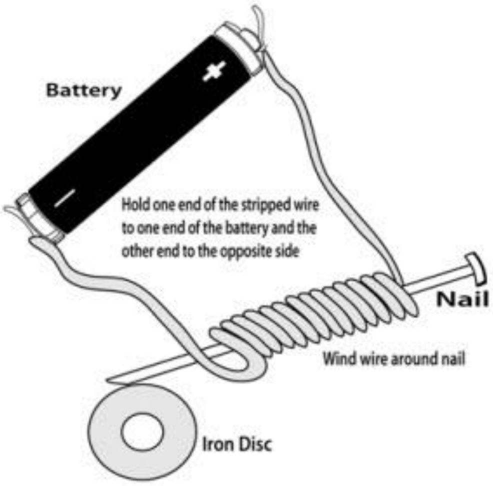
1. Simple Electromagnet

You Need:

- Large nail
- Plastic coated wire (stripped of the plastic at each end)
- Battery
- Washer or paper clip (any metal object containing iron will work)

What to do:



1. Wind the plastic coated wire tightly around the nail about 40 times - more turns makes a stronger magnet. It doesn't matter if the wire turns overlap.
2. Hold one end of the stripped wire to one end of the battery (terminal), and the other end of the stripped wire to the other battery terminal.
3. With the wire connected to the battery, pick up your metal object (washer or paper clip) with the sharp end of your new electromagnet.
4. To turn off the magnetism, break the circuit by removing the wire from the end of the battery.
5. Can you think of a way to hold the wires onto the battery without using your fingers - masking tape and paper clips might get you started?
6. As a further project you might like to use things around your house to design a base and mount to hold the nail and battery in place. Make sure you get your parents to help.

2. Split Light To Make A Rainbow

You Need:

- Shallow dish
- White wall (or large piece of white paper/card)
- Small mirror
- Water
- Sunlight (the stronger the better)

What to do:

1. Pour some water into the shallow dish.
2. Place the small mirror in the water and prop it at an angle against the side of the dish.
3. Put the dish near a sunny window and position the mirror so that sunlight bounces off it onto a white wall.
4. If you don't have a white wall you can use a large piece of white card or paper attached to the wall.
5. You should see a faint rainbow appear on the white wall or paper. If not, adjust the mirror until you see it.

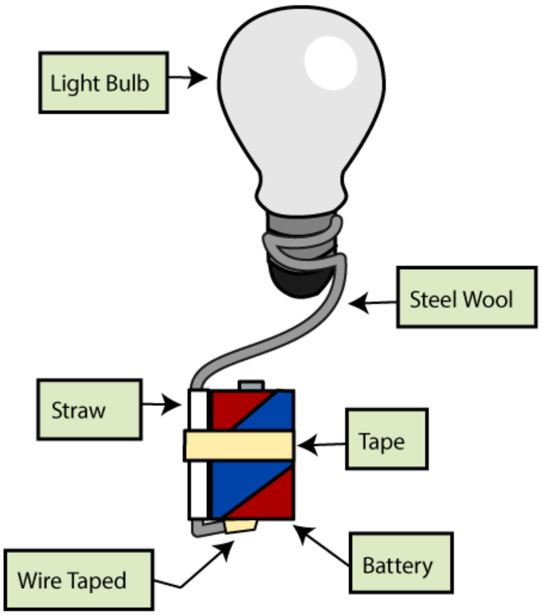
3.Does Electricity Move Better through Thick Wires or Thin Ones?

You Need:

- Plastic straw
- Scissors
- 2 unused D batteries
- Electrical tape

- Steel wool pad
- 2 new flashlight bulbs

What to do:



4. Series and Parallel Circuits

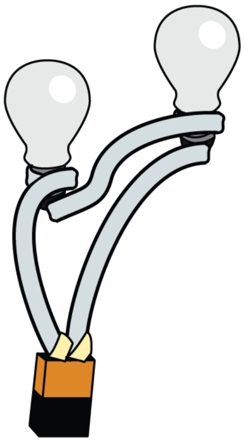
You Need:

- 9V battery
- Tape
- Aluminum foil
- 2 identical flashlight bulbs

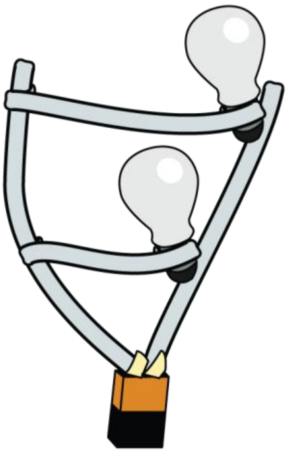
What to do:

1. Tape an 8-inch strip of aluminum foil to the positive terminal of the 9V battery. Make sure the aluminum foil is touching the metal.
2. Tape another 8-inch strip of aluminum foil to the negative terminal of the 9V battery.

3. Wrap the end of the aluminum strip attached to the positive terminal around the light bulb's metal screw cap.
4. Take a 4-inch strip of aluminum foil and wrap one end around the second light bulb.
5. Place the bottom of the light bulb attached to the positive terminal on the loose end of the other battery's foil strip.
6. Place the bottom of the second light bulb on the foil strip attached to the negative terminal.
7. You have created a series circuit. Take note of how brightly the bulbs shine.



Series Circuit



Parallel Circuit

8. Now, let's create a parallel circuit. First, remove the light bulbs from the system.
9. Take two 4-inch strips of aluminum foil and fold one of each of the ends around the strip coming off the positive terminal of the battery. It should look like the rungs of a ladder, but only connected on one side.
10. Wrap the loose ends of the 4-inch strips around the metal screw cap of each light bulb.
11. Place the bottom of each of the light bulbs against the foil strip attached to the negative terminal.
12. Record your observations, comparing the brightness of the two circuits you created.

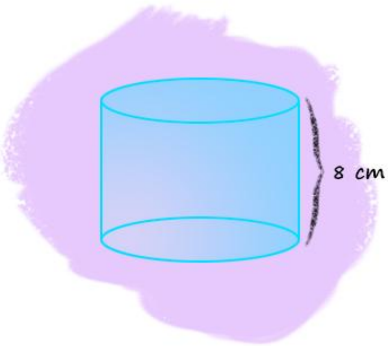
4. Renewable Energy Project for Kids: Power from Water

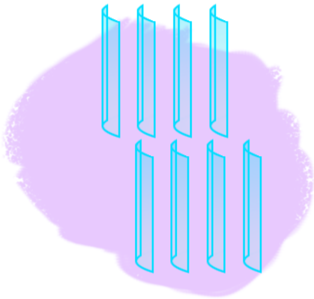
You Need:

- 2-liter plastic soda bottle
- Ruler
- Marker
- Craft knife (have an adult help you use it)
- Scissors
- 2 corks
- 1 wooden barbeque skewer
- Sewing thread (16 inches)
- Small objects to lift (small fishing sinker, an eraser)
- Sink
- Duct Tape
- Large Funnel
- Paper clips

What to do:

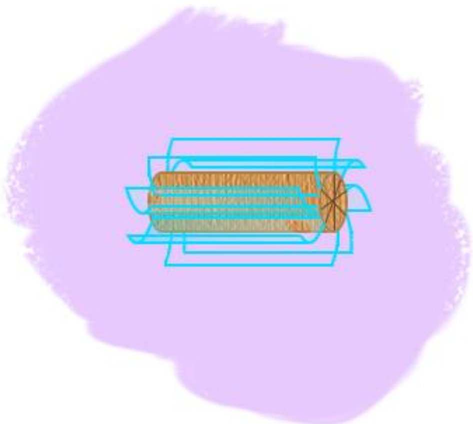
1. Using your marker and ruler, measure and mark a few dots 6 cm up from the bottom of the bottle. Connect your dots and have an adult help you cut off the bottom using the craft knife.
2. Measure an 8cm section from the cut part of the bottle. Cut out this section so that you have a cylindrical section of plastic.

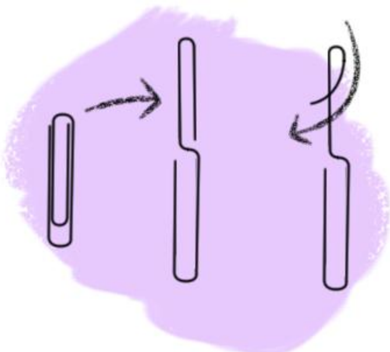




3. Cut four 2 cm-wide strips from the 8cm section with your scissors. Cut these strips in half so you are left with eight curved strips that measure 4 cm by 2 cm.

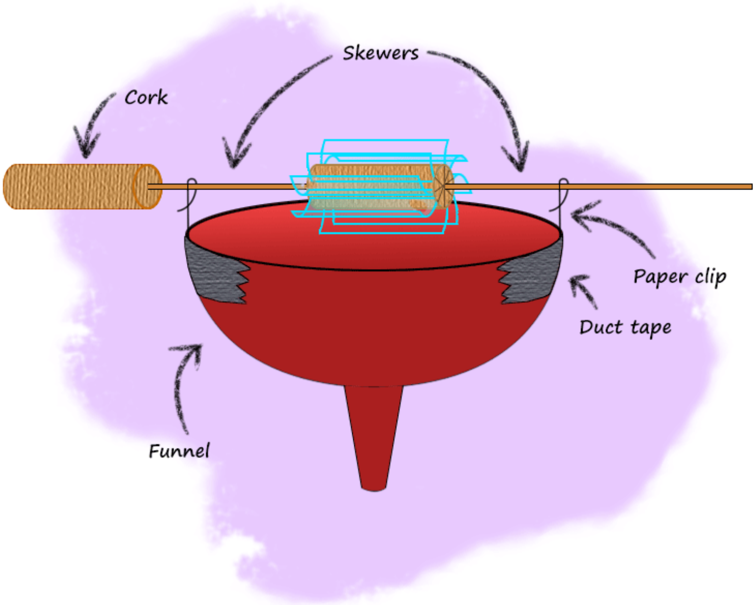
4. Draw 8 evenly spaced lines lengthwise on the cork, and make slits along each line with your hobby knife. Making sure that the plastic pieces all curve in the same direction, slide each 4 cm by 2 cm plastic piece into its own slit. *Why do you think it's important that the strips all curve in the same direction?*





5. Unfold two paperclips and flex one end of each to create a small loop. These paperclips will act as supports for the water wheel's axle.

6. Affix your supports on opposite sides of your plastic funnel using your duct tape.
7. Cut the skewer in half and poke each half into one side of the wheel cork. Guide each end through a loop on your paper clip support. Make sure your paper clip's loops are loose enough to allow the wheel to turn freely.



8. Insert one of the skewers into the other cork and tie thread tightly around it. Tie the loose end of the thread to a weight or other small household object.
9. Place your completed water wheel under a gentle stream of water in your sink. Slowly run water over the wheel so that the plastic pieces on the cork catch the falling water and turn it into mechanical energy.

5.Salt Melting Ice

You Need:

- Regular table salt
- Kosher salt
- Epsom salt
- Rock salt
- 5 blocks of ice

- Clear plastic containers/ boxes big enough to hold the blocks of ice

What to do:

1. If you don't have blocks of ice ready-bought, then your first step should be to pop some water into the freezer and to make the ice. They should be approximately the same size.
2. Once you have the ice ready set them in separate clear plastic containers, side by side. Label these containers with the kind of salt that will be added to it.
3. Sprinkle an even amount of each kind of salt in each separate container. Now, you'll just have to wait to see what happens! 10-minute intervals are good times to check on the ice.
4. Observe the progress of the melting ice and record your findings until all the ice has melted.
5. Record your results. How fast did it take for all the ice to melt out of each container?

6. Does Mint Actually Cool Things Down?

<u>You Need:</u>

- Pack of regular mints (Altoids, Tic-Tac, Mentos, etc.)
- 2 glasses of hot water
- Thermometer
- Pen and paper for notes

<u>What to do:</u>

1. Get a glass of hot water and take the temperature with a thermometer. Record this.
2. Place 5 mints in the glass of hot water and take the temperature again. Was there a change?
3. Place more mints in the glass of hot water 5 at a time and record whether you see any change at all. You should monitor it for 30 minutes.
4. The other glass of hot water is to be used as a reference. This is because we know that water cools over time and we want to make sure that if there is any change in temperature, it is not independent of time, but of the mints speeding up the cooling process.
5. Record your results. Any changes?

Suggested Chart

	Initial Temp.	After 5	After 10	After 15	After 20	After 25
Minty Water						
Control Water						

7. How to Make Lightning

<u>You Need:</u>

- Rubber glove
- Plastic fork
- Tin Foil
- Wood or plastic cutting board

- Styrofoam plate or rubber balloon
- Head of hair or wool
- Cool, low-humidity day (< 45% humidity, < 75 F temperature)

What to do:

1. Fold tin foil around your plastic fork so that it looks like a big spatula. Make sure it's as flat as possible with no sharp corners.
2. Put on the rubber glove and use your gloved hand to rub the Styrofoam plate or rubber balloon on your hair or wool.
3. Place the plate or balloon on your cutting board, and use the gloved hand to pick up your tin foil spatula.
4. Place the tin foil part of your spatula on the balloon or plate. Touch the foil with your other hand. *What happened? How can you explain what you saw?*
5. Pull the spatula up from the balloon or plate, and touch it again. *What happened this time? Did you expect that?*
6. Experiment with other materials. Recharge your charged object using your hair or wool if necessary. *Does your hand spark when it touches the balloon? Why do you think this is so?*

Extra: for even cooler results, conduct this experiment in a room that you can darken as much as possible!

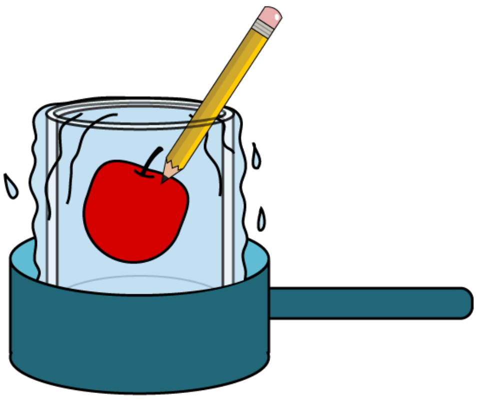
8. Sink or Swim: Calculating Density of Fruits and Vegetables

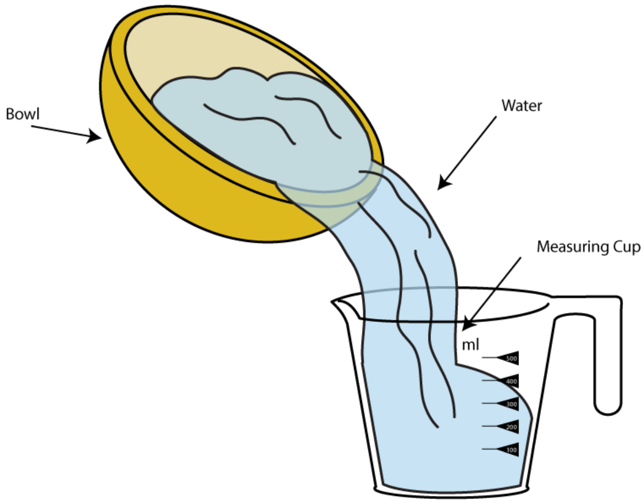
You Need:

- Selection of fruits and vegetables
- Kitchen scale
- Jar large enough to submerge the fruits and vegetables
- Large pan
- Pencil
- Measuring cup that measures volume in milliliters
- Calculator
- Towel

What to do:

1. Grab some fruits and vegetables from your kitchen or the grocery store. You can test as many as you'd like.
2. After you've collected your produce, create a hypothesis, your best guess as to what's going to happen. For each vegetable and fruit, guess whether it will float or sink.
3. Begin by placing the jar into the pan. Fill it up with water. Make sure that no water goes into the pan.
4. Now, weigh your first fruit or vegetable. Note its weight in grams.
5. Carefully lower your fruit or vegetable into the jar. Does it float or sink? Make a note of the results.
6. If the fruit or vegetable sinks, remove the jar from the pan and pour the water into a measuring cup. Measure the amount of water in milliliters. This is the volume – the amount of space that food took up.
7. If the fruit or vegetable floats, push it down with the tip of a pencil until water spills out and over into the pan. Measure the water in milliliters.





8. Now it's time to calculate the **density** of your produce. For each piece of food, divide the fruit or vegetable's weight in grams by its volume in milliliters. In a table, make a note of the weight, volume, and density of each fruit or vegetable. Your table might look like this:

Name	Floats/Sinks	Weight (grams)	Volume	Density

9. Repeat this process for each fruit or vegetable. Which ones float? Which ones sink? Is this related to the density? How?

9.How to Make a Compass

You Need:

- Cardboard
- Scissors
- Ruler
- Plastic cup
- Pen
- Needle
- Magnet
- Cork
- Tape
- Water

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What to do:

1. Cut out a large cardboard circle that is about an inch wider on each side than the mouth of the cup.
2. Cut a smaller circle from the center of the large circle. The smaller circle should be just a bit smaller than the mouth of the cup.
3. Divide the remaining doughnut into four equal quadrants, and label the quadrants with the letters N, S, E, and W.
4. Stroke a needle with a magnet from eye to tip 30 times. Make sure to stroke it in the same direction each time.
5. Cut a cork lengthwise down the middle. Lay the cork so that its new flat (cut) surface faces upwards.
6. Tape the needle to the flat surface, facing it in the same direction as the cork.
7. Fill the cup with water, almost to the rim.
8. Place the doughnut cutout over the mouth of the cup, so that the hole is directly over the water.
9. Place the cork on the water's surface so that the needle is pointing from north to south.

Try out your compass, and compare it with the results of a real compass. Alternatively, look at a map of your area to figure out where you are, and see whether magnetic north and geographic north are very different from each other

10. How Do We Hear?

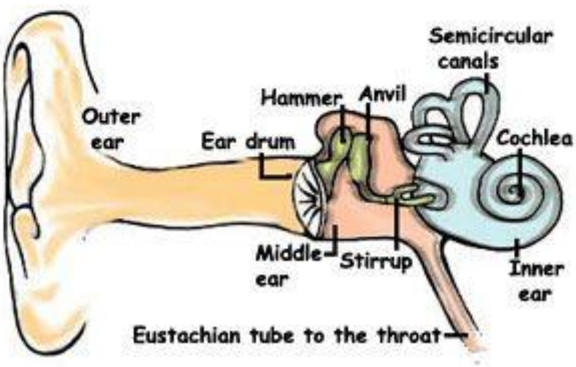
You Need:

- Coffee can (without the top and with the bottom of the can cut out)
- Tape
- Water
- Cup
- Large balloon
- Flexible straw

What to do:

1. Make sure that your coffee can is cleaned out and the bottom of the can is cut out.
2. Cut the neck of the balloon off then stretch the remainder of the balloon over one end of the coffee can. Make sure that the balloon is secure.
3. Tape one end of the straw to the center of the balloon. The rest of the straw should be sticking out to the side.
4. Lay the coffee can on its side on a table. As best you can, tape the can to the table.
5. Bend the end of the straw that is sticking out so that it points down. Put that end of the straw into a glass of water.
6. Have an adult or friend make noises into the open end of the coffee can. Watch the straw carefully. What happens in the glass of water?
7. Look at the diagram of the ear. What parts are represented in your model?

a. Coffee can—Outer ear
b. Balloon—Ear drum
c. Glass of water—Cochlea



11. DIY Electromagnet

You Need:

1. Two feet of fine-gauge electrical wire
2. Wire clipper

3. Iron nail, about 3” long
4. 9-volt battery
5. Paper or ceramic plate
6. Paper clips made of ferrous metal (use the small magnet to check if it’s the right kind; it should be attracted to the magnet)
7. Iron filings
8. Two small magnets
9. Pencil and paper (or, optional, a camera)

What to do:

1. Use the wire cutter to strip the insulation from about one inch of each end of the wire. Be careful, this tool can snip you, too, and the ends of the wire are probably sharp!
2. Wrap the wire in a snug coil around the shaft of the nail, leaving a few inches of wire dangling at each end.
3. Wrap one of the dangling wire-ends around the larger connector at the top of the battery.
4. Touch the other end of the wire to the other connector. Be careful! The wire might get hot now. You may want to get a partner or an adult to help you with this part.
5. Now touch one end of the nail to a paper clip and see if you can move the paper clip with the nail. Has it become magnetic? Will it lift the paper clip? Will it lift two? Three? The stronger the magnetic field is, the more paper clips it will hold.
6. Now, while the paper clips are sticking to the nail, move the loose end of the wire to break the connection between it and the battery. Notice how the paper clips fall. The nail hasn’t become magnetic on its own; the wire coiled around it is creating a magnetic field when the circuit is closed and electrical current runs through it.
7. Want to see the magnetic field? Sprinkle a good layer of iron filings on the plate—carefully, some of them might be sharp, and you definitely don’t want to get them in your eyes!—carefully place the nail in the middle of the filings, and reconnect the wire to the battery. You should see the filings move around the nail, showing you the shape and size of the magnetic field you’re creating. Draw a picture of this (or, optionally, take a photo).
8. Now take the two small magnets and place them end to end, pushing the ends together. Then flip over just one of the magnets and try it again. You should find that in one position, the ends of the magnets will stick together, and in the other position, they push each other apart. This is because magnetic fields are polar, meaning they go in one direction along a line or pole.
9. Now dangle the nail from the battery and close the circuit by holding the loose wire against the second connection. See if you can make the nail move without touching it using one of the magnets. Can you flip the magnet over and make the nail move in the other direction?

12. Latent Fingerprints

You Need:

- Small, plastic container (approximately 8”X10”) with lid
- Bottle of superglue
- Clear plastic wrap
- Two aluminum tart shells
- Lamp with a shade
- Compact disc

What to do:

1. Run your hand through your hair and place a few fingerprints on the compact disc
2. Place the disc in the center of the plastic container

3. Place seven drops of Superglue in one of the aluminum tart shells and place it in the corner of the plastic container.
4. Fill the other aluminum tart shell with hot water and place it in the opposite corner of the plastic container.
5. Cover the entire plastic container with plastic wrap and then place the lid over of that
6. Place the container on top of a lamp for 15 minutes. (If the superglue has fumed properly, you will notice that the fingerprints have turned white. Allow to dry for a minimum of three hours.)

13.Does Liquid Weigh More after Freezing and Boiling?

You Need:

- Water (ordinary tap water will work)
- Two cups that can hold boiling liquids
- Kettle
- Freezer
- Kitchen scale
- Pen and paper for notes

What to do:

1. Weigh the cups you are going to pour the water in on the kitchen scale. Take a note of these numbers.

2. Fill both cups with equal amounts of water and weigh this on the kitchen scale. Keep note of this number.
3. Subtract the first number (the weight of the cup) from the second number (total weight) to find the weight of the water.
4. Take one cup and label it "boiling hot" and pour the water from this cup into a beaker (if you are using a lab burner) or in a pot if you are using a kitchen stove. Watch until it bubbles (you can also stick a thermometer in) and carefully pour all of the water back into the cup. Weigh this on the kitchen scale and keep note of this number.
5. Now take the other cup and label it "freeze." Put this in the freezer for at least two hours or until it is completely frozen. Take it out and weigh it on the kitchen scale.
6. Evaluate your results: Did the weights change at all?

14. Charge a Light Bulb Experiment

You Need:

- Light bulb
- Comb
- Woollen scarf

What to do:

Go to a dark room and bring all the materials with you - the light bulb, the comb and the scarf. Rub the comb thoroughly against the woollen scarf for 5 to 10 minutes. If you do not have a woollen scarf around, you may just run the comb through your hair in at least 30 strokes to achieve the same effect.

After doing such, quickly stick the comb to the metal end of the light bulb and observe the filament of the bulb light up! Magic!

15. Lifting Ice Cube Experiment

You Need:

- Glass of water
- Ice cubes
- String
- Salt

What to do:

Drop an ice cube in the glass of water. Take the string and dangle the end of it on the ice cube, and then keep it still.

While the string is dangled down onto the ice cube, sprinkle a bit of salt on the ice cube. Set aside for a few minutes. After some time, try to lift the string and observe what happens to the ice cube.

16. Self-inflating balloons

You Need:

- Test tube
- Vinegar
- Small balloon
- Funnel
- Teaspoon of baking soda

What to do:

1. Put the test tube where it will stand upright securely, or have a partner hold it. Fill it halfway with vinegar.
2. Give the balloon a good stretching, like you would if you were about to blow it up.
3. Use the funnel to put the baking soda inside the balloon. Gently shake the balloon until all the baking soda goes to the bottom.
4. Making sure none of the baking soda gets into the test tube, carefully stretch the opening of the balloon until it's completely over the opening of the test tube. If it's not a tight fit, your balloon is probably too big and you should use a smaller one instead.
5. Once the balloon is attached to the test tube, lift the rest of the balloon so that the baking soda falls into the vinegar. You might have to give it a gentle shake to make sure it all goes in.
6. Watch the balloon inflate! What's happening here is the vinegar, an acid, is creating a chemical reaction with the baking soda, a base. When the two substances mix, you get carbonic acid, which is unstable and decomposes (falls apart) to become carbon dioxide (the gas that's filling the balloon!) and water. Since the carbon dioxide is much less dense than the stuff you used to create it, it wants to expand, and the balloon is stretchy enough to allow it to do just that!

17. Break the Tension: A water experiment

You Need:

- Drinking glass
- Water
- Liquid dishwashing detergent

- Ground pepper
- Paper clips
- Piece of paper towel

What to do:

1. Fill a cup of water. Ask your child: “Do you think a paper clip will float in the water?” Drop one in the cup to find out. Since the paper clip is denser than the water, it will sink to the bottom of the cup.

2. Now find out if you can use surface tension to float the paper clip: Gently lay the paper clip flat on the surface of the water. This can be tricky—it may help to place a piece of paper towel slightly bigger than the paper clip in the water. Then lay the paper clip on top of it. In a minute or so, the paper towel will sink, leaving the paper clip floating on top of the water. Even though the paper clip is still denser than the water, the strong attraction between the water molecules on the surface forms a type of "skin" that supports the clip.

3. Now put a drop of dish soap in the water. This will bind with the water molecules, interfering with the surface tension. The paper clip will sink. The detergent disrupts the molecules and "breaks the tension.” You can try floating other things on top of the water if you want; pepper floats well until you add dish soap. Can you find any other lightweight items that will float?

18. Observe the Greenhouse Effect in a Jar

You Need:

- 2 small thermometers
- Notebook
- Pen or pencil
- Jar or other clear container
- Clock or watch
- Access to a sunny area to perform the experiment, inside or outside

What to do:

1. Give your child the materials. Have him place both thermometers in direct sunlight.

2. Wait about three minutes before reading the thermometers to give them time to adjust to the temperature.

3. In his notebook, have your child create two columns, one for thermometer A and one for B. Alternatively, he can label them as Left and Right—whatever he prefers for identification.

4. After three minutes ask your child to read both thermometers and record the temperatures in his notebook along with the time of the readings.

5. Now, have him turn the jar upside down and place it over one of the thermometers so the jar is completely covering it. Conversely, you can put the thermometer into a see-through container and put the lid on it. Make sure the jar doesn't cast a shadow over the other thermometer. If the thermometer is too long to lie flat on the table with the jar over it, just prop it up inside the jar!

6. Once every minute for 10 minutes have him record the readings of both thermometers, without touching them, in his observation chart.

7. After the 10 minutes look over the chart with him. How did the temperature inside the jar change compared to the other one?

19. Egg in a bottle

You Need:

- Adult helper
- Hard-boiled egg
- Glass bottle with opening slightly smaller than egg (apple cider or juice bottles work well)
- Matches

What to do:

1. Hard boil an egg by placing the egg in a pot of cool water so the water entirely covers the egg and bring the water to a boil on high heat. You may want to hard boil several eggs at a time so you can do the trick more than once.

2. Once the water comes to a boil turn the heat off, but don't take the pot off the stove yet. After about 10 minutes, remove the pot from the stove and place the pot and egg under cold running water for a few minutes. Let the egg cool.

3. Remove the egg from the water and help your child peel the shell.

4. Have your child place the egg on the opening of the bottle. Point out that the egg will not simply fall into the bottle. Tell him that despite appearances, it *is* possible to get this egg into the bottle in one piece.
5. Take over duties and light two matches. Quickly drop them into the bottle. Have your child quickly place the egg on top of the bottle, wait a few seconds, and watch the egg drop into the bottle.

20. Under pressure

You Need:

- Small glass bottle (vanilla bottle, medicine bottle, eye-dropper bottle, nail polish bottle)
- Styrofoam craft ball (not packing Styrofoam)
- Knife
- Deep glass vase
- Plastic lid
- Water
- Towel

What to do:

1. Help your child gather supplies and set up a work area by placing a towel on the kitchen counter. You'll need a deep, wide-mouth vase or jar, a plastic lid to cover it, and a small glass bottle that fits inside of it.

2. Have your child cut a Styrofoam "cork" for the inner bottle. It doesn't have to be round. The cork should show 1/4" above bottle rim.

3. Invite your child to add a little water to the inner bottle and cork it.

4. Your child should fill the vase with water, place inner bottle in it and observe. If bottle sinks, he can shake a few drops of water out of it. If it "wallows," he can add a few drops of water to coax it upright.

5. When the bottle floats just so, your child can re-fill the vase, if needed, to the very top. Then, have your child place a plastic lid over the vase mouth to seal it.

Invite your child to press on the lid. Pressing increases air pressure. When air trapped in the bottle compresses, it no longer provides enough buoyancy to float. The bottle sinks. When pressure is released, a few drops of water are forced into the bottle to replace air, undoing the equilibrium. (To make it float again, shake out the few drops.)

21. Electromagnetic Induction Experiment

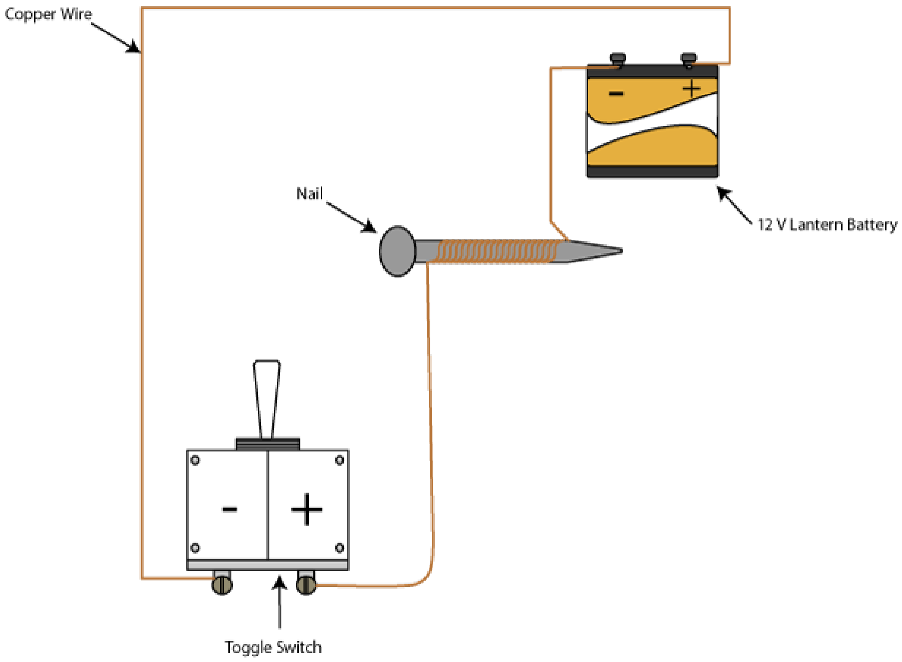
You Need:

- Thin copper wire
- Long metal nail
- 12-V lantern battery
- 9-V battery
- Wire cutters

- Toggle switch
- Electrical tape
- Paper clips

What to do:

1. Cut a long length of wire and attached one end to the positive output of the toggle switch.
2. Twist the wire at least 50 times around the nail to create a *solenoid.*
3. Once the wire has covered the nail, tape the wire to the negative terminal of the 12V battery.
4. Cut a short piece of wire to connect the positive terminal of the battery to the negative terminal of the toggle switch.



5. Turn on the switch.
6. Bring paper clips close to the nail. *What happens? How many paper clips can you pick up?*
7. Repeat the experiment with the 9V battery.
8. Repeat the experiment with the 9V and 12V batteries arranged in series (if you don't know how to arrange batteries in series, check out this project that explains how).

22. How to make and anemometer

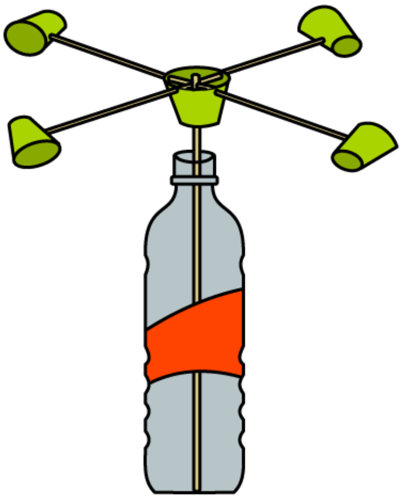
You Need:

- 5 small paper cups
- Hole punch
- Scissors
- Duct tape
- 3 thin wooden dowels
- Empty water bottle
- Stopwatch

What to do:

1. Use the hole punch to make a hole in the side of each of the 4 paper cups.
2. Use the hole punch to make 4 holes spaced evenly around the rim of the last cup. This will be the center of the anemometer.

3. Slide 2 of the wooden dowels through the holes in the center cup. They should cross in an "X."
4. Insert the ends of the dowels into the holes of the other cups and tape them into place. Make sure the cups are all facing the same direction.
5. Take the last wooden dowel and make a hole in the bottom of the center cup.
6. Push the dowel up until it meets the X and tape everything together. This will be your rotation axis.
7. Put the center dowel into an empty water bottle and begin testing!



To calibrate your anemometer:

1. On a windless day, have an adult drive you down the street at 10 miles per hour.
2. Hold the anemometer out the window and count the number of rotations in 30 seconds.
3. However many times your anemometer spins in 30 seconds will correspond roughly to wind blowing at 10 miles per hour.

23. Caffeine and Heart Rate: What Is the Effect of Caffeine on Heart Rate?

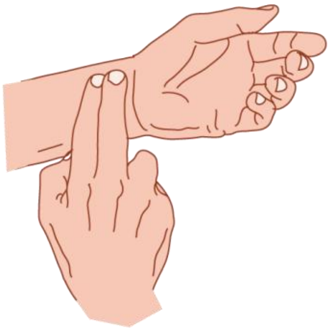
You Need

- 10 Adults or more (We want to test as many as possible. *Why do you think this is?)*
- Mp3 player loaded with relaxing music
- Clock and stopwatch (a cell phone usually has both of these functions)
- Eye mask
- 5 cans of a caffeinated version of a drink

- 5 cans of a non-caffeinated version of the same drink
- Paper and tape
- Notebook

What to do:

1. Spend some time learning how to accurately take a person's pulse. There are plenty of good resources online that can teach you how. Using a stopwatch, make sure to practice taking somebody else's pulse until you're sure you can get an accurate reading every time.



2. Mask your drinks using your paper and tape and label each can with a number.
3. Make sure that you record whether each number is caffeinated or non-caffeinated in your notebook.
4. Arrange a time to test each adult. It will take around 30 minutes to perform the test. Test each person at around the same time of day, in the same circumstances (same chair, same song, etc.). Be sure to test each adult one at a time. Ask each person to refrain from eating or drinking for two hours before the test. *Why do you think we want to make sure all of these things are the same from one test to the next?*
5. Ask each subject what his or her caffeine consumption habits are. Record the subject's answers on a sheet of paper dedicated to that subject, and be sure to keep your records confidential.
6. Have your subject put the mask over his or her eyes. Have the subject put the headphones on, listen to the music, and relax.
7. After five minutes have passed, take and record your subject's starting pulse without disturbing them.
8. Provide your subject with a randomly selected drink. Record the drink's number in your notebook. Ask your subject to drink it as quickly as possible.
9. Wait five minutes, and then take and record your subject's pulse. Continue taking the subject's pulse at 5-minute intervals until 15 minutes have passed.
10. Graph the data you recorded.
11. *Do people who consume caffeine regularly react to the caffeine? To the placebo? To both? Is there a correlation between habitual caffeine consumption and the change in pulse rate?* Try to think of as many questions as you can, and keep an eye out for surprising results. After you are satisfied with your analysis, look up the effects of caffeine on the body and see if your study agrees with what other scientists have found.

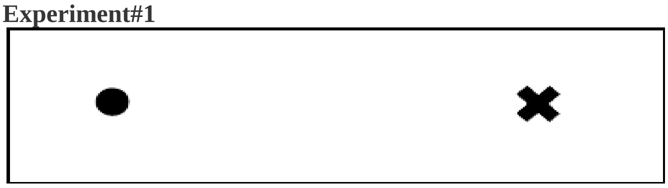
24. Retinal Blind Spots

You Need

- A pen or marker
- Card stock
- A yardstick

What to do:

Experiment#1



1. Cut out the image below and blue it to cardstock.
2. With your arm completely extended, hold the card at eye level about an arm's length away. You can prop the card up on a yardstick to steady it. The yardstick should be roughly parallel to the floor, with one end touching your cheek. The "X" on the card should be on your right-hand side.
3. Close your right eye. Look at the "X" with your left eye. Stay focused on the "X," but also be aware of the dot.
4. Slowly move the card toward you, staying focused on the "X." As you slowly move the card, you will find a region where the dot disappears and reappears. You have found your blind spot.
5. Repeat steps 3 and 4 with your left eye closed and your right eye focused on the dot. Can you identify a distance in which the "X" disappears?

Experiment#2

Sometimes our brain plays tricks on us to compensate for this blind spot.

1. Cut out the image above and glue it to cardstock.Using the card just as you did in the first experiment, close your right eye. Hold up the card, balancing it on your yardstick.

2. Focus your left eye on the "+" and slowly move the card towards you. The empty space between the lines will disappear when you reach your blind spot because your brain is compensating for the lack of an image.

25. Which Type Of Rocks Are Most Damaged By Freezing?

You Need

- Sedimentary rocks (such as sandstone or limestone)
- Igneous rocks (such as granite or pumice)
- Metamorphic rocks (such as slate or marble)
- Several water bottles (each to hold each type of rock in one container)
- Water
- Freezer

What to do:

1. Take your rocks and put each kind in a separate water bottle.
2. Fill each with the same amount of water. Cover all the rocks. Label all the bottles.
3. Put into the freezer and freeze until the water becomes ice.
4. Take it out and thaw the ice.
5. Repeat steps 3-4 for about 3-5 more times for each bottle.
6. Take the rocks out and observe which kind looks the most damaged.

7. Record your results.

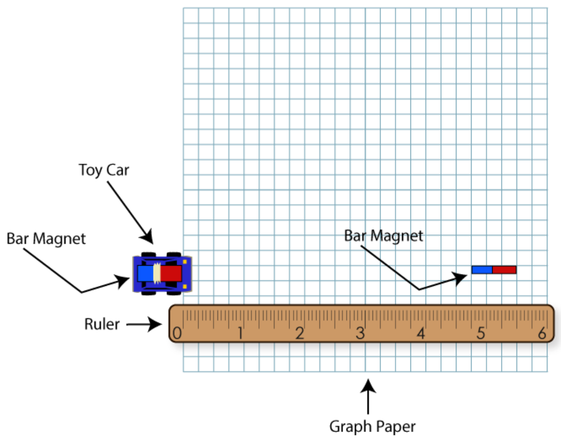
26. Magnet Science Fair Project: How to Measure the Strength of a Magnet

You Need

- Metric ruler
- Graph paper (4 squares per inch ruling is ideal)
- Tape
- Small, plastic toy car (not steel) with wheels that can turn freely. Avoid using a windup car for this reason.
- Small bar magnets (at least 4)

What to do:

1. First, get your racetrack in order. Take a sheet of graph paper and tape it to your table.
2. Place your ruler alongside your graph paper and line it up with the lines on the graph paper so you know what distance each line indicates (Depending on what graph paper you're using, your sheet may be ruled in inches or centimeters. Check the ruling on your graph paper to make sure you're using the appropriate units!)
3. Take out one of the small magnets. The magnet should be the same size or smaller than the toy car. Tape it to the top of the car.
4. Now, put your car on the track. Set the car at the end of the ruler so that the front-facing end of the magnet is lined up with 0.
5. Check your magnets. What end of the magnet makes the car move forward? Make sure that this end is facing the car, and place your other magnet at the other end of the ruler.



6. It's time to create a hypothesis. *How close does the magnet need to get to the car before the two magnets start to work together to pull the car along?*
7. Start your engines! Slowly start to move the magnet along the track, stopping every centimeter. *Is the car moving yet?* Note how far you had to move the magnet before the car moves. Do this four times, resetting the position of your car and your magnet each time. Record your results for each trial.
8. Now, stick two of your magnets together.
9. Repeat steps 5-7 with your compound magnet. *What happens? Does the car move earlier? Later?*
10. Continue to add magnets to your pile, starting a new set of trials each time you add a magnet. Remember to put the car back at the beginning each time!

11. When you're done, take the average of the four results from each set of trials (take the sum of all 4 numbers and divide by 4). This will give you the usual distance that it took for the car to start moving.

27. Paper Towel Science Project: Capillarity

You Need

- 5 different types of paper towels cut into 3"x3" rectangular strips (be sure that you use a variety: rough, soft, brown, white, recycled material, etc.)
- 5 cups filled with a small amount of water
- 1 marker
- Notebook

What to do:

1. Cut a 3"x8" strip from each type of paper towel.
2. Observe any differences you see between the paper towels. (*Are some more "quilted" than others? Rougher? Softer?)* Take note of any differences.
3. Fill each of 5 cups halfway with water.
4. Note which bowl you will be testing which paper towel in. (make small labels if this is helpful)
5. Carefully dip 1st strip about 1 inch into the cup of water.
6. Use marker to note how much water is absorbed upwards into the towel. Be sure to mark it right above the damp part so that it is dry and doesn't smear.
7. Repeat steps 4-6 with each paper towel strip.

28. Do Hand Soaps and Sanitizers Prevent the Growth of Bread Mold?

You Need

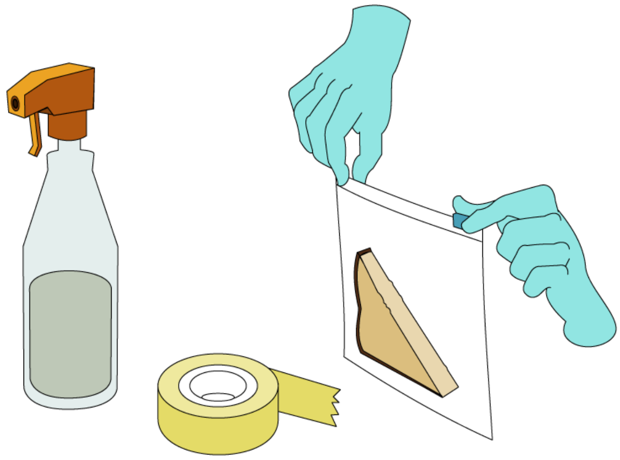
- 8 slices of fresh bread with no preservatives
- 16 sealing plastic sandwich bags
- Latex or Nitrile gloves
- Sticky labels or masking tape
- Pen
- Toaster
- Knife

- Spray bottle
- Baking sheet
- Camera
- Measuring teaspoon
- Liquid Soap
- Hand Sanitizer

What to do:

1. Put on the gloves. *In addition to keeping our hands clean, why else do you think we might want to wear gloves while we set up our experiment?*
2. Toast 4 slices of bread. *What effect do you think toasting the bread will have on mold growth?*
3. Cut all 8 of the bread slices in half so that you have 16 pieces total: 8 toasted pieces and 8 untoasted pieces.
4. You will be creating specimens in sandwich baggies according to the following chart:

Bag Number	Sealed?	Toasted?	Treatment:
1	Sealed	Toasted	None
2	Sealed	Toasted	Water only
3	Sealed	Toasted	Hand Soap only
4	Sealed	Toasted	Hand Sanitizer only
5	Sealed	Untoasted	None
6	Sealed	Untoasted	Water only
7	Sealed	Untoasted	Hand Soap only
8	Sealed	Untoasted	Hand Sanitizer only
9	Unsealed	Toasted	None
10	Unsealed	Toasted	Water only
11	Unsealed	Toasted	Hand Soap only
12	Unsealed	Toasted	Hand Sanitizer only
13	Unsealed	Untoasted	None
14	Unsealed	Untoasted	Water only
15	Unsealed	Untoasted	Hand Soap only
16	Unsealed	Untoasted	Hand Sanitizer only



5. Put 1 piece of untoasted bread in a sandwich bag and seal it. Label it as "untoasted, sealed."
6. Put 1 piece of toasted bread in a sandwich bag and seal it. Label it as "toasted, sealed."
7. Put 1 piece of untoasted bread in a sandwich bag and leave it unsealed. Label it as "untoasted, unsealed."
8. Put 1 piece of toasted bread in a sandwich bag and leave it unsealed. Label it as "toasted, unsealed". *Why do you think we're leaving some of the bags unsealed? What effect do you think this will have on mold growth?*
9. Fill the spray bottle with water.
10. Put 2 pieces of toasted bread and 2 pieces of untoasted bread into their own sandwich bags.
11. Spray each piece lightly with water.
12. Close 1 of the toasted bags and 1 of the untoasted bags, leaving the other two unsealed. Label each bag appropriately (for example: "untoasted, unsealed, water").
13. Add 1 teaspoon of soap to the water in the spray bottle. Mix well.
14. Put each of 2 pieces of toasted bread and each of 2 pieces of untoasted bread into their own sandwich bags.
15. Spray each piece lightly with the soapy water.
16. Close 1 of the toasted bags and 1 of the untoasted bags, leaving the other two unsealed. Label each bag appropriately (for example: "sealed, toasted, soap")
17. Dump out the soapy water in the spray bottle and wash the bottle well. Fill it again with water and add 1 teaspoon of hand sanitizer. Mix well.
18. Put each of 2 pieces of toasted bread and each of 2 pieces of untoasted bread into their own sandwich bags.
19. Spray each piece lightly with the hand sanitizer-water mixture.
20. Close 1 of the toasted bags and 1 of the untoasted bags, leaving the other two unsealed. Label each bag appropriately (for example: "sealed, untoasted, hand sanitizer").
21. Lay out all of the bags on the baking sheet spray-side up. Be sure the labels are visible.
22. Place the tray in a warm, dark place. *Why do you think we're leaving our bags in these conditions? What does mold need to grow?*
23. After 1 week, seal all of the open bags. Be sure not to open any of the bags again once mold starts to grow. *Which bread do you think will grow the most mold? Which bread do you think will grow the least? Why?* Use this as an opportunity to formulate your**hypothesis.**
24. Take notes and pictures over the next 21 days. *When does mold start growing? Which grows the fastest?* If you cannot take pictures, a great way to document mold growth is by recording your observations in a sketchbook!
25. After you've completed your experiment, dispose of the bread, keeping the bags sealed.

29. Does Adding Salt to Pasta make it Cook Faster?

You Need

- Pasta (any shape, but keep the shapes in both pots the same)
- 2 stockpots (both identical)
- A stove
- A clock or timer
- 2 food thermometers
- Slotted spoon for stirring
- Water
- Salt
- 

What to do:

1. Fill both pots with enough water, the more the better...as long as it doesn't overflow. About ¾ of the pot is a good measure.
2. Set both pots on separate ranges.
3. Add salt to one of the pots, about a teaspoon or two.
4. Bring both pots to a rolling boil in the same heat setting.
5. Stick 2 food thermometers in the pots, 1 in each. Watch the temperature rise.
6. Add equal amounts of pasta in each pot. Give both pots a stir.
7. Periodically check the pasta in both pots.
8. See which one softens faster. Record the time.

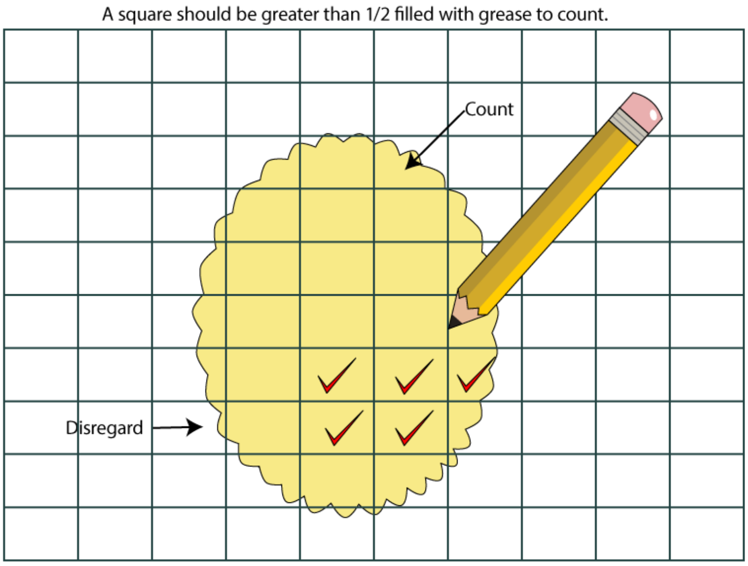
30. Potato Chip Science: How Greasy Are Your Potato Chips?

You Need

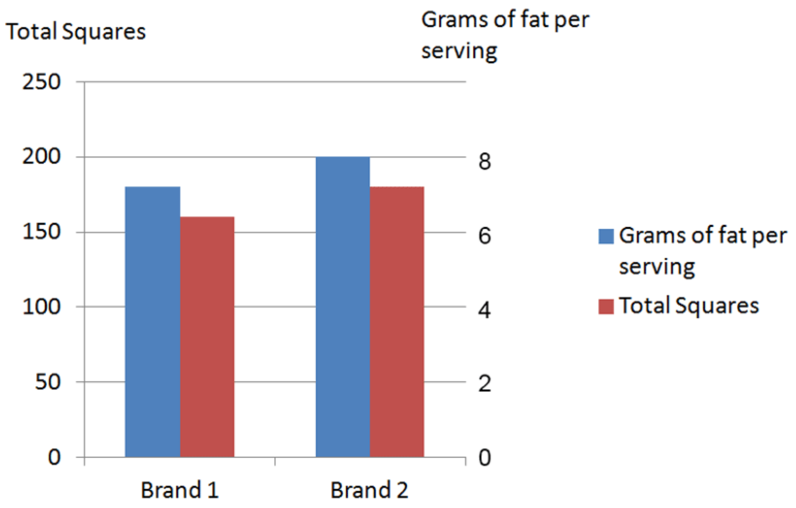
- Several bags of potato chips (different brands)
- Something to write with
- Rolling Pin
- Wax Paper, plastic wrap, or large sandwich bag
- Graph paper
- Tape
- Window
- Sunlight

What to do:

1. Find the **serving size** listed in the nutrition facts for each brand of chips.
2. Write down the serving size for each brand. *If we're trying to determine if a serving of one brand of chips is greasier than another, why do you think recording the serving size for each brand of chip is important?*
3. Find the **total fat** per serving for each brand of chips, in grams. Record this number.
4. Pick a brand of chips. Count out a number of chips equal to the serving size for that brand. Make sure to pull chips randomly from the bag. Don't pick big or small ones, specifically. *If we want to take an accurate average, why do you think this is important?*
5. Place the chips on a sheet of graph paper. Record the amount of chips you pulled out for this brand of chips.
6. Lay the wax paper, plastic wrap, or large sandwich bag over the chips.
7. Use this time to formulate your **hypothesis.** *Which brand of chips do you think will be the greasiest?*
8. Roll over the chips several times with the rolling pin, making sure they're totally pulverized.
9. Remove the graph paper and throw away the chips. Tape the graph paper to a window (or the surface of your school's overhead projector, if you have access to one).
10. Count the number of squares that are translucent from the grease. (Hint: make a check mark in each square you're counting. You can use a pencil, pen, or grease pencil if you're marking the graph paper itself. If you're using an overhead projector, you can use a dry-erase marker to mark squares projected onto the whiteboard.) Only count squares that are ½ full or more. Record the number of squares you count for this brand.



1. Repeat steps 4-10 for each brand.
2. The average grease per serving size is simply the amount of squares you counted for each brand. To calculate the average grease per chip, divide squares counted by the number of chips tested. Record this number for all brands in your data chart.
3. Draw a graph like the one below comparing the listed fat value per serving for each brand of chips and the number of squares you counted when you did the experiment.*Does the data surprise you, or is it what you expected? What does it suggest about the accuracy of your measurements?*



31. Inverted Images

You Need

- Flashlight
- Black construction paper
- Scissors
- Tape
- 2 single lens magnifying glasses (not compound lenses)

What to do:

1. Cut out a piece of black construction paper that will fit over the end of the flashlight.
2. From this piece of paper, very carefully cut out a lower case "k" or another asymmetrical shape of your choice. Why should the shape be asymmetrical?

3. Tape the paper over the end of the flashlight.
4. If you are doing your experiment during the day, find a room that will be dark if you turn off the lights and close the window blinds.
5. Tape or pin a large piece of black construction paper to a wall in the room.
6. Set the stage—turn off the lights and cover the windows so that there is minimal light in the area.
7. Turn on the flashlight and shine it against the black construction paper on the wall. Record your observations about the shape of the light.
8. Take one magnifying glass and shine the light through the magnifying lens against the black construction paper on the wall. Record your observations about the shape of the light.
9. With the help of a parent or friend, shine the light so it passes through two lenses to the construction paper on the wall. Record your observations about the shape of the light.

Results

The “k” will appear in its original orientation when projected without a lens. When shone through one lens, it will appear inverted, which means both upside down and backwards. When the light is shone through two lenses, it will appear in its original orientation.

Inverted "k"

32. Heat Convection in Liquids

You Need

- Clear quart container or jar
- Water
- Freezer
- Coffee mug or other container that can withstand heat
- Blue food coloring
- Spoon
- Dropper

What to do:

1. Fill the clear jar halfway with cold water.
2. Place the jar freezer for 15 minutes. You don’t want the water to freeze.
3. Fill the coffee mug about ¼ full with hot water.
4. Add 10 drops of blue food coloring to the hot water and stir.
5. Remove the jar from the freezer and set it on table. Wait until all the sloshing around from moving it has stopped.
6. Fill the dropper with hot blue water.
7. Lower the tip of the dropper until it is near the bottom of the large jar.
8. Carefully release two drops of hot blue water onto the cold water. Observe what happens, looking at the side and top of the jar.
9. Add ten more drops, two drops at a time, observing what happens between each.
10. Once you have added all the hot blue liquid drops, observe the jar for an additional five minutes.

33. Tropical Rainforest Trees: Buttress Roots

You Need

- 10-inch long, thin dowel
- 12 pipe cleaners
- Scissors
- 3 small squares of floral foam
- Hair dryer
- Plastic ruler

What to do:

1. First, place your dowel on the top of one of the pieces of foam. Balance it there.
2. Turn on the hairdryer and point it at the dowel from about 2 inches away. What happens?
3. Next, take the plastic ruler in your hand and pull it backwards about half an inch, releasing it so it hits the dowel. What happens to the dowel?
4. Now, you'll create some roots for your dowel tree. Cut a pipe cleaner into two-inch-long sections and wrap them around the bottom of the dowel. Place the "roots" into the floral foam as pictured in the diagram. Turn on the hairdryer and point it at the dowel from about 2 inches away. Next, take the plastic ruler in your hand and pull it backwards about half an inch, releasing it so it hits the dowel. What happens to your tree?
5. Finally, design some buttress roots for your tree. Cut several pipe cleaners in half and wrap them around the middle of the dowel tree. Sink the ends into the floral foam so that they're just barely extending into the foam. Turn on the hairdryer and point it at the dowel from about 2 inches away. Next, take the plastic ruler in your hand and pull it backwards about half an inch, releasing it so it hits the dowel. What happens to the dowel?