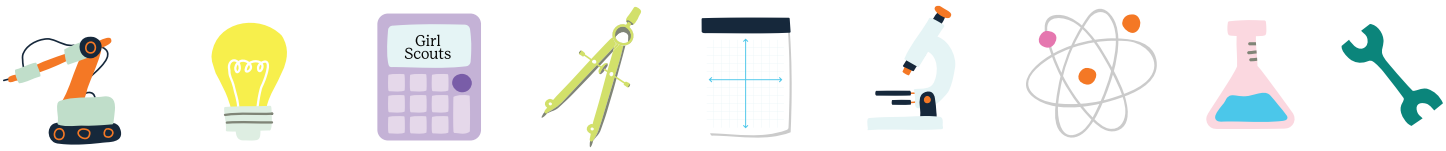
Science Exploration Patch Program

girl scouts of utah



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Complete: Daisies 5 / Brownies 7 / Juniors 9 / Cadettes, Seniors, & Ambassadors 12

**Starred activities can also be found in the Brownie Home Scientist badge*

Bonus Activities!

Seek out science in your community by:

- Attending a Girl Scout STEM event
- Attending a local STEM event in the community

Chemistry Activities

Activity 1 - Blow up a Balloon

Time: 10 minutes
Supplies: Empty 16-oz. water bottle or similar bottle, balloon, baking soda, white or apple cider vinegar, spoon

1. Place 2 spoonfuls of baking soda in a balloon and fill the water bottle about an inch deep with vinegar.
2. Put balloon on lip of bottle without putting in baking soda.
3. Ask the girls what they think will happen when they add the baking soda to the vinegar. When ready, have the girls tip baking soda into bottle, keeping the balloon attached. The balloon will blow up.

4. **The science:** This is an acid-base reaction. Acids and bases are a way that we describe substances that reflects their pH, which is the concentration of hydrogen atoms. The vinegar is the acid, and the baking soda is a base. They react to release a gas called carbon dioxide. The gas expands until it is bigger than the bottle and then it fills the balloon, blowing it up.

Activity 2 - Slime

Option 1 – Cloud Dough
Time: 10-15 minutes
Supplies: hair conditioner, corn starch, ¼ measuring cup, tablespoon, bowl, popsicle stick or spoon, food coloring (optional)

1. Optional: Mix 1-2 drops of food coloring with 2 tablespoons of hair conditioner. Combine well.
2. Add ¼-cup of cornstarch.
3. Mix well with the popsicle stick or spoon, and then your hands.
4. Enjoy your slime!

5. **The science:** Cornstarch is a thickener, that's why we use it when we make gravy and fillings for pies. When we mix it with the conditioner, it gets thicker and makes this cloud dough slime.

Chemistry Activities

Option 2 – Liquid Starch
Time: 10-15 minutes
Supplies: Glue (such as Elmer's or other school glue), water, liquid starch, bowls, measuring cups, popsicle sticks or spoons, food coloring (optional), glitter/ confetti (optional)

1. In a bowl, mix ½-cup water with ½-cup glue and stir well. Add 2-3 drops of food coloring and glitter if desired. Mix thoroughly.
2. Add ¼-cup of liquid starch and stir. The slime should start to come together and thicken. Continue stirring until all the liquid is gone and the slime is one big blob.
3. Enjoy your slime!

4. **The science:** Similar to slime made with borax, this is a polymerization reaction. The small molecules in a glue, sometimes called monomers (mono means one, like mono-rails have one rail), come together to form a polymer (poly means many, like polygons have many sides), which is a long chain or other grouping of attached molecules.

Activity 3 - Oobleck

Time: 10 minutes
Supplies: Large bowl, cornstarch, water, food coloring (optional)

1. Mix equal parts water and corn starch in a large bowl. You can add the food coloring as well, about 1-5 drops.
2. Have the Girl Scouts touch the Oobleck. When girls gently put their finger in, it feels like a liquid. When they push on it, it feels solid.

3. **The science:** This is called a non-Newtonian fluid. This means that it has properties of both a solid and a liquid, but it shows those different properties under different conditions, in this case different amounts of force. Other common non-Newtonian fluids include ketchup (it becomes runnier when shaken), silly putty, honey, tooth paste, and custard. Many other interesting experiments can be done with Ooblek: When you have a small pool full of the mixture, you can walk on top of it without sinking. Plus, when placed on a subwoofer covered in plastic wrap, the mixture will form solid globs that move up and down with the sound waves.

Chemistry Activities

Activity 4 - Dissolving Candy

Time: 5-10 minutes
Supplies: clear cups, sugar-based candy (such as candy corn or jaw breakers), various liquids such as cooking oil, water, soda, and vinegar

1. Give each Girl Scout 2-3 candies and 1 clear plastic cup. Put their candy into their cup.
2. Have each Girl Scout select their liquid. Have options such as water, vinegar, cooking oil, and soda. Have the Girl Scouts make predictions about what will happen to their candy.
3. Pour the liquid into the cup so that it covers the candy with a little extra on top.

4. **The science:** The candies, such as candy corn, candy pumpkins, and jaw breakers, are made of different kinds of sugars. Sugars dissolve into many different liquids, and this is an example of sugar dissolving. When the sugar dissolves into the water or other liquid, it's called a solution, which just means that there's something else mixed in with the liquid. Since there are other things in the pumpkin, there might be some leftovers. It also can take a while for all of the sugars to dissolve and get rid of the entire pumpkin, which is why there's still some left.

Activity 5 - Lava Lamps

Time: 20 minutes
Supplies: water, Alka-Seltzer or similar tablet, food coloring, cooking oil, clear jar or bottle

1. Fill the clear bottle half full of water and add 2-3 drops of food coloring. Mix well.
2. Carefully add cooking oil until the jar is mostly full. Allow to separate into two layers.
3. Break the Alka-Seltzer tablet into quarters and add to the bottle so that the tablet sinks into the water portion of the bottle.
4. Enjoy your Lava Lamp!

5. **The science:** In this experiment, we play with density. Density is how we measure an object's weight (mass) depending on how big it is (volume). Water is denser than oil, so it sinks to the bottom. When we add the Alka-Seltzer, it combines with the water to make a gas called carbon dioxide. The gas is less dense than both the water and the oil, so it rises to the top, bringing a little bit of the colored water with it. Once the gas has left the bits of colored water, they sink back down because they are denser than the oil.

Biosciences Activities

Activity 1 - Elephant Toothpaste

Time: 10 minutes
Supplies: Hydrogen peroxide (3% or 6% solution; 6% solution will cause a bigger reaction), 1 packet of yeast, water, tablespoon, small bowl, dish soap, plastic water bottle, baking pan or tray, food coloring (optional), safety glasses (recommended)

1. Put the yeast in a small bowl and add 3 tablespoons of water. This will activate the
2. Put on safety glasses. Mix ½-cup hydrogen peroxide with 2 squirts of dish soap in the plastic water bottle. You may add food coloring if you want.
3 Place the water bottle on the tray in an area that is easy to clean up.
4. Have the Girl Scouts make a prediction about what will happen when you add the yeast to the hydrogen peroxide.
5. Carefully add the yeast to the hydrogen peroxide mixture and stand back. What happened?
6. The mixture should have foamed and then shot out of the bottle. This mixture can be dumped down the sink to clean up.

7. **The science:** The mixture foamed and shot out of the bottle because of a chemical reaction. The hydrogen peroxide is breaking down into water and oxygen due to the yeast, which is something called a catalyst. The foam is from all of that oxygen being released and mixing with the dish soap. The oxygen is a gas and takes up more space than when it was part of the hydrogen peroxide, which causes it to release some energy as heat, which you may have noticed as steam. This is called an exothermic reaction.

2 - Snot Experiment

Courtesy of University of Utah Dept. of Bioengineering, Dr. Jessica Kramer, PhD
Time: 1 hour
Supplies: Pipettes, corn syrup, water, gelatin, food coloring, popsicle sticks, cups, measuring cups and spoons, large paper, pens or pencils, measuring tape

1. Snot, also known as mucus, is a gel that comes from your nose. Mucus also covers your eyes, lungs, heart, digestive system, and reproductive system. You have 200 times more snotty surface area than skin, about 20 square feet of skin versus 4,300 square feet of mucus surface! Mucus prevents tissues like your eyes and lungs from drying out and protects you from germs. Mucus is made from proteins and sugars that form the gel. Some parts of the body have snot that is more or less sticky, also known as viscosity. Mucus also changes when you get sick.

Biosciences Activities

2. Today, you will be making snot using protein and sugar, in the form of gelatin and corn syrup. You will be making both thin and thick snot and testing which would travel farther with a fake sneeze.
3. To prepare, mix the different solutions to make snot. For the sugar solution, mix 2/3-cup of corn syrup with 1/3-cup of water. For the two protein solutions, mix 7 packets of gelatin with 1 ½-cups boiling water, twice, then add 1 drop of green or red food coloring to each. This should make enough for 30 Girl Scouts.
    a. To adjust for size, make a sugar solution using 1 part water to 2 parts corn starch. You will need about a ¼-cup for every 4 groups (pairs) of Girl Scouts.
    b. To adjust for group size, make a protein solution using 1 packet of gelatin with about 6 tablespoons of boiling water. This is enough for 2 groups (pairs) of Girl Scouts.
    c. The gelatin mixture cannot be made ahead of time.
4. Have the Girl Scouts get into pairs.
5. Prepare the snot mixtures. Each group (pair) will need one cup of thick snot and one cup of thin snot. Label the cups with thick or thin.
    a. In the thick cups, mix 1 tablespoon of the corn syrup solution (10 mL) with 3 table spoons (30 mL) of the green gelatin solution. Stir gently for 15 seconds.
    b. In the thin cups, mix 1 ½-teaspoons of the corn syrup mixture (5 mL) with 3 table spoons (30 mL) of the red gelatin solution. Stir gently for 15 seconds.
6. In each pair, one Girl Scout will “sneeze” the thick mucus/snot and one will “sneeze” the thin mucus.
7. On the piece of paper (large paper or several pieces of smaller paper taped together recommended), draw a line at one end and label it “start.”
8. Have the Girl Scouts suck up their mucus in a pipette.
9. Please the pipette tip on the start line.
10. Say “achoo!” and press down on the bulb of the pipette to “sneeze.”
    a. Do not use the pipette in the air, only on the table.
    b. Only push the pipette with 2 fingers, not your whole fist.
11. Measure how fair the snot traveled and keep track.
12. Repeat steps 8-11 three times with both the thin and thick mucus.
13. Average the three distances for the thick and thin snot.
14. Ask your Girl Scouts reflection questions:
    a. Which kind of mucus traveled the farthest? Why do they think that?
    b. Why did we repeat the experiment?

Biosciences Activities

Activity 3 – Lungs in a Bottle

Time: 20 minutes
Supplies: Plastic bottle (1 L or smaller), balloons, straws, rubber bands, scissors, craft knife (optional but recommended)

1. Measure an inch or two from the bottom of the plastic bottle and cut it off using scissors or a craft knife.
2. Place one balloon inside the bottle. Fold the edge of the balloon around the rim of the bottle so that the balloon hangs down into the bottle. Wind a rubber band around the balloon and the rim of the bottle to hold it in place. Alternatively, tape the balloon in place.
3. Tie a knot in a second balloon, like you would if it were full, but without blowing it up. Cut that balloon in half horizontally.
4. Stretch this balloon around the open bottom of the bottle. Secure using a rubber band or tape.
5. Gently pull down on this balloon to inflate the upper balloon, simulating how the diaphragm (lower balloon) inflates the lung (upper balloon).

6. **The science:** In real life, the diaphragm inside your chest draws air into your lungs by moving up and down. This is how we breathe.

Activity 4 – Chlorophyll Chromatography

Time: 30 minutes
Supplies: Cups, pencils, rubbing alcohol, coffee filters, masking or scotch tape, various leaves or grasses, markers (optional)

1. Chromatography is a process that allows chemists and forensic scientists to separate the parts of a mixture. There are many kinds of chromatography, and it can be used for all sorts of mixtures in different amounts. In this kind of chromatography, we will be using a coffee filter to separate out the colored components of a leaf.
2. Cut the coffee filters into strips about 1 ½-inches wide and the same height as the cup.
3. Draw a line in pencil about ¼- to ½-inch from the bottom of the strip of coffee filter.
4. Mash 1-3 different kinds of leaves. Using the mash, make small dots on the pencil line. The dots should not touch and be visibly the color of the leaf. Green leaves are recommended, but you can try it with any leaf that is still alive.

5. Tape the coffee filter strip to the pencil and hang over the cup so that it is almost touching the bottom of the cup (about a quarter inch).
6. Mix equal portions of water and rubbing alcohol and carefully pour into cup so as not to splash the liquid on to the coffee filter. The liquid should cover the bottom and just touch the strip of coffee filter, but not cover the dot of leaf rubbings.
7. Wait until the alcohol mixture has traveled up the coffee filter. This should take about 15 minutes.
8. Remove the coffee filter. Look at what has happened to the dots.

9. **The science:** Scientists in real life take samples of the different colors in the chromatography. They run different tests on those samples like spectroscopy and chemical reactions to determine what the color is made of. They can determine lots of things about the material, like its size and which atoms are in it.

Activity 5 – Cloud in a Jar and the Water Cycle

Time: 30 minutes
Supplies: Clear jar such as a 16-oz. mason jar (glass recommended), ceramic or plastic plate, hot water, ice, match, paper, markers

1. Boil enough water to fill the clear jar 1/3-1/2 full.
2. Place ice cubes on the plate. It should be enough to cover most of the plate.
3. Add the water to the jar. While the water is still hot, light a match and drop it into the water. Cover the jar with the plate of ice.
4. What happens?

5. **The science:** This experiment is similar to the water cycle. Warm water evaporates due to heat, condenses on the ice, and uses the smoke particles to form cloud that precipitate (rain).

Physics Activities

Activity 1 - Color Mixing Lights

Time: 10 minutes
Supplies: 3-4 flashlights; green, red, and blue cellophane OR green, red, and blue balloons; rubber bands or tape; dark room

1. Let's talk about colors. Does anyone know what the primary colors are?
2. Turn the lights off and point the red and green flashlights together on a white screen. What happens?
3. Have the girls try out different combinations of the colored lights. What happens?

4. **The science:** All the colors of the rainbow can be made by mixing the primary colors of light: red, blue, and green. These are different than the primary colors we usually think of, red, blue, and yellow. The colors that you make by mixing the colors of light are called secondary colors. Yellow is a secondary color of light, not a primary color. When you mix all three colors, you get white light.

Activity 2 - Jumping Pepper

Time: 10 minutes
Supplies: Paper plate, pepper, balloon

1. Give each girl a balloon and have them blow it up. Alternatively, have adults blow up one balloon for each girl.
2. Have the girls rub the balloons on their hair for about 30 seconds. Have them pull away the balloon. What happens to their hair?
3. In the world, there are lots of itty-bitty bits. Some of them have positive and negative charges. When you rub the balloon on your shirt/hair, the balloons become more negative, meaning it has more electrons, the tiny negatively charged particles that are responsible for electric current when they move, and the hair/clothes more positive. The not-moving electrical charge from the electrons is called static electricity.
4. Give each girl a paper plate and pour a small amount of pepper on it.
5. Have the girls "recharge" the balloon by rubbing it on their clothes or hair again. Ask them what they think will happen when they hold the balloon above the plate.
6. Have the girls hold their balloon above the plate with pepper, about an inch. What happens? Does anybody have a guess about why that happened?
7. This is because of the static electricity that we said builds up in the balloon. It makes very small things, like pepper, jump up to meet the charge.

Physics Activities

Activity 3 - Dancing Raisins

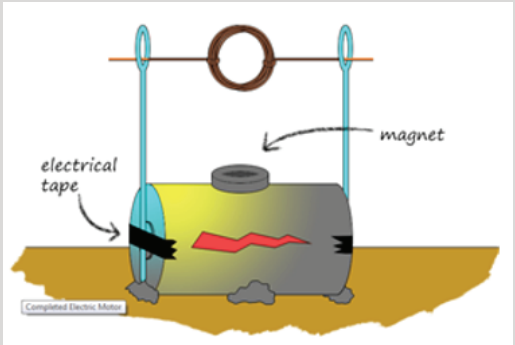
Time: 10 minutes
Supplies: clear jar or cup, Sprite or 7UP, raisins

1. Go around and pour about a half to three quarters cup of Sprite into their clear cups.
2. Explain: Let's keep looking into density. We have given you all some Sprite. Next, we are going to add some raisins to this Sprite. What do you think will happen?
3. Have a girl pour in raisins.
4. Watch the raisins move up and down in the soda.

5. **The science:** Raisins sink at first because they are denser than the soda, but the bubbles that attach to the wrinkles of the raisin bring them back up. Then the bubbles pop and the raisins sink again.

Activity 4 – Magnetic Motor

Time: 20-25 minutes
Supplies: Coated wire, sandpaper, paper, AA batteries, electrical tape, sewing needles with large eyes, small round magnets, modeling clay, pens



1. Give the girls about 1.5 feet of wire and have them make a wire loop with many turns in the middle, about as big as a quarter. Leave 3 inches on each end not in the loop.
2. Rub the sandpaper on these two ends to strip off the insulation. This could take a few minutes. Alternatively, if you are using insulated wire with plastic, you can use wire strippers to remove the plastic.
3. Using the electrical tape, tape the needles to the ends of the battery.
4. Attach the battery and needles to the paper on the table using modeling clay.
5. Carefully thread the wire ends through the needles.
6. Attach a magnet to the top of the battery, below the wire loop. You may need modeling clay.
7. The wire loop should spin.

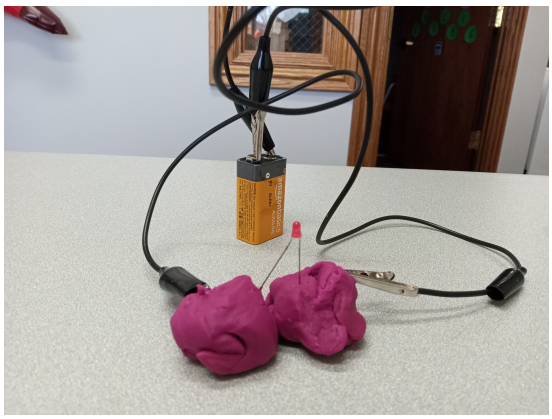
Physics Activities

8. If you have extra time, you can decorate the loop with a paper. We suggest drawing a bird on one side and a cage on the other. As the loop spins, it looks like the bird is in a cage. This is an automated version of something called a thaumatrope, an old-fashioned method of animation.

9. **The science:** We have electric motors in the world in lots of places, like the wheels of robots, cars, DVD players, vacuum cleaners, and fans. This builds a simple electric motor, which can be used to turn electricity into motion.

Activity 5 – Play-Doh Circuits

Time: 15 minutes
Supplies: Play-Doh, LED lights, alligator clips and wires, 9-volt battery



1. Using the Play-Doh, make 2-4 different shapes. They can be letters, small animals, abstract shapes, or any other solid object.
2. Arrange the Play-Doh shapes in a row near each other but not touching, leaving about half an inch in between shapes.
3. Take the LEDs and place each end of the LED in two side-by-side Play-Doh shapes, so hat the LED is connecting the two shapes. LEDs have different length wires, and they are generally directional, meaning the current only flows if the wire is in a certain direction in the circuit. Try to place the LEDs so that they are all pointed in the same direction (such as all of the long wires to the left). Continue until all shapes are connected.
4. On the first and last playdough shapes, clip on one end of an alligator clip. Clip the other end of the alligator clips to the two terminals of the 9-volt battery.
5. This should make the LED lights light up. If they don't try switching the direction of the LED.

6. **The science:** Circuits can be made out of many different things, such as wires, pickles, stacks of metal, and more. In this case, the Play-Doh is acting like a wire, conducting the current from the battery through the LEDs to make them light up. The Play-Doh can do this because it has chemicals in it, such as salts, that conduct electricity.

Food Science Activities

Activity 1 - Ice Cream in a Bag

Time: 1 hour
Supplies: Half and half, sugar, vanilla, gallon and quart plastic baggies, rock or ice cream salt, ice, measuring cups and spoons, spoons, ice cream toppings (optional), gloves (optional), bowls (optional)

1. In a quart-sized plastic bag, have each girl add 1 cup of half and half, 1 teaspoon of vanilla, and 2 tablespoons of sugar. Seal the bag tightly, then shake and squish to mix well. This is her ice cream mixture.
2. Fill a gallon plastic bag about half full of ice and then add about 3-4 tablespoons of rock salt.
3. Place the bag of ice cream mixture in a second quart sized plastic bag to protect it from the salt in case one bag gets knocked open. Place the double-bagged mixture into the gallon bag of ice and rock salt. Seal well.
4. Have the girls take their bags outside, then shake their bag and move the ice around. If they have them, wearing gloves that can get dirty is helpful as some girls dislike the cold of the ice or the possibility of salt dripping out of the bag with the ice melt.
5. It does take a while to get the ice cream to harden, usually 20-30 minutes. To see if it's ready, move the ice to the sides so that you can touch the ice cream mixture through the bag. When it's done it should feel like soft-serve ice cream.
6. Once the ice cream is done, remove the inner quart sized bag. They can either eat it directly from the bag or they can put it in a bowl. Also, allow them to add toppings.
7. The main principle at play here is a chemistry principle called freezing point depression, a colligative property (properties that depend on the number of things dissolved in a liquid).

8. **The science:** When something freezes or solidifies, the molecules stop moving and form bonds to crystalize. If other things are in that liquid, freezing becomes more difficult, and a lower temperature is required. The more things there are in the liquid, the harder it is to solidify. In this case, we are adding sugar to the half-and-half and this is preventing it from becoming completely solid. Instead, it forms a soft icecream.

Food Science Activities

2 - DIY Gummy Worms

Time: 30 minutes, plus setting time
Supplies: Jell-O, gelatin, water, large pot, measuring cups and spoons, pipette (optional), small cup (3-5 oz.), bowls, popsicle sticks, straws, rubber band, refrigerator (preferred)

1. For 40-50 people: Measure out 1 cup of Jell-O mix. This should be about 5-1/3 packets. Mix the Jell-O with 3 cups of gelatin (about a pound). To scale the recipe down, you should have a 1:3 ratio of Jell-O to gelatin. Please note: Jell-O and gelatin packets from the store do not necessarily have the same amount in them.
2. Give each Girl Scout a bowl, a pipette, a popsicle stick, a small cup, a rubber band, and 12 straws. You may have to adjust the number of straws.
3. Cut the straws in half and place into the cup. Put a rubber band around the straws.
4. Go around and give each participant 1 tablespoon of the gelatin/Jell-O mixture.
5. Bring 12 cups (3 quarts) of water to a boil.
6. Go around and carefully add a quarter cup of hot water to each bowl. Have the Girl Scouts stir with a popsicle stick until it is entirely dissolved.
7. Once the mixture is cool enough to be handled, you can either pipette the mixture into the straws or just pour it from the bowl.
8. Place the straw bundles into the refrigerator if available. They should set within 60-90 minutes.

9. **The science:** Gelatin is a protein, which is a kind of thing that we eat that helps to build muscle and keep us healthy. Gelatin comes from a protein called collagen, which is found in many kinds of body parts. Gelatin is very unique because it doesn't connect to itself easily, so it stays liquid when you dissolve it in water. Since gelatin proteins are long and stringy, they connect as they cool down, lining up next to each other and then twisting. This is what makes gelatin and Jell-O bouncy and semi-solid.

Activity 3 - Fizzy Lemonade

Time: 15 minutes
Supplies: Lemons, large cups, baking soda, sugar, water, strainer, spoon, manual juicer (optional), food service gloves (recommended but optional)

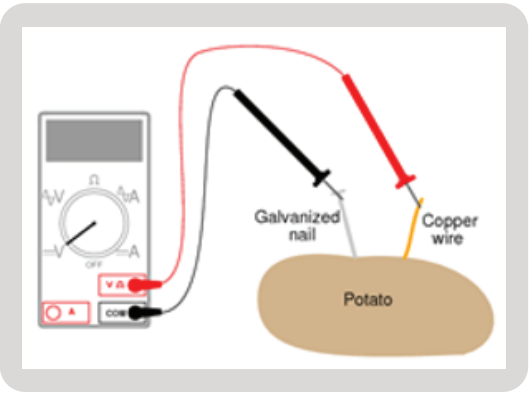
1. Put girls into pairs. Have each pair take 1-2 lemons (cut in half) and a cup.
2. Have the girls put on gloves (optional but recommended).

3. Using the juicer or by squeezing, get the lemon juice out of the lemon and into the large cup, using a strainer so the seeds are removed.
4. Have the girls add 1 teaspoon of baking soda and stir. The mixture should bubble, similar to the baking soda and vinegar with the balloon.
5. Once they have had enough of the bubbling, pour half of the mixture into a second cup, and add sugar and water to taste. This should be at least the same amount as they have of lemon juice.
6. Have them taste their fizzy lemonade!

7. **The science:** This is an acid-base reaction. Acids and bases are a way that we describe substances that reflects their pH, which is the concentration of hydrogen atoms. The lemon juice is the acid, and the baking soda is a base. They react to release a gas called carbon dioxide. The gas makes bubbles, which makes it fizzy.

Activity 4 - Electrochemical Kitchen

Time: 20 minutes
Supplies: Potatoes, lemons, other fruits and veggies (optional), pennies or copper wire, galvanized nails, multimeter or voltmeter, alligator clips or wire (optional)



1. Give each girl or group a potato or lemon, a nail, and a penny.
2. Have the girls squish the potato or lemon a bit to get the juices flowing.
3. Have the girls make their battery circuit by placing the penny or a 1–2-inch piece of copper wire into one end of the potato or lemon and the nail on the other end.
4. Test it by touching the multimeter or voltmeter to the two pieces of metal.
5. Have the girls test the various fruit batteries and see what gives the best voltage
6. Optional: Try wiring potatoes together in series and parallel. In series means that the potatoes are connected one after another and then it loops back around to form a circuit. In parallel means that the wires to each potato go back to the same place, rather than the wires connecting the potatoes to each other.

7. **The science:** Circuits can be made out of many different things, such as wires, pickles, stacks of metal, and more. In this case, the potato is acting like a wire, conducting the current from the battery through the LEDs to make them light up. The potato can do this because it has chemicals in it, such as salts, that conduct electricity.

Activity 5 - Celery Colors

Time: 10 minutes, plus overnight or longer
Supplies: food coloring, celery, water, clear jar or cup, knife

1. Clean a stalk of celery.
2. In the jar, mix 5-7 drops of food coloring with about 2 inches of water.
3. Cut about a half-inch off the celery stick and add it to the water.
4. Allow to sit overnight.

5. **The science:** Overnight, something called capillary action happens, where the small tubes inside the celery bring the colored water up through the celery, making it change colors.

References

Chemistry

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- Lungs in a Bottle: https://ctsciencecenter.org/blog/-science-at-play-make-your-own-lung-model/

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- Gummy Worms: https://onelittleproject.com/how-to-make-jello-worms/
- Fizzy Lemonade: https://www.learnwithplayathome.com/2014/09/how-to-make-fizzing-lemonade-edible.html
- Celery Science: https://rainydaymum.co.uk/celery-science-exploring-plants/