moving upwards is called capillary action. It's the reason water moves up from the roots to the leaves of a plant, and why water moves up the paper towels in this experiment.

Will water move faster or slower when it goes from a higher to lower cup?

Create one "walking water" chain by lining up four cups with paper towel connectors on a flat table, and fill the first with water. Also stack some books to create four small steps. Place a cup on each of the steps, and fill the highest one with water to set up a second chain. Make a prediction about how fast the water will "walk" across the cups in each of the chains. The height of the cups is your **independent variable** (the thing you change) Then, put your folded paper towel into the cups, and time how long it takes for the water levels to stop changing in each of the cups. The time taken is the **dependent variable** (the thing you measure).



Troubleshooting:

If you can't get the water to move, try filling your cups a bit more, or trimming your paper towels so they don't stick up too far from the rim of the cups.

INK CHROMOTOGRAPHY

CREATE A SCIENCE EXPERIMENT FROM THIS FUN DEMONSTRATION!

Supplies

- Coffee filters, paper towels, or napkins
- Pens, washable markers, and permanent markers
- Water

Demonstration

Draw a circle with one of your pens about an inch from the center of a coffee filter. Fold your coffee filter into eighths. In a cup, put in about a half inch of water Then, dip the pointed end of the folded filter into the water and hold it there for a few minutes. You should see the colors start to move up the filter. Unfold and allow to dry to save your experiment.

Explanation

Water moves up the coffee filter because of a phenomenon called **capillary action.** Water molecules like to stick to each other (cohesion), and to other things (adhesion). The attraction between water and another surface will move the water upward along the surface until it's stopped by gravity. This process of moving upwards is called capillary action.

(Continued on the next page)

Turn it into an experiment.

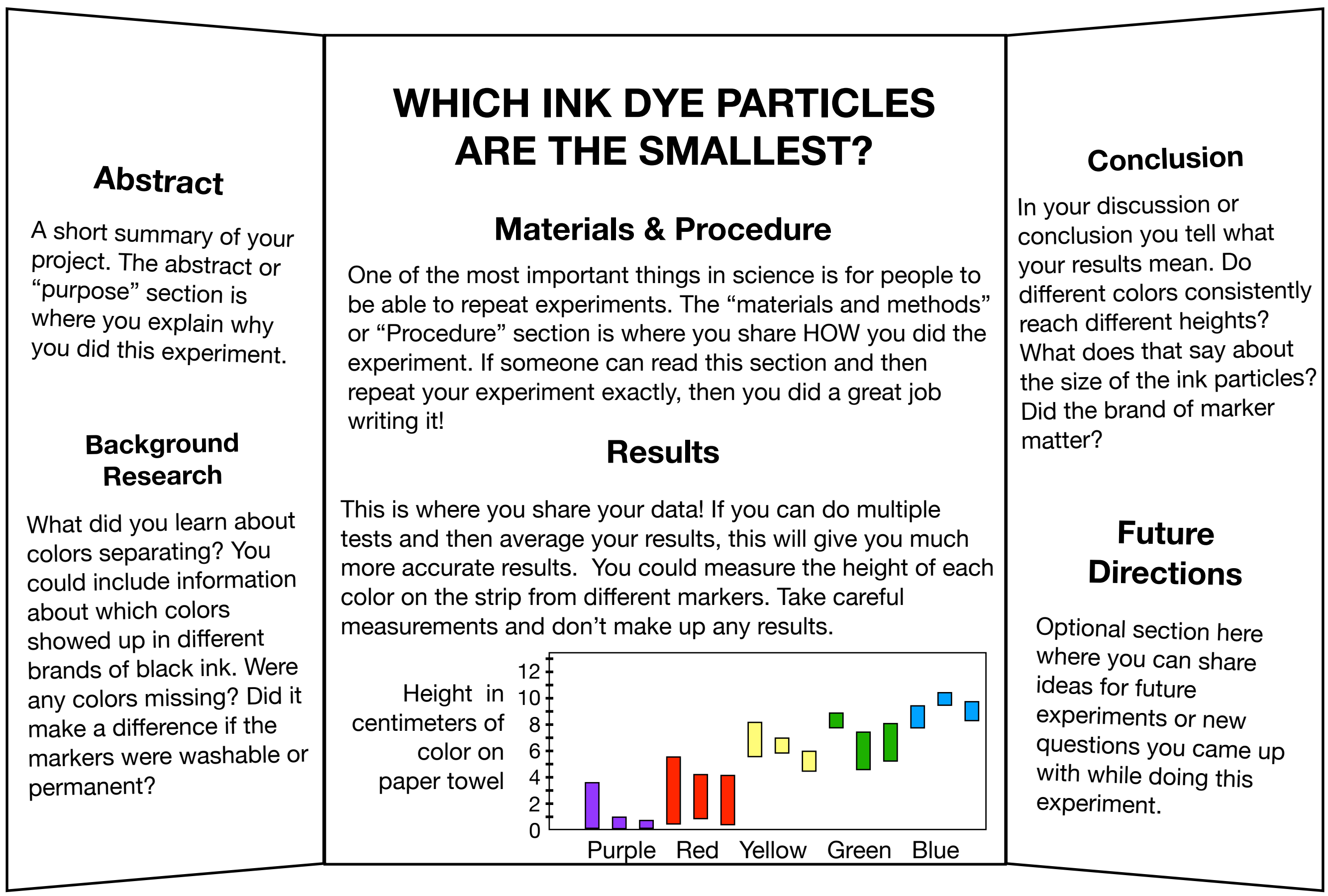
Great experiments begin with great questions. Read these questions first and think of ways you might answer them, then look at the next page for our experiment design suggestions. Follow one of those or make your own!

QUESTIONS:

- What happens if you use different types of pens -- washable markers, permanent markers, dry erase makers, even pencils?
- What happens if you use different colors of the same type of marker (washable colored markers work well for this)
- What happens if you layer a few colors on top of each other?
- Does the temperature of the water make a difference?

Explanation

Capillary action is the reason water moves up from the roots to the leaves of a plant, and why fuzzy towels and paper towels are so good at mopping up water. The smaller the spaces, the more dramatic the effect of capillary action. Coffee filters and paper towels are made of thousands of small interwoven fibers, and those small spaces are the reason water moves up the coffee filter or paper towel in this experiment! Each ink is made up of many pigments, and because some of them dissolve in water better or are less dense, they move higher up as the water rises compared to less soluble, heavier pigments.



Do washable or permanent inks rise higher?

Get two coffee filters, and draw a circle on one with a washable marker and with permanent marker on the other. Make a prediction about which ink will spread the most when you dip the filter in water. To make sure they're as similar as possible, use pens that are roughly the same thickness and color. The **independent variable** (the thing you change) is the type of pen. Dip each filter into water until he water has moved all the way up the paper. Use a ruler to measure how far the ink spreads from the center of the filter. The distance it spreads is the **dependent variable** (the thing you measure). Repeat at least 5 times for each marker and record your results.

PEPPER SCATTER

CREATE A SCIENCE EXPERIMENT FROM THIS FUN DEMONSTRATION!

Supplies

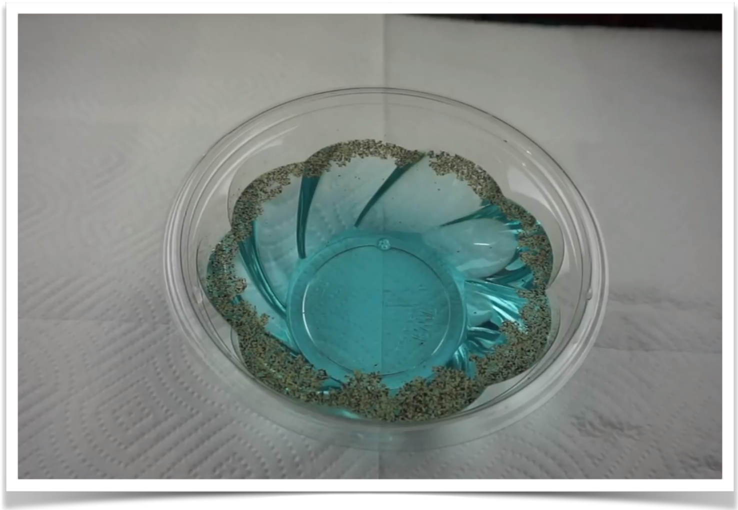
- Plate
- Pepper
- Water

Demonstration

Pour water onto a plate, and sprinkle pepper evenly over the surface. Place a drop of detergent on your finger, and touch the center of the plate. The pepper will quickly scatter to the edges of the plate.

Explanation

Surface tension is an effect where the surface of a liquid is especially strong and can hold up weight and allow things to float, like bits of pepper. It is caused by the molecules on the surface being more attracted to each other. Soaps and detergents are molecules that have both water-loving (hydrophilic) and water-fearing (hydrophobic) parts. They decrease surface tension by covering the surface of the water. The speed of the pepper moving out from the drop of soap indicates how quickly the detergent or soap molecules are forming a layer on the top of the water.

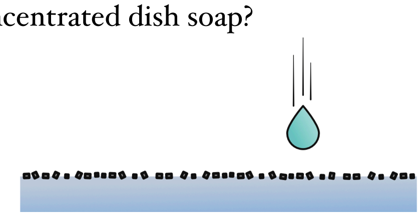


Turn it into an experiment.

Great experiments begin with great questions. Read these questions first and think of ways you might answer them, then look at the next page for our experiment design suggestions. Follow one of those or make your own!

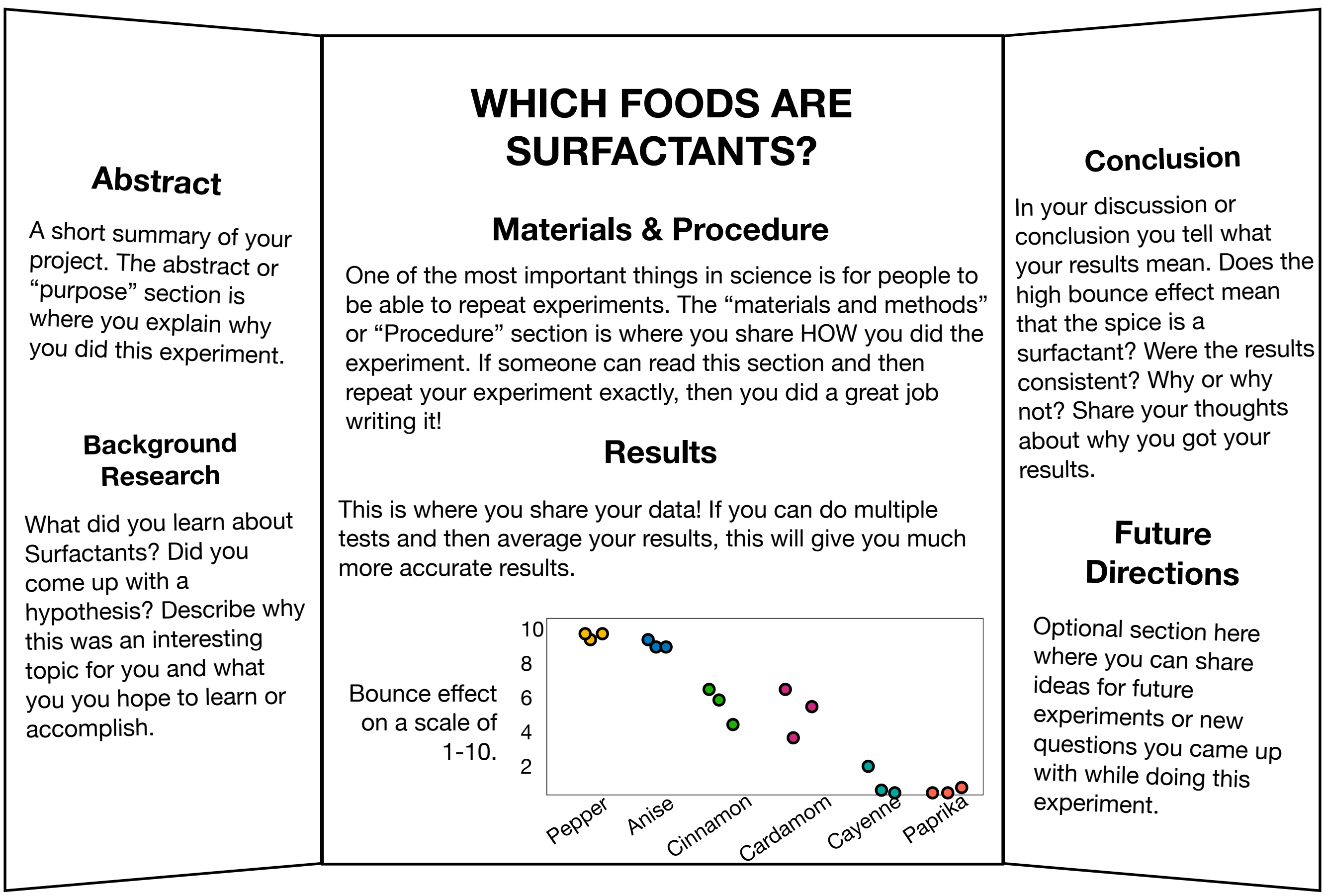
QUESTIONS:

- What happens if you use more or less pepper?
- What if you use a different spice, like cinnamon, paprika, cumin, sugar, or turmeric?
- Does the experiment still work if you replace the detergent with oil, toothpaste, or rubbing alcohol?
- What would happen if you replaced the water in the bowl with something else like oil or corn syrup?
- Do you get the same effect with hand soap as you do with concentrated dish soap?



What happens if you use something other than dish soap?

Set up at least two plates with water and pepper. Pick liquids to test, like dish soap and oil. You could also try different brands of soap, or other cleaning liquids like vinegar, rubbing alcohol, or window cleaning fluid. These are your **independent variables** (the thing you change). Make a prediction about how they'll affect the pepper in the water. Prepare your cleaning liquids and/or oils and place one drop of each in the center of the bowls covered in pepper. Measure how much the pepper moves. This is your **dependent variable** (the thing you measure). It may help to have a scale for movement, where 0 is no movement, 5 is a bit of movement, and 10 is a lot of movement.



Troubleshooting:

Be sure to wash the bowl thoroughly before trying a new spice. If there is even the smallest amount of soap in the container, the spices won't react! You will also get much better results using concentrated dish soap rather than hand soap. A mild detergent will not produce as noticeable or large of a spread as a strong or extra concentrated detergent.

GRAVITY DEFYING LID

CREATE A SCIENCE EXPERIMENT FROM THIS FUN DEMONSTRATION!

Supplies

- Cup
- Lid or a flat piece of plastic, cardboard, or metal
- Water
- Other liquids (such as cooking oil, rubbing alcohol, and syrup)

Demonstration

Fill the cup with water (at least 1/8 to 1/4 of the way full), then place a lid on top of the cup. Using two hands to keep the lid securely in place, turn both the cup and lid upside down. The lid should stay.

Explanation

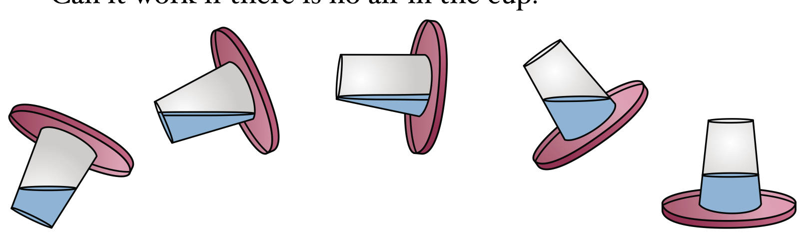
Water is very cohesive (water molecules are attracted to other water molecules) and a liquid, so it makes a seal around the bottom of the cup which prevents air from entering. If the level of water were to drop or the water molecules were to spread away from each other creating some empty space (a partial vacuum), then air would be able to get in. But a partial vacuum would create such an imbalance in forces that pressure from the surrounding atmosphere would push up on the lid, preventing it from falling.

Turn it into an experiment

Great experiments begin with great questions. Read these questions first and think of ways you might answer them, then look at the next page for our experiment design suggestions. Follow one of those or make your own!

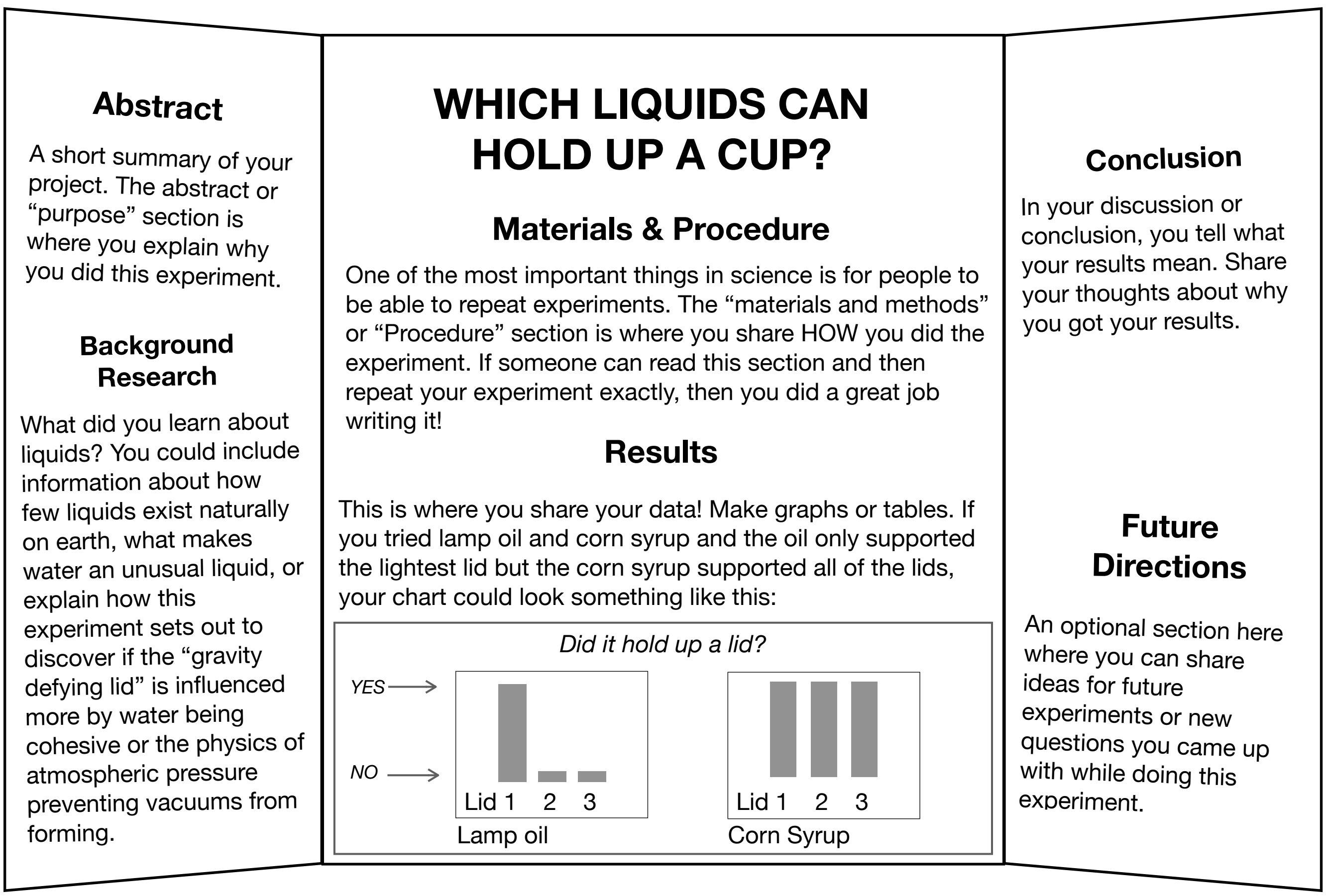
QUESTIONS:

- How heavy can the lid be? Is there a weight of lid so heavy that it can't be held up with water and a cup?
- Will this work with other liquids? Would you see the same results with oil, soda pop, rubbing alcohol, or syrup?
- Does this work better with cold water or hot water?
- Will it work better with more or less water?
- Can it work if there is no air in the cup?



How much weight can water hold?

Find two identical lids and use them to perform the gravity defying lid demonstration. Then tape coins on the bottom of one of the lids and try the demonstration again. Continue adding coins until the lid becomes so heavy that it will not "defy gravity" when the cup is turned upside down. The **independent** variable (the thing you change) is the weight of the lid. The **dependent** variable (the thing you measure) is whether the lid stays on the cup or not. For best result, test each weight multiple times and use the same cup and temperature of water while doing your experiments.



What liquids can hold up a cup?

Pick a few different liquids (water, cooking oil, lamp oil, rubbing alcohol, syrup) and try the gravity defying lid with each of them. For best results, have several lids of different weights, some of which are too heavy for water to support. Try each type of lid with each liquid. The **independent** variable (the thing you change) is the liquid in the cup. The **dependent** variable (the thing you measure) is which lids each liquid can support. If you find that every liquid can support the light lids, then this gives evidence that the physics matters more for this demonstration than water being cohesive. If water and water-based liquids perform better than oil-based liquids, then this tells you that the cohesion of water is an important part of how this demonstration works.

MAGIC SCREEN

CREATE A SCIENCE EXPERIMENT FROM THIS FUN DEMONSTRATION!

Supplies

- A cup or mason jar
- Rubber bands or the metal ring that fits the top of the mason jar
- Variety of screens, such as a window screen, netting, tule, nylon stocking, etc…

Demonstration

Secure the screen to the top of the cup or mason jar. Be sure that the screen is flat and free of wrinkles and that the screen covers the entire opening of the cup or jar. Fill the cup or jar with water. Cover the opening with a lid or with your hand and turn it upside down. Carefully remove the lid or hand.

Explanation

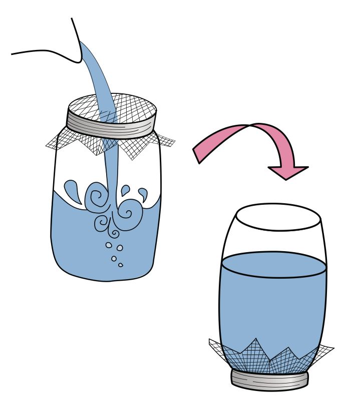
The reasons this demonstration works are very similar to the reasons the "gravity defying lid" demonstration works: pressure from the atmosphere pushes on the water, preventing the formation of a partial vacuum of empty space in the cup. Also, water is very *cohesive* (wants to stick together) and has strong *surface tension*, which means the water molecules touching the air hold together even more tightly. As long as the surface of the screen is parallel to the ground, the combination of these forces keep the water behind the screen.

Turn it into an experiment

Great experiments begin with great questions. Read these questions first and think of ways you might answer them, then look at the next page for our experiment design suggestions. Follow one of those or make your own!

QUESTIONS:

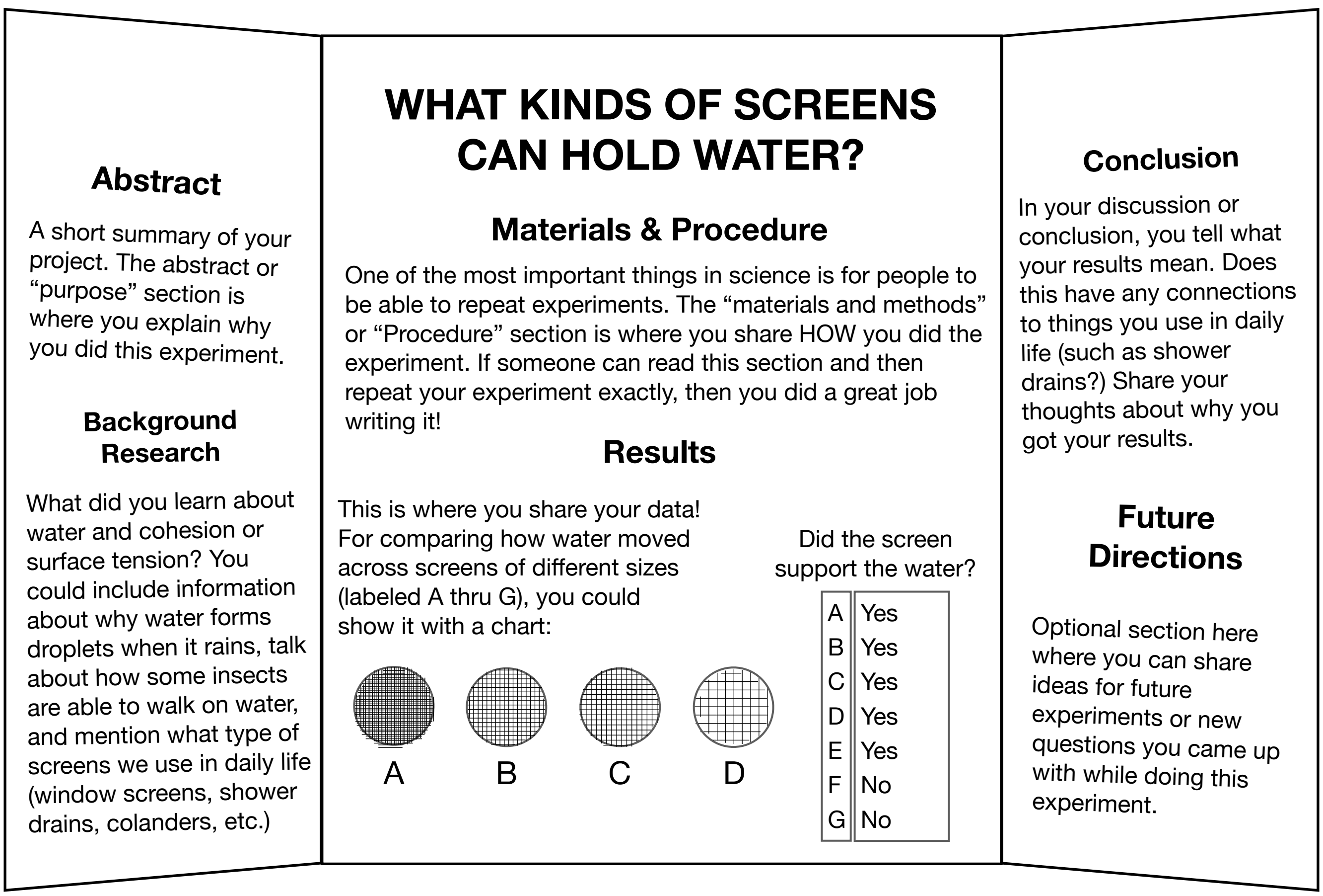
- Does one type of screen work better than another?
- Will it work with a thick fabric like a kitchen towel?
- What happens if you tap the top of the cup or jar when the water is inside?
- What happens if you swirl the cup or jar to get the water moving quickly?
- What happens if you tap the screen?
- What happens if you use a different liquid or temperature?



How big can the holes in a screen be?

Find screens with different sizes of holes, from small to very large. Set them up over a cup or jar. If you are not able to find screens with different sized holes, it would be possible to make your own by gluing or taping thread across the top of mason jars at regular distances and creating a grid.

Once you have your screens ready, perform the "magic screen" demonstration and record whether it works with each size. The **independent** variable (the thing you change) is the size of the holes in the screen or netting. The **dependent** variable (the thing you measure) is whether the water stays behind the screen when the container is turned upside down.



Does this work better with cold or hot water?

Set up the screen with ice cold water and try it several times. Pay attention to what angle you can move the cup or jar to before the water rushes out. Then increase the water temperature to very warm or hot water and try it again. The **independent** variable (the thing you change) is the temperature of the water. The **dependent** variable (the thing you measure) is how well the water stays behind the screen. The easiest way to measure this would be to measure what angle you can tip the jar or screen to before the water drops. The higher the angle (the further you can tip it before the water drops) the better the "magic screen" is working.

STRING WATER BRIDGE

CREATE A SCIENCE EXPERIMENT FROM THIS FUN DEMONSTRATION!

Supplies

- Large bowl
- Duct tape
- Pitcher of water
- Variety of string and other materials such as yarn, wire, twine, thread, dental floss, ribbon, etc…

Demonstration

Tape a piece of string to the spout of the pitcher. Hold the loose end of the string over the bowl, and then pull the pitcher away from the bowl until the string is taut. Slowly pour the water out. The water should follow the string into the bowl.

Explanation

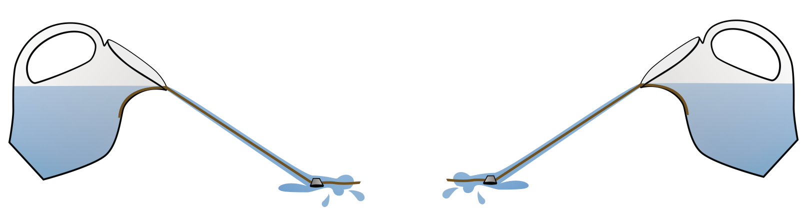
This demonstration works because water is very *cohesive,* which means water molecules are attracted to other water molecules. Water likes to stick together. So when the string is wet, the water will follow the string instead of falling straight down. If the string is dry, the water will not follow the string; it will fall straight down instead.

Turn it into an experiment

Great experiments begin with great questions. Read these questions first and think of ways you might answer them, then look at the next page for our experiment design suggestions. Follow one of those or make your own!

QUESTIONS:

- Does one type of string transfer water better than another?
- How long of a string will the water travel along?
- Do different liquids move differently on the string?
- How fast can you pour without spilling the water?
- Can you use a different container to pour the water?
- What happens if you change the shape of the string?



What material creates the best water bridge?

Find several different materials (for example: cotton twine, jute twine, bailing twine made of polypropylene or sisal fibers, yarn, ribbon, waxed dental floss, thread, bare wire, insulated wire, shoelace, and thread) and cut equal lengths of each material. Then tape one end inside a pitcher and the other end to a table or the inside of a bowl. Lift the pitcher to the same angle each time and slowly pour. Record how well the water travels along the bridge. The **independent** variable (the thing you change) is the material the "string" is made from. The **dependent** variable (the thing you measure) could be how easily water travels along the string (rate on scale from 1 to 5), or how much time passes before you transfer one cup of water from the pitcher to the bowl. (If using the latter method, choose a time that equals a null result (i.e. after trying for 5 minutes to transfer water and being unable to, you would mark that material as "5 min/null"). The shorter the time to transfer one cup of water, the better the material is for making a water bridge.

Abstract

A short summary of your project. The abstract or "purpose" section is where you explain why you did this experiment.

Background Research

What did you learn about water and cohesion? You could include information about why water forms droplets when it rains, talk about how water moves in plants, or you could make a connection to how people move water for agriculture with sprinkler systems or aqueducts.

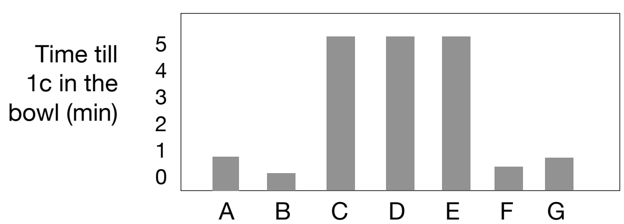
WHICH MATERIAL MAKES THE BEST WATER BRIDGE?

Materials & Procedure

One of the most important things in science is for people to be able to repeat experiments. The "materials and methods" or "Procedure" section is where you share HOW you did the experiment. If someone can read this section and then repeat your experiment exactly, then you did a great job writing it!

Results

This is where you share your data! If you can do multiple tests and then average your results, this will give you much more accurate results. For comparing how water moved across different materials (labeled A thru G), you could represent it with a graph that might look something like this:



Conclusion

In your discussion or conclusion, you tell what your results mean. Did you learn that cotton absorbs water better than wool? That waxy or metal materials work differently? Share your thoughts about why you got your results.

Future Directions

Optional section here where you can share ideas for future experiments or new questions you came up with while doing this

Do other liquids move like water?

Set up your pitcher and string with water first and measure how easily the water moves. Then try setting up a pitcher with oil, corn syrup, rubbing alcohol, chocolate syrup, soap, or lamp oil. Be sure to use a new string with each new liquid. The **independent** variable (the thing you change) is the liquid. The **dependent** variable (the thing you measure) is how well the liquid moves down the string. Be sure to keep the angle and length of the string the same. Either use a rating to measure how well it works (1-5 with 1 being "easily" and 5 being "difficult or no transferring of liquid"), or measure the time till a certain amount of liquid is transferred.

THERMOCLINE CUPS

CREATE A SCIENCE EXPERIMENT FROM THIS FUN DEMONSTRATION!

Supplies

- 4 clear cups
- A flat plastic lid (the edges trimmed off) or pieces of thin cardboard
- Food coloring
- Water

Demonstration

Cold water is dyed blue in one pair of cups, and hot water is dyed yellow in another pair of cups. Place the lid or cardboard on top of the cold water cup and turn it upside down, carefully placing it on the hot water cup with the lid between. Repeat in the reverse orientation (hot over cold) with the other cups. Then slowly remove the plastic lids.

Explanation

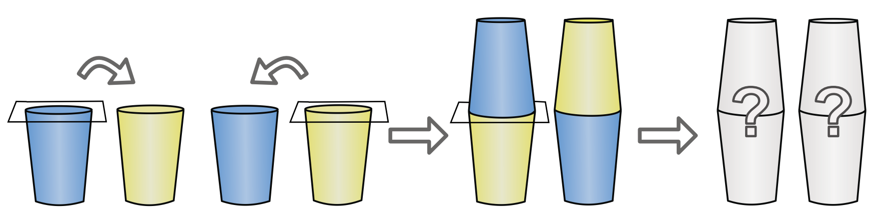
Cold water is more dense than hot water, so cold water sinks while hot water rises. When hot water is layered on top of cold water it will stay that way as long as there is a difference in temperature. This layering is called a thermocline.

Turn it into an experiment.

Great experiments begin with great questions. Read these questions first and think of ways you might answer them, then look at the next page for our experiment design suggestions. Follow one of those or make your own!

QUESTIONS:

- Does the temperature difference between the cups matter? Will you get different results with room temperature vs cold water?
- How do the results change if you dissolve salt or sugar in the water?
- What happens if you have one cup with oil and the other cup with water but they are the same temperature?



Does the difference in temperature matter?

Get multiple cups of water of various temperatures (e.g. 40 °F, 70 °F, 100 °F, and 130°F). Run the experiment with six different combinations: 40 °F, vs 70 °F, 40 °F, vs 100 °F, 40 °F, vs 130 °F, 70 °F, vs 110 °F, 70 °F, vs 130 °F, and 110 °F, vs 130 °F. Record how long it takes for the water to mix evenly. The **independent** variable (the thing you change) is the difference in the temperatures. The **dependent** variable (the thing you measure) would be the time it takes for the water to mix together to a uniform color. Do you expect that a bigger temperature differential will result in a longer time for the colors to mix? Note also, that this setup has three different independent variables of a 30 °F temperature difference. Did it make a difference if the liquids were relatively cool (40 °F, vs 70 °F) as opposed to relatively warm (110 °F, vs 130 °F)?

DOES THE TEMPERATURE CHANGE HOW WATER MIXES?

Abstract

A short summary of your project. The abstract or "purpose" section is where you explain why you did this experiment.

Background Research

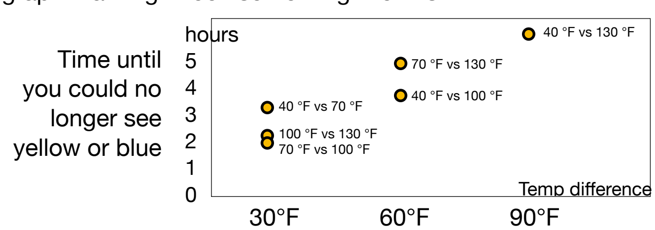
What did you learn about water mixing and temperature? You could include information about water in the ocean and why so much ocean life lives near the surface. What would happen to the ocean if cold water were to rise to the surface? Explain what density is and how it is measured.

Materials & Procedure

One of the most important things in science is for people to be able to repeat experiments. The "materials and methods" or "Procedure" section is where you share HOW you did the experiment. If someone can read this section and then repeat your experiment exactly, then you did a great job writing it!

Results

This is where you share your data! If you can do multiple tests and then average your results, this will give you much more accurate results. For comparing the mixing time for different water temperatures you could represent it with a graph that might look something like this:



Conclusion

In your discussion or conclusion you tell what your results mean. Did the difference in temperature make a difference? Did these results explain anything you've experienced? Share your thoughts about why you got your results.

Future Directions

Optional section here where you can share ideas for future experiments or new questions you came up with while doing this experiment.

How do the results differ if the water has sugar or salt dissolved in it?

Salt water and sugar water have different densities than pure water. Dissolve sugar and salt into water by boiling the water and mixing in the sugar and salt (say 1/4 cup sugar or salt per 1 cup water.. Color the sugar water, the salt water, and the pure water different colors. Carry out the procedure of the hot and cold water cups with these new cups. The **independent** variable (the thing you change) is the liquids involved. The **dependent** variable (the thing you measure) is how long it takes for the colors to mix. Is it possible that the colors will stay separate even when the temperatures are the same? Does sugar water have the same density as salt water?

ROLLING A CAN

CREATE A SCIENCE EXPERIMENT FROM THIS FUN DEMONSTRATION!

Supplies

- Balloon (or a length of PVC pipe)
- Empty soda pop can
- Empty steel can
- Water
- Fuzzy cloth
- Flat surface

Demonstration

Charge the balloon or PVC pipe with static by rubbing it on a fuzzy cloth or a person's head. Hold the charged pipe or balloon next to the can. The can will roll towards the pipe or balloon.

Explanation

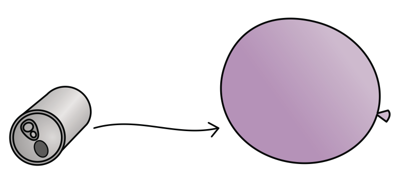
The friction between the balloon or pipe builds up an electrical charge (an excess of electrons) and materials that conduct electricity will be attracted to this charge. We only observe movement when we have objects that conduct electricity AND are light and easily moved, such as empty soda or soup cans which are on their sides, or bubbles resting on a wet surface.

Turn it into an experiment.

Great experiments begin with great questions. Read these questions first and think of ways you might answer them, then look at the second page for our experiment design suggestions. Follow one of those or make your own!

QUESTIONS:

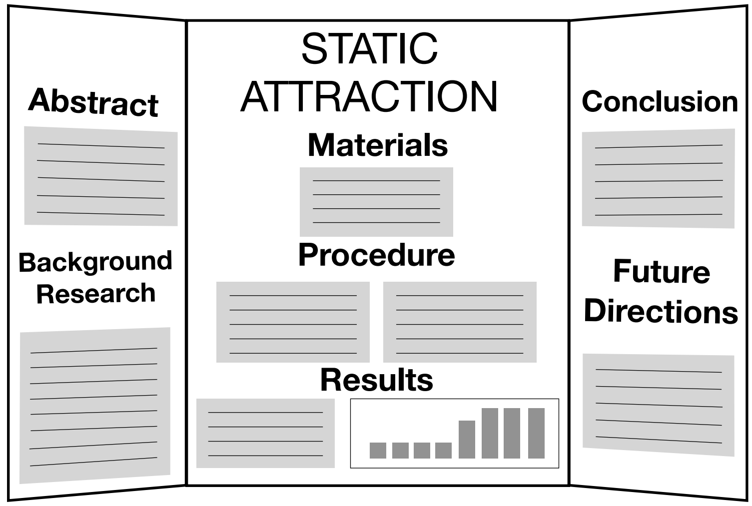
- Does the can need to be metal or would any light cylinder work? Can other things (like bubbles) be moved by a pipe?
- How heavy can the aluminum can be? If we add water to the inside of a soda can, will it still work?
- Will the can roll uphill? If yes, at what slope does gravity become "too strong" for the static attraction to overcome?
- Does the size of the balloon matter? Will it work just as well with a small balloon vs. a large balloon?



JUST KEEP ROLLING ALONG . . .

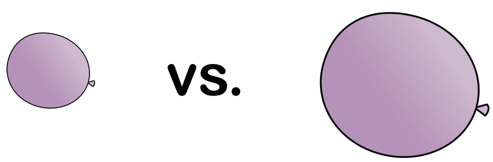
How much weight can static pull?

Charge a balloon or pipe by rubbing it for 30 seconds. Then add different amounts of water to the soda can and see if the can will roll. The **independent** variable (the thing you change) is the weight of the can. The **dependent** variable (the thing you measure) is whether the pipe can roll the can. Everything else you do (such as rubbing the balloon or pipe) you want to keep as similar as possible between each test. Start with an empty can (your **control**) and then add a tablespoon of water and see if the can will roll. Continue adding water and testing until the can is too heavy to roll. Record how much water was in the can and whether it rolled (this is your **data**). For best accuracy, do multiple tests for each weight and average your results.



Extension question: if the "too heavy to roll" weight is more than an empty can, then why can't you move a can across the table or floor when it's upright? Why is "rolling" a can easier than "sliding" it? (hint: friction)

Related experiment: instead of changing the weight of the can, change the slope of the surface. Start with a flat surface, then increase the slope gradually.



Which gathers better static, a small balloon or a large one?

Blow up two balloons, one of them being very small and only partially blown up and the other being large. The **independent** variable (the thing you change) is the size of the balloon (how tight and stretched the rubber is). The **dependent** variable (the thing you measure) is how well the can rolls. Rub both balloons on the same material for the same amount of time, and then slowly move them toward the aluminum can. Measure how far away they are when the can begins rolling toward the balloon. The further away the balloon is when the can moves, the more static it had. For best results, try rubbing the balloons on several different materials and do the test multiple times!

What kind of materials will follow a static charge?

Find cylindrical objects that are of similar weight to an aluminum can (toilet paper tube, plastic water bottle) and see if they roll after the charged balloon or pipe. Then try placing the pipe next to a very small stream of water (hint: fill up a paper or plastic cup with water and poke a hole in the bottom with a toothpick. The water should fall out in a very smooth and thin stream). Do you observe the water moving? Then try spreading bubble solution over a flat surface in a thin film and blow bubbles so that they land on the wet surface. Do the bubbles respond to the charged balloon or pipe? When you consider the various materials (metal, paper, plastic, water) and how they reacted to static, how does this relate to electrical conductivity? In other words, do things that conduct electricity follow a static charge?

BALLOON ON A WALL

CREATE A SCIENCE EXPERIMENT FROM THIS FUN DEMONSTRATION!

Supplies

- Balloon
- Fuzzy cloth
- Carpet
- Variety of vertical surfaces (white board, glass, wooden bookshelf, cinderblock or drywall walls, fridge)

Demonstration

Charge the balloon by rubbing it for several seconds on a fuzzy cloth or someone's head. Then hold the balloon on a surface and slowly let go. Does it stick? If yes, you can measure how long it stays on the wall.

Explanation

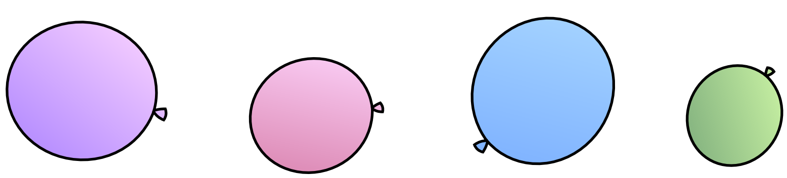
The friction between the balloon and other object causes a build up of electrical charge (an excess of electrons) on the balloon. Electrons are negatively charged so once the balloon is charged, it will be attracted to neutral or positively charged objects. The balloon should stick well to people, most whiteboards, and most dry-wall style walls. If it is very humid, it will be more difficult to build up charge on the balloon.

Turn it into an experiment.

Great experiments begin with great questions. Read these questions first and think of ways you might answer them, then look at the next page for our experiment design suggestions. Follow one of those or make your own!

QUESTIONS:

- If you rub the balloon on an object for a longer time, does it stick on the wall longer?
- What kind of materials will the balloon stick to? Will it stick to glass, wood, metal, and bricks?
- If you blow on a balloon can you get it to change its position but still stay on the wall?
- Does the size of the balloon matter? Will it work just as well with a small balloon vs. a large balloon?



What material creates the best static charge?

Find several different materials (for example carpet, cotton cloth such as a towel, polyester cloth such as a fuzzy blanket, a person's hair, leather, glass) and charge the balloon by rubbing it on each material. Then hold the balloon on a wall and slowly let go. The **independent** variable (the thing you change) is the material the balloon is rubbed against. The **dependent** variable (the thing you measure) is how long the balloon stays on the wall. Time the balloon and see how long it takes to drop. Do multiple tests for each material and average your results.

Abstract

A short summary of your project. The abstract or "purpose" section is where you explain why you did this experiment.

Background Research

What did you learn about electricity and static? You could include information about what balloons are made of and which materials are conductors of electricity (metal, water) and which things do not conduct electricity (insulators - which include plastic, rubber, and dry wood)

WHICH MATERIAL MAKES THE BEST STATIC?

Materials & Procedure

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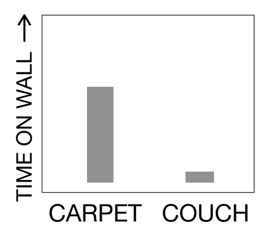
Results

This is where you share your data! If you can do multiple tests and then average your results, this will give you much more accurate results. For comparing static from rubbing a balloon on carpet and a leather couch, you could represent it with a graph like this:

	CARPET	COUCH
Time on wall:	15 min	2 min
	11 min	3 min
	22 min	1 min
Average:	**18 min**	**2 min**



Conclusion

In your discussion or conclusion you tell what your results mean. Did you learn that polyester gives better static than cotton? That dry materials work better than damp ones? Share your thoughts about why you got your results.

Future Directions

Optional section here where you can share ideas for future experiments or new questions you came up with while doing this experiment.

Which gathers better static, a small balloon or a large one?

Blow up two balloons, one of them being very small and only partially blown up and the other being large. The **independent** variable (the thing you change) is the size of the balloon (how tight and stretched the rubber is). The **dependent** variable (the thing you measure) is how long the balloon sticks on the wall. Rub both balloons on the same material for the same amount of time, and then place them both on the wall. Start a timer and record how long each balloon stays on the wall. For best results, try rubbing the balloons on several different materials and do each test multiple times!

Tip: for advanced students look up "triboelectric" and "flexoelectric effect" and consider how these might influence rubber that is stretched tight versus rubber that is under less tension.

PEPPER VACUUM

CREATE A SCIENCE EXPERIMENT FROM THIS FUN DEMONSTRATION!

Supplies

- Balloon
- Fuzzy cloth
- Salt and Pepper
- Tissue Paper and tape

Demonstration

Charge the balloon by rubbing it for several seconds on a fuzzy cloth or someone's head. Then hold the balloon over a plate that has both pepper and salt. The pepper will fly up first because it is lighter than the salt. For another fun variation, cut a small piece of tissue paper out and tape one end to a plate, then use the balloon to make the tissue paper rise.

Explanation

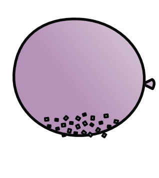
The friction between the balloon and other object causes a build up of electrical charge (an excess of electrons) on the balloon. Electrons are negatively charged so once the balloon is charged, neutral or positively charged objects will be attracted to the balloon. If they are light enough, they will rise up and stick to the balloon.

Turn it into an experiment.

Great experiments begin with great questions. Read these questions first and think of ways you might answer them, then look at the next page for our experiment design suggestions. Follow one of those or make your own!

QUESTIONS:

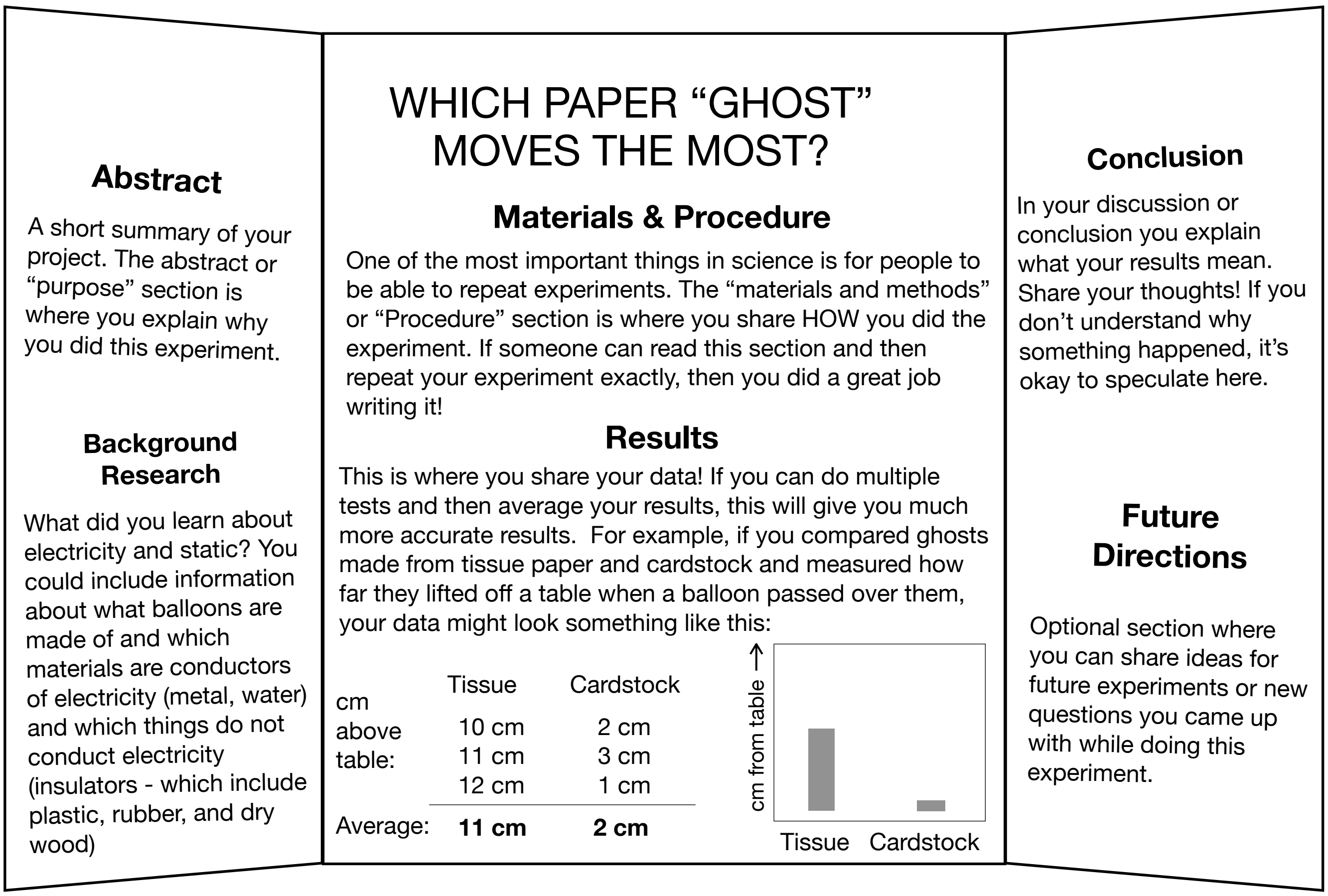
- If you try other spices will they work as well as the pepper?
- Will different thicknesses and weights of paper change how the tissue "ghost" rises? Will a regular paper ghost also reach for the balloon?
- Does the size of the balloon matter? Will it work just as well with a small balloon vs. a large balloon?
- What other materials will the balloon vacuum up? Paper confetti? Dandelion seeds? Sand?



What type of paper responds best to static?

Find several different types of paper (for example tissue paper, printer paper, cardstock, glossy photo paper, crepe paper, parchment paper, waxed paper) and cut identically-shaped ghosts (or rectangles, or any other shape you want) out of each type of paper. Use a small piece of tape to secure one end to a table. Then charge a balloon and slowly move it over the papers. The **independent** variable (the thing you change) is the type of paper. The **dependent** variable (the thing you measure) is how high the paper lifts off the table when the balloon is held over it. For best results, do multiple tests for each material and average your results.

Alternative approach: test a variety of thin objects besides or in addition to paper. Consider things like aluminum foil, dried seaweed, a tortilla, phyllo dough, part of a plastic bag, and various types of cloth (silk, cotton, polyester).



Which gathers better static, a small balloon or a large one?

Blow up two balloons, one of them being very small and only partially blown up and the other being large. The **independent** variable (the thing you change) is the size of the balloon (how tight and stretched the rubber is). The **dependent** variable (the thing you measure) is how high the *same paper ghost* lifts up under each balloon OR measure how much pepper each balloon lifts up when held the same distance from a plate of pepper. For best results, try rubbing the balloons on several different materials and do each test multiple times!

Tip: for advanced students, look up "triboelectric" and "flexoelectric effect" and consider how these might influence rubber that is stretched tight versus rubber that is under less tension.

LEVITATING ORB

CREATE A SCIENCE EXPERIMENT FROM THIS FUN DEMONSTRATION!

Supplies

- Balloon
- A length of PVC pipe
- Fuzzy cloth
- Tinsel (britestar brand) or a thin ring of plastic cut from a produce bag
- A very thin plastic sack

Demonstration

Tie six strands of tinsel together and then make another knot tying all the strands together about 5 inches away from the first knot. Trim the excess tinsel from your "orb." Charge the balloon or PVC pipe by rubbing it for several seconds on a fuzzy cloth or someone's head. Then hold the tinsel above the charged pipe and let it fall so that it lands on the pipe. If there is enough static charge, the tinsel will become charged as well and float above the pipe (or balloon).

Explanation

The friction on the balloon or PVC pipe causes a build up of static electricity (an excess of electrons). If there is enough charge, when the tinsel touches the pipe it will also become charged with static. Since both the tinsel and the balloon/pipe are negatively charged, they repel each other. This is what keeps the

Turn it into an experiment.

Great experiments begin with great questions. Read these questions first and think of ways you might answer them, then look at the next page for our experiment design suggestions. Follow one of those or make your own!

QUESTIONS:

- If you tried this with one strand of tinsel instead of six, would it work? What about 2, 3, 4, or 5 strands tied together?
- Tinsel is made out of PVC plastic. Would small strips of plastic from a grocery or produce bag also work?
- Dryer sheets and fabric softener reduce static. If you had two people try the levitating orb demonstration and one of them was wearing clothes laundered with dryer sheets and/or fabric softener, would they have a more difficult time getting the orb to float?

What type of shapes float the best?

Use tinsel to make several different sizes of circles, starfishes (five strands tied together at one end) and orbs (six strands tied together at both ends). Charge a balloon or pipe by rubbing it on a fuzzy surface and then record how well the various objects float. The **independent** variable (the thing you change) is the shape and size of the tinsel. The **dependent** variable (the thing you measure) is how well the tinsel floats. Since this activity can be tricky and the amount of static gathered can be quite variable, consider giving each tinsel attempt a rating of 0 (complete fail, no bounce at all), 1 (tinsel bounced up but floated for less than 2 seconds), or 2 (tinsel bounced up and floated for more than 2 seconds). Do at least 10 attempts for each shape and record how they behave.

Consider aerodynamics, stability, and balance when comparing different shapes. Be creative and see what kind of variety you can create when making your test shapes! Then look at what the "good floaters" have in common.

Abstract

A short summary of your project. The abstract or "purpose" section is where you explain why you did this experiment.

Background Research

What did you learn about electricity and static? You could include information about what tinsel is made from and talk about which materials are conductors of electricity (metal, water) and which things do not conduct electricity (insulators - which include plastic, rubber, and dry wood).

WHICH TINSEL SHAPE IS THE BEST AT HOVERING?

Materials & Procedure

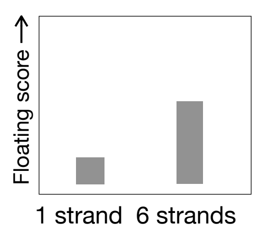
One of the most important things in science is for people to be able to repeat experiments. The "materials and methods" or "Procedure" section is where you share HOW you did the experiment. If someone can read this section and then repeat your experiment exactly, then you did a great job writing it!

Results

This is where you share your data. If you can do multiple tests and then average your results, this will give you much more accurate results. For example, if you compared a single strand of tinsel with a 6-stranded orb and measured how well they floated, your data might look something like this:

0 = no float
1 = poor float
2 = good float

	1 strand	6 strands
	0	2
	1	1
	0	2
	0	1
	1	1
Average:	**0.4**	**1.4**



Conclusion

In your discussion or conclusion you explain what your results mean. Share your thoughts! If you don't understand why something happened, you can speculate or share a guess.

Future Directions

Optional section where you can share ideas for future experiments or new questions you came up with while doing this experiment.

A quick troubleshooting tip:

The brand of tinsel makes a big difference in whether or not this demonstration works. It needs to be a flimsy, thin tinsel that is very light (Britestar brand works well). Newer, heavier tinsel will not float, no matter how much static you have. A piece of a produce bag will also levitate over a balloon or pipe if it is rubbed to give it static charge. Also, humidity has a strong effect on static. This demo will not work if it is raining outside or if the weather is hot and muggy. It might take many attempts to get the demo to work.

REPELLING BALLOONS

CREATE A SCIENCE EXPERIMENT FROM THIS FUN DEMONSTRATION!

Supplies

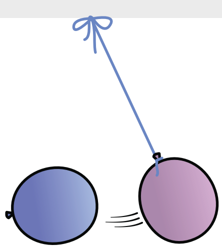
- Two balloons
- A length of PVC pipe or a stick
- Fuzzy cloth
- Ribbon or string

Demonstration

Use a piece of string or ribbon to suspend a balloon from a stick, ruler, or PVC pipe. Rub the balloon with a fuzzy cloth to charge it and then let it hang straight down. Next charge a second balloon and bring it close to the balloon hanging from the string. Observe.

Explanation

The friction on the balloon causes a build up of static electricity (an excess of electrons). When both balloons become negatively charged, they repel each other. The balloon tied to the string is light enough that it will move to "get away" from the other balloon.



Turn it into an experiment.

Great experiments begin with great questions. Read these questions first and think of ways you might answer them, then look at the next page for our experiment design suggestions. Follow one of those or make your own!

QUESTIONS:

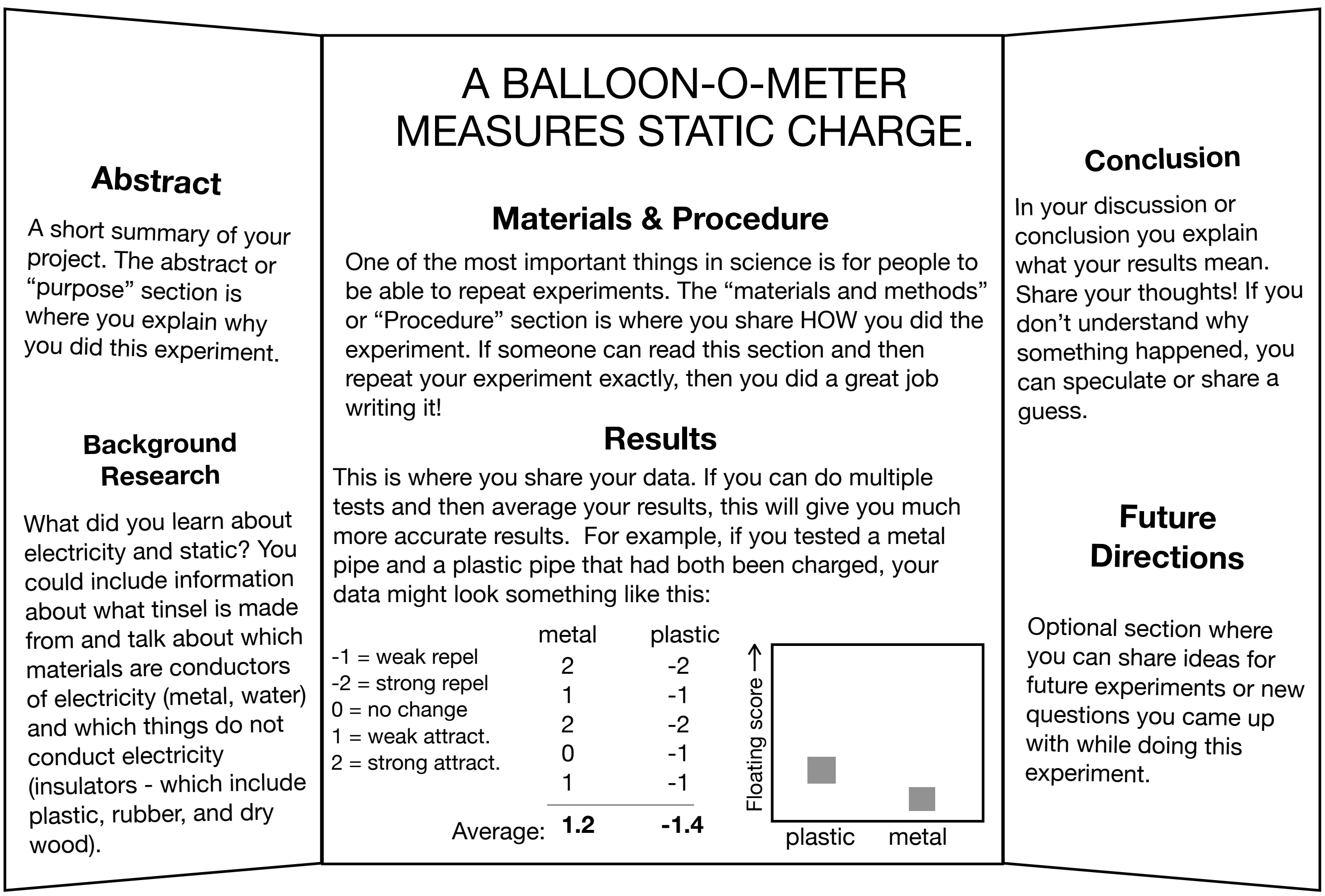
- If you put a barrier in-between the balloons, would they still repel each other?
- Can you make a balloon move by bringing other objects close to it?
- Will an uncharged balloon hanging from a string still move if you place a charged balloon next to it?

DID YOU KNOW?

The first rubber balloon was invented in 1824 by Michael Faraday, an English scientist who made significant discoveries in our understanding of electricity, magnetism, and chemistry.

What objects move the balloon the most?

Tie a balloon to a string or ribbon and hang it so that the string is straight and the balloon has at least three feet of free space on all sides. Charge the balloon by rubbing it on a fuzzy surface and then experiment by bringing various objects near the balloon and observing whether the balloon is attracted or repelled by those objects. The **independent** variable (the thing you change) is the object placed by the balloon. The **dependent** variable (the thing you measure) is how the balloon moves. Consider measuring the movement of the balloon using the following categories: strongly repelled, weakly repelled, strongly attracted, weakly attracted, and neutral or no movement. For objects, consider testing both a metal and a plastic pipe. Test each pipe in both a neutral state (no friction) and a "static electricity" state (rub them vigorously on a fuzzy cloth before placing them by the balloon). If you wanted to expand your experiment you could test other materials as well (balloons, objects made of wood, empty water bottle vs a full water bottle, etc.



A quick troubleshooting tip:

The brand of tinsel makes a big difference in whether or not this demonstration works. It needs to be a flimsy thin tinsel that is very light (Britestar brand works well). Newer heavier tinsel will not float, no matter how much static you have. Also, humidity has a strong effect on static. This demo will not work if it is raining outside or if the weather is hot and muggy.

CHLADNI PLATE

CREATE A SCIENCE EXPERIMENT FROM THIS FUN DEMONSTRATION!

Supplies

- A big cylinder (an oatmeal canister works great)
- A smaller cylinder (paper towel tube)
- A balloon
- Duct tape
- Knife or scissors
- Salt

Demonstration

Cut a hole in the side of your large cylinder to fit your smaller tube (it's OK if it isn't perfect!). Stick the smaller tube in the hole. Cut the neck off the balloon and then stretch your balloon over the top of the large cylinder, and tape it in place. Sprinkle salt over the top of the balloon. Speak or sing into the smaller tube, and watch patterns form on the balloon!

Explanation

The stretched out balloon vibrates differently when different sound waves hit it. Test it out! See if singing or speaking in a low voice makes patterns that are different from ones when you sing in a high squeaky voice.

Turn it into an experiment.

Great experiments begin with great questions. Read these questions first and think of ways you might answer them, then look at the next page for our experiment design suggestions. Follow one of those or make your own!

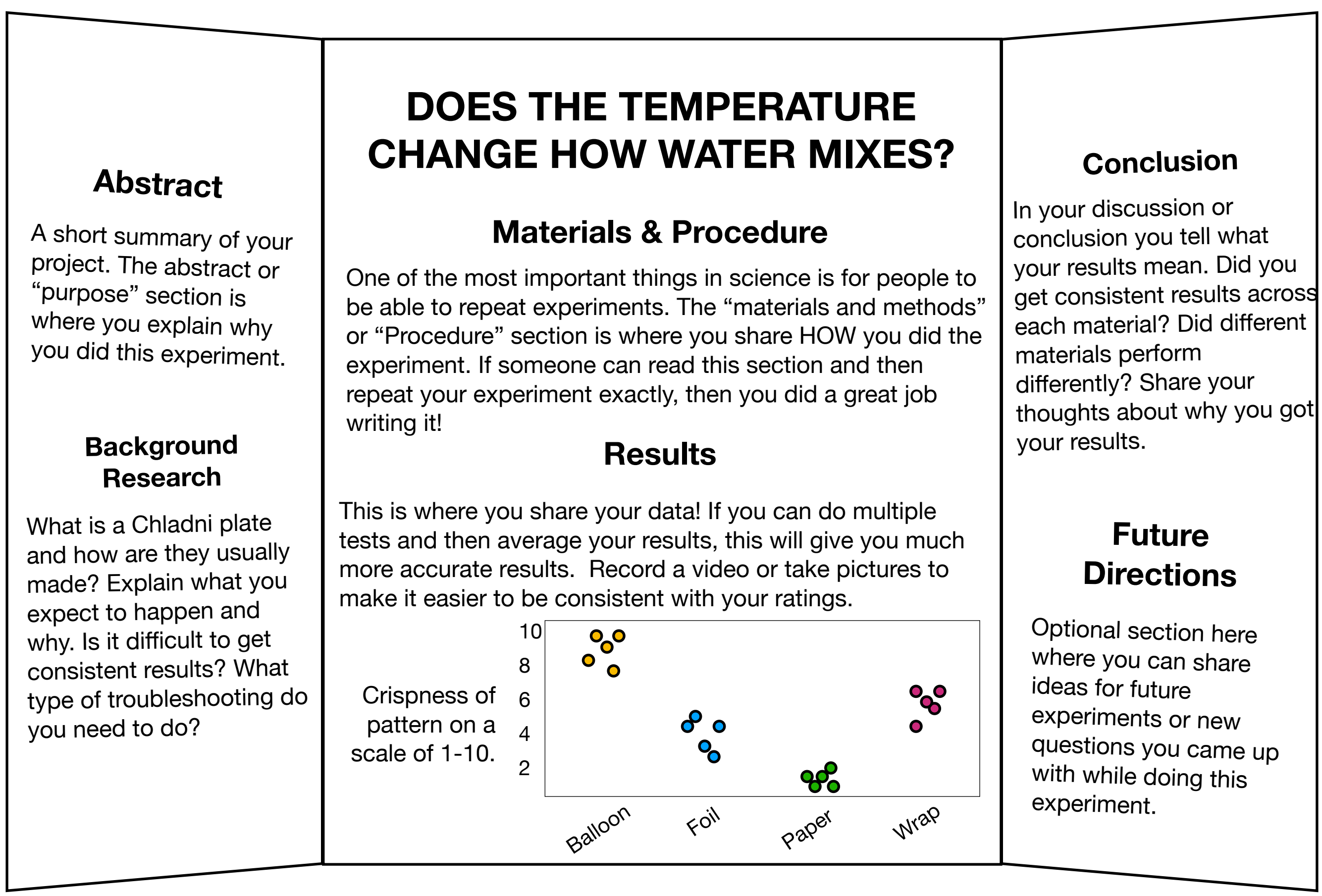
QUESTIONS:

- What happens if you talk into the tube with a deep voice vs. a high-pitched voice?
- What happens if you use coarse-grained salt or sand instead of fine salt?
- What happens if you use a square container (such as a milk carton with the top cut off) instead of a cylindrical one?
- Will it work with a rigid surface (such as a piece of cardboard) instead of a stretched balloon?

What type of surface vibrates the most?

Cut out different materials to form the surface of your plate. In addition to a balloon, you can try paper, cardboard, foil, plastic wrap, or even the lid of your oatmeal container. Attach or place each surface on top of the large cylinder and sprinkle salt. Make a sound into the smaller cylinder and record how clear the pattern is. Consider using a rating of 0 (completely random salt grains), 5 (a bit of a pattern is visible), or 10 (pattern is very clear). Make sure to use the same sound, at the same pitch of the same length, every time. The **independent variable** (the thing you change) is the material of the surface. The **dependent variable** (the thing you measure) is how well it transmits the sound and creates a pattern. Repeat at least 5 times for each surface and record your results. Think about how thick, rigid, or flat each surface is.

Then look at what the best surfaces have in common and why they might do a better job creating salt patterns from sound.



Trouble-shooting tip

Before cutting your balloon, inflate the balloon and let the air out a couple of times to stretch it out. The larger the balloon, the easier it will be to get it over the container. If available, use jumbo sized (18 inch) balloons.

RAINBOW MILK

CREATE A SCIENCE EXPERIMENT FROM THIS FUN DEMONSTRATION!

Supplies

- A plate
- A cup of warm milk (almond milk works well too!)
- Food coloring - a few different colors
- Dish detergent
- Rags or towels to clean up!

Demonstration

Put your plate on a stable surface and carefully pour milk onto your plate. Put in a few drops of each color on the milk. With a drop of dish detergent on the tip of your finger, touch the detergent to the milk and watch the magic rainbow swirl around!

Explanation

Detergents are surfactants. These are things that break up the surface tension of liquids like water or milk. All surfactants are made up of molecules with two parts: a hydrophilic part that attracts water, and a hydrophobic part that repels water but interacts easily with other things, like fat molecules and the surface of casein micelles.

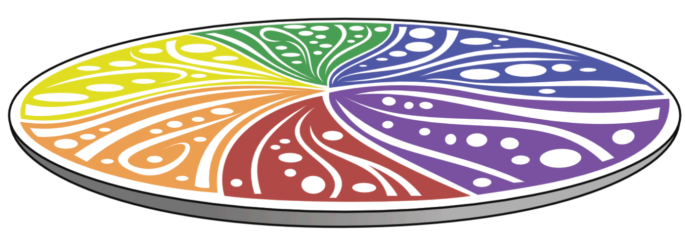
When you add a bit of detergent to milk, the detergent's hydrophobic end tries to link up with the fats and proteins in milk, but repels the water around them. When this happens, the food coloring gets bumped around too, which lets us see how much movement there is in the milk!

Turn it into an experiment.

Great experiments begin with great questions. Read these questions first and think of ways you might answer them, then look at the next page for our experiment design suggestions. Follow one of those or make your own!

QUESTIONS:

- Try touching different parts of the milk with the soap, what happens? Is there a difference between putting soap in the middle of the plate vs the edge?
- Will the results be different between skim milk vs. whole milk?
- Would you see the same effect with water instead of milk?
- Will this demonstration work with non-dairy milk?
- Does temperature matter? Is there a difference between using hot milk vs. cold milk?



Does warm or cold milk produce the best rainbows?

Set up two plates and pour cold milk into one and warm milk into the other, adding food coloring drops to both. Touch a bit of detergent to both and note how fast the milk swirls. The **independent variable** (the thing you change) is the temperature of the milk. The **dependent variable** (the thing you measure) is how fast the milk swirls. The easiest way to measure this is to record how long it takes for the milk to stop swirling on each plate. Repeat the experiment and record your results at least 5 times, then take the average time for your result.

Abstract

A short summary of your project. The abstract or "purpose" section is where you explain why you did this experiment.

Background Research

What did you learn about surfactants and milk? You could include information about hydrophobic and hydrophilic molecules, and how they react to milk. Have you encountered any other hydrophobic/hydrophilic materials? How do you know?

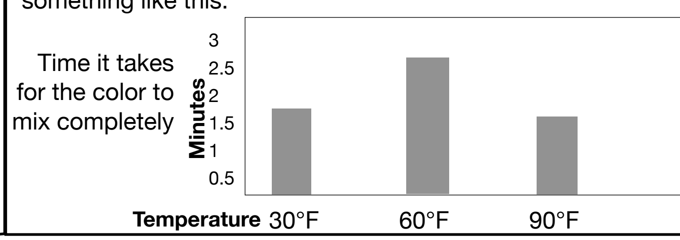
How does the temperature of the milk affect the rainbow?

Materials & Procedure

One of the most important things in science is for people to be able to repeat experiments. The "materials and methods" or "Procedure" section is where you share HOW you did the experiment. If someone can read this section and then repeat your experiment exactly, then you did a great job writing it!

Results

This is where you share your data! If you can do multiple tests and then average your results, this will give you much more accurate results. For comparing different amounts of milk, you could record the time it takes for the food coloring to reach a certain point in the bowl in a graph that might look something like this:



Conclusion

In your discussion or conclusion you tell what your results mean. Did the difference in temperature make a difference? What temperature was best? Share your thoughts about why you got your results.

Future Directions

Optional section here where you can share ideas for future experiments or new questions you came up with while doing this experiment.

Does skim milk produce different results than whole milk?

Set up two plates and pour whole milk into one and skim milk into the other, adding food coloring drops to both. Touch a bit of detergent to both and note how fast the milk swirls. The **independent variable** (the thing you change) is the fat content of the milk. The **dependent variable** (the thing you measure) is how fast the milk swirls. You can measure how long it takes for the milk to stop swirling on each plate or you can have several people rate how colorful the swirls were on a scale of 1 (no swirling) to 10 (lots of swirling colors).

CABBAGE JUICE LEMONADE

CREATE A SCIENCE EXPERIMENT FROM THIS FUN EDIBLE DEMONSTRATION!

Supplies

For the cabbage water:

- 1 cup chopped cabbage
- 2 cups water
- 1 lemon, juiced

Optional supplies:

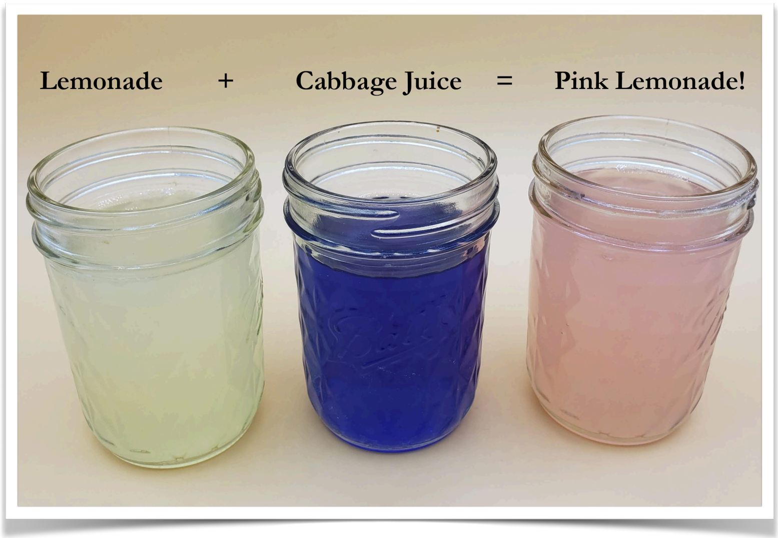
- Vinegar
- Rubbing alcohol
- Hydrogen peroxide
- Baking soda solution (a teaspoon baking soda in 1 cup water)

Demonstration

Boil cabbage and 2 cups of water together. Drain the water and let it cool. Pour your cabbage juice into clear cups. Add a teaspoon of lemon juice to your cabbage water and watch the color change!

Explanation

Purple cabbage gets its blue-purple color from a type of pigment molecule called an anthocyanin (AN-tho-SY-uh-nin). Anthocyanins change color depending on the pH of the solutions they are in. They're blue or purple in neutral conditions (like water), greenish in alkaline solutions (like water with baking soda in it), and pinkish in acidic solutions (like our lemonade in this experiment).

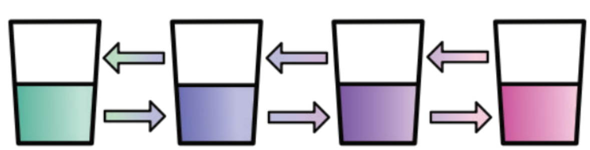


Turn it into an experiment.

Great experiments begin with great questions. Read these questions first and think of ways you might answer them, then look at the next page for our experiment design suggestions. Follow one of those or make your own!

QUESTIONS:

- Does anything change if you use a more or less lemon juice?
- How does cabbage juice compare to food coloring for making pink lemonade? Can people taste the difference?
- What happens to the cabbage water if you add something other than lemon juice to it? Would you see the same color change with vinegar, baking soda, hydrogen peroxide, or rubbing alcohol?
- What happens if you use a different source of anthocyanins, like blueberries or blackberries?



What happens to cabbage juice when you add different liquids?

Get together your optional supplies. Make a prediction about which ones you think are acidic, neutral, or alkaline. Pour out about half a cup of cabbage water into six small, clear cups. Keep one cup aside. This is your **control** (the thing you keep the same), and you'll use it to figure out how the other cups change. Add a teaspoon of vinegar to the first cup, a teaspoon of rubbing alcohol to the second cup, and so on. Each of these cups are your **treatments** (the things that you change). Note how the color changes in each of them. Did they change the way you predicted? What can you say about the pH of each of the liquids you added based on how the color changed?

Abstract

A short summary of your project. The abstract or "purpose" section is where you explain why you did this experiment.

Background Research

What did you learn about the pH of different substances? You could include details about the pH strength of different materials based on how strongly they react. What is the pH of something you drink? Are there any drinks of the opposite pH? If there aren't, why not?

What is the pH of common household materials?

Materials & Procedure

One of the most important things in science is for people to be able to repeat experiments. The "materials and methods" or "Procedure" section is where you share HOW you did the experiment. If someone can read this section and then repeat your experiment exactly, then you did a great job writing it!

Results

This is where you share your data! For comparing the pH of different substances, you might create a table like this:

Item	Color	pH
Lemon juice	Pink	2
Water	Purple	7
Baking soda	Blue-green	9

Conclusion

In your discussion or conclusion you tell what your results mean. What substance seemed to react the strongest? Did foods tend to have a low or high pH? What about other things, like cleaning products? Share your thoughts about why you got your results.

Future Directions

Optional section here where you can share ideas for future experiments or new questions you came up with while doing this experiment.

Fun fact

Anthocyanins are found in many plants -- berries like blueberries and raspberries, grains like blue corn and black rice, and even in black beans! Scientists aren't quite sure what they do in plants, but it may help them with resistance to colder temperatures.

SUNBUTTER COOKIES

CREATE A SCIENCE EXPERIMENT FROM THIS FUN EDIBLE DEMONSTRATION!

Supplies

For the Sunbutter Cookies

- 1/2 cup Sunbutter
- 1/2 cup unsalted butter
- 1/2 cup granulated sugar
- 1/3 cup brown sugar
- 1 egg
- 1 cup flour
- 1/2 tsp baking powder
- 1/2 tsp baking soda
- 1/4 teaspoon salt (omit if sunbutter contains salt)

Demonstration

Cream together the butters, sugars, and egg until light and fluffy in consistency. In a separate bowl mix the flour, baking powder and soda, and salt (if using) together. Then add the flour mixture to the sunbather mixture and combine to form a dough. Refrigerate the dough for at least 1 hour. Preheat oven to 350 degrees. Scoop dough into 1 inch balls and flatten each with a fork, making a criss-cross pattern. Bake for 10 minutes and cool on rack. After cooling for 12 hours, the inside of the cookie should be green.

Explanation

(See next page)

Turn it into an experiment.

Great experiments begin with great questions. Read these questions first and think of ways you might answer them, then look at the next page for our experiment design suggestions. Follow one of those or make your own!

QUESTIONS:

- What happens if you leave out the baking soda?
- Do other nut butters (almond butter, peanut butter, etc) produce the same effect?
- Will storing the cookies in a moist environment or baking them longer cause a change in color?

Explanation

Sunflower seeds contain chlorogenic acid, a molecule that is colorless until it reacts with protein in a basic (or alkaline) environment. If those conditions are met, then it turns green! In our cookie dough, the baking soda makes the environment basic (with a pH that's higher than 7). The egg and sunbather provide proteins. The only other things needed for the reaction are water and time. There will be variation in oven temperature and moisture content with the cookies, even when following the same recipe. But usually, when the cookies are baked for no longer than 10 minutes, the insides turn a vibrant green as they cool. You will likely observe a slight green color when they are fresh out of the oven, which will then deepen over the next 24 hours.

What happens when you bake the cookies for longer?

Based on what you know about chlorogenic acid and how it needs an alkaline environment and moisture to turn green, make a prediction about what will happen if you bake your cookies for a longer period of time. Then, mix up your cookie dough and roll into balls. Make sure all of your cookies are the same size! Bake half your cookies for 10 minutes. This is your **control** (the thing you keep the same). Bake the other half for longer than 15 minutes. This is your **treatment** (the things that you change). Wait until cookies are completely cooled, then break them in half. Note the color on the inside of each of the batches. Did are they the colors you predicted? What did the different bake time do to the chlorogenic acid?

Abstract

A short summary of your project. The abstract or "purpose" section is where you explain why you did this experiment.

Background Research

Share what you learned about sunflower seeds and chlorogenic acid. Sunflower oil is used for human food products while the sunflower meal is most often put into animal feed. Do you think chlorogenic acid has something to do with this?

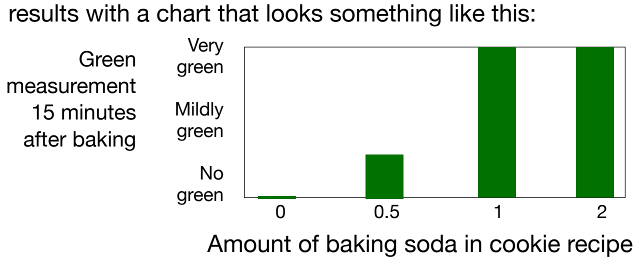
WHY DO SUNBUTTER COOKIES SOMETIMES TURN GREEN?

Materials & Procedure

The "materials and methods" or "Procedure" section is where you share HOW you did the experiment. If someone can read this section and then repeat your experiment exactly, then you did a great job writing it!

Results

This is where you share your data! If you can do multiple tests and then average your results, this will give you much more accurate results. For comparing cookies made with and without baking soda, you might represent your results with a chart that looks something like this:



Conclusion

In your discussion or conclusion you tell what your results mean. Was baking soda required for the green reaction? Did this agree or disagree with your background research? Share your thoughts about why you got your results.

Future Directions

Optional section here where you can share ideas for future experiments or new questions you came up with while doing this experiment.

Is chlorogenic acid it safe to eat?

Like ascorbic acid (also called Vitamin C), chlorogenic acid is an antioxidant. In the right amounts, antioxidants are considered healthy and chlorogenic acid had been linked to lower blood pressure and is naturally found in foods such as eggplants, plums, and coffee, to name a few. The green by product It forms when it reacts with proteins is also safe to eat.

EXTRACT DNA FROM A STRAWBERRY

CREATE A SCIENCE EXPERIMENT FROM THIS FUN DEMONSTRATION!

Supplies

- Several fresh strawberries
- Soap
- Salt
- Rubbing alcohol
- Coffee filter
- Cup and rubber band or a mason jar with a metal ring
- Toothpicks and a plastic bag (optional)

Demonstration

Place the strawberry in either a cup or a plastic bag and squish it thoroughly until it has an evenly soupy texture.

Make your extraction solution by mixing together 1/2 cup warm water, 1 tsp salt, and 2 teaspoons concentrated dish soap. Add 2 to 3 teaspoons of extraction solution to the squished strawberry and stir gently for 1 minute.

Pour the fruit mixture into a coffee filter that has been placed above a cup or jar and let it filter through for 5 minutes. Very gently close the bag and press to extract more liquid. Be careful not to press too hard if the bag breaks you will need to strain the liquid again. Carefully pour a layer of rubbing alcohol on top of the layer of soapy salty fruit liquid. The goal is for the amount of rubbing alcohol to be roughly equal to the amount of fruit liquid, but it does not need to be exact. If the rubbing alcohol is cold, that is helpful. Observe the container and watch for a white foamy substance to form on the bottom of the rubbing alcohol layer. This is the DNA! Use a toothpick to scoop it out of the jar. It should all clump together and hang from the toothpick.

Make it an experiment!

Great experiments begin with great questions. Read these questions first and think of ways you might answer them, then look at the next page for our experiment design suggestions. Follow one of those or make your own!

QUESTIONS:

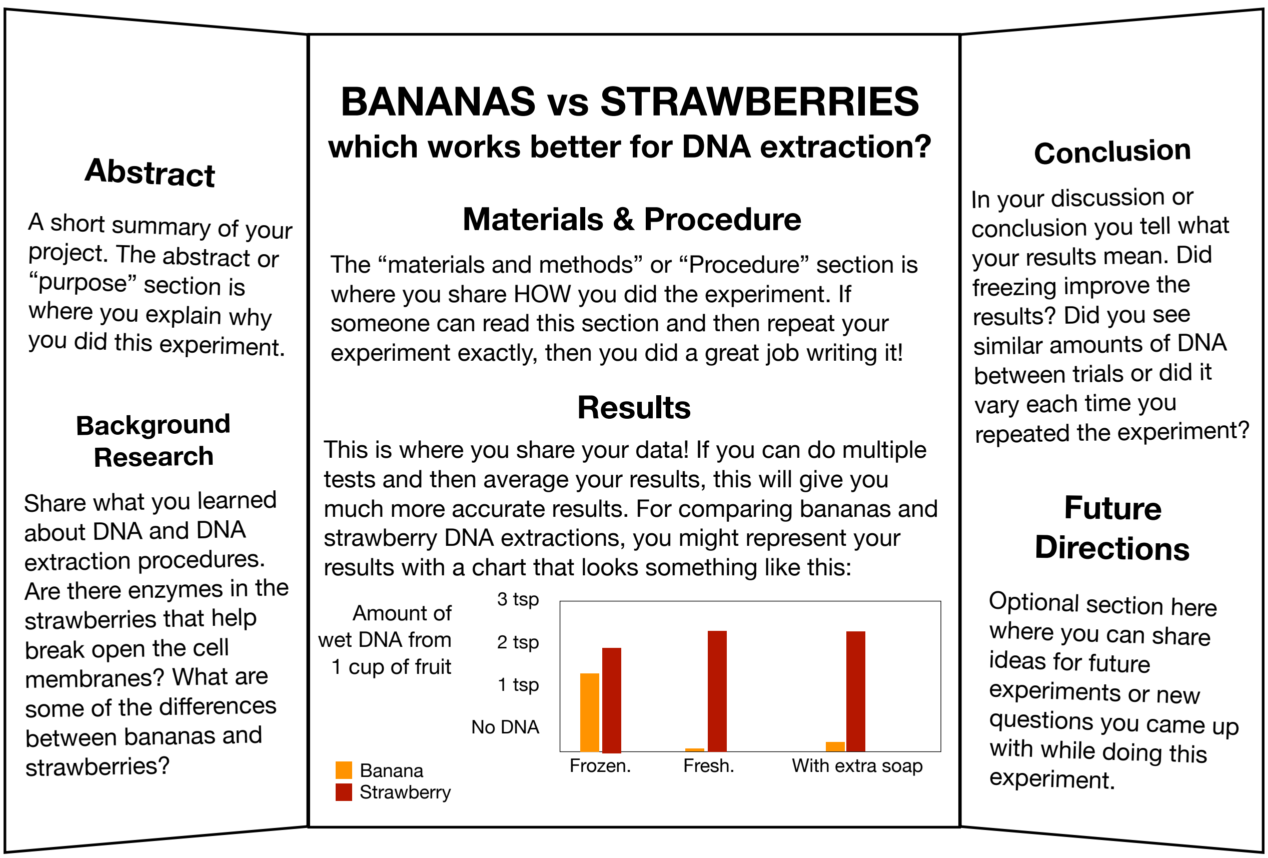
- How much DNA is in one strawberry?
- Does the amount of salt make a difference? Would you see the same effect with no salt vs one teaspoon of salt vs one tablespoon of salt?
- Can you extract DNA from other fruits like oranges, bananas, blueberries or, grapes?
- Does the amount of DNA extracted change if you freeze and thaw the fruit before squishing it?

Explanation

DNA stands for Deoxyribose Nucleic Acid. It is a **polymer**, a long strand of units which are called nucleic acids. Every cell of every living thing contains DNA but it is wrapped up and coiled fighting together inside a membrane. The salt and soap help to break open the membrane and separate the DNA so that it can be surrounded by water. When the rubbing alcohol is added, this causes the DNA to clump next to other DNA strands. If enough strands clump together then the DNA becomes visible to our eyes..

Which fruits can you extract DNA from?

Strawberries are the traditional fruit for this demonstration, but every fruit we eat is made of cells that contain DNA. If you tried the DNA extraction with bananas, blueberries, or oranges, what do you think would work better? Use the same amount of fruit and the same extraction solution for each test. Your independent variable (the thing you change) is the type of fruit. The dependent variable (the thing you measure is how much DNA is pulled from each cup or jar.



Troubleshooting tips:

The extraction will work better if the rubbing alcohol is cold. Strawberries contain an enzyme that helps break apart the cell and release the DNA, so they are a favorite fruit for this activity. Bananas will typically only work if they are first frozen and then puréed with a blender. Split peas also work well if meat tenderizer is added. Other fruits and vegetables typically do not work with this recipe for DNA extraction, even though they all contain DNA.