girl scouts of eastern pennsylvania

# Science Sampler

Grades 6-12

# Program Overview

The focus of this program is for girls to explore and learn more about the fields of science through fun, hands-on activities and experiments.

There are 11 30-45 minute activities in this program that are age appropriate for girls in grades 6-12. Some of the activities involve more complex concepts and will require hands-on assistance from adults especially for younger girls. Depending on the length of your program, you can choose as few or as many activities as you would like. There is no order in which the activities need to be done. All of the supplies needed for each activity are listed with the directions on how to complete the activity. It is recommended that you practice each activity before facilitating with a group so you are aware of any issues/problems the girls might encounter.

Each activity fulfills national leadership outcomes from the Girl Scout Leadership Experience, where girls Discover, Connect, and Take Action. Girls achieve these outcomes through the three Girl Scout processes: Girl Led, Learning by Doing, and Cooperative Learning. An important piece of the activities is the reflection that you do with the girls at the end. Doing the reflection in an enjoyable way helps girls process and retain what they have learned through their Girl Scout experience. One easy way to do reflection is to ask the girl: What?, So What?, and Now What?

When choosing the activities, use the information below as a guide:

- One day program- 5 activities
- 4 week program- 6-8 activities
- Incorporate into troop meetings- 1 activity per meeting

1. Snow Day!
2. Cartesian Divers
3. Polymer Bouncing Ball
4. Peppermint Bath Salts
5. Stroop Effect
6. Digesting Fats
7. Fingerprinting
8. Operation Espionage
9. Strawberry DNA
10. Lipstick
11. Whodunit?

Through these activities, girls will…..

**Discover**

1. Seek challenges in the world
2. Develop critical thinking

**Connect**

1. Promote cooperation and team building.
2. Resolve conflicts

**Take Action**

1. Feel empowered to make a difference in the world.

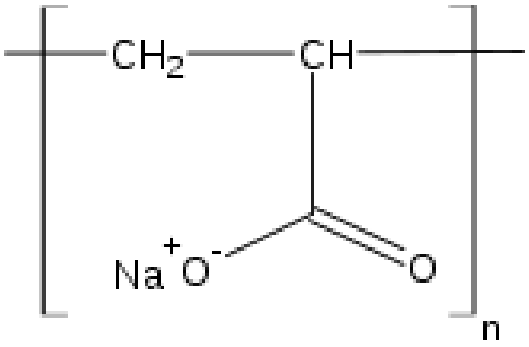
# Activity 1: Snow Day!

This activity is most appropriate for $9^{th}$-$12^{th}$ graders.

**Introduction:**
Movies and TV shows are often produced in areas very different from the climate that is shown. The makers of the movie might need to have a winter snow scene but it is the middle of summer and they are inside a studio. To solve this problem, they have to make fake snow. In this activity, you will make and observe fake snow on a smaller scale. Four different types of fake snow will be made by combining different amounts of water with a polymer called sodium polyacrylate. A polymer is a long chain of molecules that are made of repeating units of the same arrangements of atoms. The sodium polyacrylate is a long chain composed of many repeats of the structure shown below. This polymer changes as water is added.

**Materials Needed:**

- 1 ¼ teaspoons sodium polyacrylate, can be purchased online or found in baby diapers
- 8 tablespoons distilled water
- Magnifying glass
- 5 small clear plastic plates
- 3 wooden stir sticks
- 3 plastic cups (5 ounce)
- Measuring spoons




**Procedure:**
Plate A: Polymer Crystals

1. Measure ¼ teaspoon of sodium polyacrylate and pour onto a small clear plastic plate.
2. Touch the crystals, view with a magnifying glass, and record observations in the table "What did you see?"

Plate B:

1. Measure ¼ teaspoon of sodium polyacrylate and pour onto a small clear plastic plate.
2. Pour 1 teaspoon of distilled water onto the sodium polyacrylate (do not stir).
3. Touch the mixture, view with magnifying glass, and record observations.

Plate C:

1. Measure ¼ teaspoon of sodium polyacrylate and pour into a small clear plastic cup.
2. Pour 4 teaspoons of distilled water into the sodium polyacrylate and stir with a wooden craft stick.
3. Pour onto a clear plastic plate to more easily observe.
4. Touch the mixture, view with magnifying glass, and record observations.

Plate D:

1. Measure ¼ teaspoon of sodium polyacrylate and pour into a small clear plastic cup.
2. Pour 2 tablespoons of distilled water onto the sodium polyacrylate and stir with a wooden craft stick.
3. Pour onto a clear plastic plate to more easily observe.
4. Touch the mixture, view with magnifying glass, and record observations.

Plate E:

1. Measure ¼ teaspoon of sodium polyacrylate and pour into a small clear plastic cup.
2. Pour 4 tablespoons of distilled water onto the sodium polyacrylate and stir with a wooden craft stick.
3. Pour onto a clear plastic plate to more easily observe.

**Explanation:**

So where's the chemistry? Sodium polyacrylate is a polymer that absorbs water really well. When water is added, the sodium polyacrylate traps the water, which makes the polymer expand. The polymer traps the water because it has negatively charged oxygen atoms and water is attracted to atoms and molecules that have a charge. As you add more water, the polymer looks even bigger and the texture changes, much like different types of snow.

# Activity 2: Cartesian Divers

This activity is most appropriate for $6^{th}$ -$12^{th}$ graders.

**Introduction:**
This experiment demonstrates the property of **buoyancy**. An object is buoyant in water due to the amount of water it displaces or 'pushes aside'.

**Materials Needed:**
- 2 liter soda bottle and its cap or some other 'squeezable' clear plastic bottle
- Small container such as a large water glass or bowl
- Glass medicine dropper (one that sinks in water) [or plastic drinking straws, a paper clip, and some modeling clay]

**Procedure:**
1. Take the empty soda bottle and fill it completely with water.
2. Fill the water glass with water and place the medicine dropper in the glass.
3. Get some water inside the dropper by squeezing the rubber bulb while the end is in the water. You want to get the dropper to just barely float upright in the water.
4. Once you've done this, place the dropper in the soda bottle and screw on the cap tightly. Don't allow much air to be between the top of the bottle and the cap.
5. Gently squeeze the bottle. As you squeeze, the diver will dive (sink) to the bottom of the bottle. If you stop squeezing, the diver floats back to the top.

   Note: If you can't find a medicine dropper, you can duplicate the same effect by bending half of a plastic drinking straw in half and securing it with a paper clip. Put a small amount of modeling clay on the bottom end of the straw and, like the medicine dropper, just get it to barely float on the surface of the water in the water glass.

**Explanation:**
If the weight of water that is displaced by an object in water exceeds the weight of the object then the object will float. As you apply pressure to the bottle, you apply pressure to the air bubble in the dropper reducing its size. As the bubble's size reduces, the dropper becomes less buoyant and begins to sink. Release the pressure on the bottle and the dropper begins to rise back to the top.

Fish keep themselves from either sinking or floating to the surface by using muscles to squeeze or relax a small sac (with a small air bubble inside) in their bodies. By squeezing the sac smaller, the fish will sink. By relaxing their muscles, the sac increases in size, displaces more water, and a fish will begin to rise to the surface. Man uses this same principle to control the buoyancy of a submarine. By pumping water in and out of tanks stored in the submarine, a submarine can be made to rise and sink.

# Activity 3: Polymer Bouncing Ball

This activity is most appropriate for $6^{th}$ -$12^{th}$ graders.

**Introduction:**
Balls have been toys practically forever, but the bouncing ball is a more recent innovation. Bouncing balls were originally made of natural rubber, though now bouncing balls can be made of plastics and other polymers or even treated leather. You can use chemistry to make your own bouncing ball. The bouncing ball in this activity is made from a polymer.

**Materials Needed:**
- Borax (found in the laundry section of the store)
- Cornstarch (found in the baking section of the store)
- White glue (e.g., Elmer's glue - makes an opaque ball) or blue or clear school glue (makes a translucent ball)
- Warm water
- Food coloring (optional)
- Measuring spoons
- Spoon or craft stick to stir the mixture
- 2 small plastic cups or other containers for mixing
- Marking pen
- Watch with a second hand
- Metric ruler
- Ziplock plastic baggie

**Procedure:**
1. Label one cup 'Borax Solution' and the other cup 'Ball Mixture'.
2. Pour 2 tablespoons warm water and 1/2 teaspoon borax powder into the cup labeled 'Borax Solution'. Stir the mixture to dissolve the borax. Add food coloring, if desired.
3. Pour 1 tablespoon of glue into the cup labeled 'Ball Mixture'. Add 1/2 teaspoon of the borax solution you just made and 1 tablespoon of cornstarch. Do not stir. Allow the ingredients to interact on their own for 10-15 seconds and then stir them together to fully mix. Once the mixture becomes impossible to stir, take it out of the cup and start molding the ball with your hands.
4. The ball will start out sticky and messy, but will solidify as you knead it.
5. Once the ball is less sticky, go ahead and bounce it!
6. You can store your plastic ball in a sealed Ziploc bag when you are finished playing with it.

**Explanation:**
Polymers are molecules made up of repeating chemical units. Glue contains the polymer polyvinyl acetate (PVA), which cross-links to itself when reacted with borax.

# Activity 4: Peppermint Bath Salts

This activity is most appropriate for $6^{th}$ -$12^{th}$ graders.

**Introduction:**
In this activity, girls will make their own bath salts to use at home and learn about the benefits of bath salt over soap.

**Materials Needed:**
- ½ cup Epson salt
- ¼ teaspoon Peppermint oil
- Wax paper
- Ziplock bags

**Procedure:**
1. In a food processor, have the girls grind the Epson salts to a fine powder and pour into a bowl.
2. Next, have the girls add the peppermint oil and stir thoroughly until mixed.
3. After the Epson salt and peppermint oil is mixed, spread the mixture thinly onto a piece of wax paper to dry. If the girls are unable to leave their peppermint bath salts out to dry, give each girl Ziplock bag to put the mixture into and a piece of wax paper to let it dry at home.

**Explanation:**
Most households in America have hard water. Hard water has a high mineral content whereas soft water contains less of these minerals. The minerals calcium and magnesium in the hard water react with the soap forming a soap scum rather than a lather. This is why you need more soap to get clean and the bathtub gets a grimy ring around it. One way to soften hard bath water is to add bath salts. The calcium and magnesium ions are replaced with sodium and potassium from the salt, allowing the soap to lather more easily.

Another benefit of adding bath salts to your bath has to do with osmosis. Osmosis is the movement of water through a membrane, like your skin, to achieve equilibrium. Your body contains water and salt whereas and ordinary bath contains mainly water. Therefore, water passes through your skin in an effort to balance the concentration of water and salt. This excess water causes “pruning”.

# Activity 5: The Stroop Effect

This activity is most appropriate for $6^{th}$-$12^{th}$ graders.

**Introduction:**
Different pathways of the brain are used for completeing different activities. Seeing colors and reaidng words use two different pathways. During this activity, girls learn what happens when the brain is asked to read the color of the word and not the word itself. The famous "Stroop Effect" is named after J. Ridley Stroop who discovered this strange phenomenon in the 1930s.

**Materials Needed:**
- White cardstock paper
- Colored markers (red, black, green, yellow, purple, blue)
- Watch or clock

**Procedure:**
1. Divide girls up into groups of two.
2. Provide each group a sheet of white paper.
3. Have girls label one side of the paper as “Side 1”. Have girls write the colors in written form using the corresponding colored marker in a list. For example, write G-R-E-E-N using a green marker.
4. Have girls flip the paper over and label as “Side 2”. Have the girls write the colors in written form as follows:
   GREEN using red marker
   YELLOW using purple marker
   BLACK using yellow marker
   RED using green marker
   GREEN using blue marker
   YELLOW using red marker
   BLUE using yellow marker
   BLACK using purple marker
   RED using blue marker
   BLUE using green marker
5. Using side 1, have the girls say the color of the word they see as fast as they can. Time them to see how fast it takes to say the color of the word.
6. Using side 2, have the girls say the color of the word they see and not the word itself. Time them to see how fast it takes to say the colors.
7. Compare times for each side.

**Explanation:**
The girls experienced what is called interference. Some girls may have been reading the words of the colors instead of the colors themselves. The interference was seeing colors and reading words. The words themselves have a strong influence over your ability to say the color. The interference between the different information (what the words say and the color of the words) your brain receives causes a problem. There are two theories that may explain the Stroop effect:

1. Speed of Processing Theory: the interference occurs because words are read faster than colors are named.
2. Selective Attention Theory: the interference occurs because naming colors requires more attention than reading words.

# Activity 6: Digesting Fats

This activity is most appropriate for $6^{th}$-$12^{th}$ graders.

**Introduction:**
The girls will learn about how our body digests the fats and oils we consume.

**Materials Needed:**
- 2 glasses per group
- Warm water
- Dishwashing liquid
- Cooking oil
- Tablespoon
- Teaspoon

**Procedure:**
1. Fill the glasses ½ full with warm water.
2. Add a tablespoon of cooking oil to each glass of warm water.
3. Add one teaspoon of liquid dishwashing liquid to one glass.
4. Stir both.
5. Ask the girls what they see happening.

**Explanation:**
During digestion, fats and oils are difficult to digest. Instead of dissolving, the fat and oil molecules clump into blobs which make it more difficult for the enzymes in our digestive system to work on them. In order to be easily digested, the fats and oils need to be emulsified (broken into tiny droplets) so that their molecules are more exposed to the enzymes. In our body, the fats and oils are emulsified in our small intestine.

# Activity 7: Fingerprinting

This activity is most appropriate for $6^{th}$-$12^{th}$ graders.

**Introduction:**
Read the girls the following scenario: One evening you opened your diary and noticed a chocolate fingerprint smudge on the page describing your latest crush. You wonder who would have read your diary.

**Materials Needed:**
- Ink pads
- Magnifying glasses
- Wet wipes
- Fingerprint grid
- Types of Fingerprints

**Procedure:**
1. Share with the girls the different types of fingerprints and their characteristics. Refer to the Types of Fingerprints page to discuss the three common types of fingerprints which are:
    a. Loops
    b. Ridges
    c. Whorls
2. Provide each girl a copy of the Fingerprint Grid for her own fingerprints.
3. Next, have each girl roll each finger separately on the ink pad and then gently roll that finger onto the corresponding square on their handout.
4. After each girl has completed rolling all fingertips, wash hands with soap and water to prevent fingerprint smudging.
5. Next, have them examine their fingerprints with the magnifying glasses. Compare them to the three different types of fingerprints on the Types of Fingerprints page.
6. Are they able to tell what types of fingerprints they have? Let them know that they can have a combination of the three different types of fingerprints between both of their hands.

**Explanation:**
Fingerprints are really just patterns of tiny circles and ridges and valleys on the tips of fingers. They are there to help people get a better grip on smooth surfaces, but they are tiny so as not to interfere with a finger's sensitive ability to feel things. Each person's distinct fingerprint pattern was formed before birth. No two people have the exact same fingerprints – not even identical twins.

## Fingerprint Grid

Name: _____

| Right Thumb | Right Index Finger | Right Middle Finger | Right Ring Finger | Right Pinky Finger |
|---|---|---|---|---|
| | | | | |
| Left Thumb | Left Index Finger | Left Middle Finger | Left Ring Finger | Left Pinky Finger |
| | | | | |

Types of Fingerprints I have:

1. Loops = _____
2. Whirls = _____
3. Ridges= _____

**Types of Fingerprints**

Loop

Whorl

Ridge

# Activity 8: Operation Espionage

This activity is most appropriate for $6^{th}$-$12^{th}$ graders.

**Introduction:**
Secret agents from Washington just gave you the bad news! Your missing dog's collar has fallen into the hands of a canine spy, who's smuggling secret messages inside the collar. A double agent intercepted one of the messages-but it's blank. Could it be written with invisible ink?

**Materials Needed:**
- 1 tsp. of baking soda
- Water
- 3 bowls, 1 filled halfway with purple grape juice, 1 with grape juice concentrate and 1 with cranberry juice, each labeled
- 1 bowl filled halfway with water
- 1 spoon
- Cotton swabs
- Cotton balls
- Cup
- Paper
- Pencil
- Paper towels

**Procedure:**
1. Combine 1 tsp. of baking soda and 1 tsp. of water in a cup and stir.
2. Fold a sheet of paper into four equal parts.
3. Then unfold.
4. Dip a cotton swab into the invisible ink mixture and use it like a pen to write a secret message on each of the four sections.
5. Let the paper dry completely, this takes about 10 minutes. You may need to fan it in the air to help it along. What happens to your messages as they dry?
6. While your paper dries, line up the bowls filled with different kinds of liquids.
7. On each section of paper, test a different liquid.
8. Starting with one section, dip your cotton ball in one of the juices. Squeeze out the excess juice.
9. Gently pat (don't rub) the cotton over one of the sections of paper. Did your message appear?
10. Test each liquid on the three remaining sections of your paper. Use a new cotton ball each time. Does one liquid work better than the others to reveal the hidden message? What color is the message?

**Explanation:**
When you patted the juice on the dried baking soda, you caused a chemical reaction. Baking soda is what chemists call a base. The juices are acids. When a base and an acid come in contact, a chemical reaction can occur. Some chemical reactions result in a change in color, which is

what happened here. The chemical reaction turned the invisible message bluish-green, and that's why you could read it.

# Activity 9: Strawberry DNA

This activity is most appropriate for $6^{th}$-$12^{th}$ graders.

**Introduction:**

- Place Isopropyl alcohol in the freezer at least 30 minutes prior. The colder it is, the better separation the kids will get.
- Buffer solution: Mix 900mL water with 50mL of dish soap and 2 teaspoons of salt.

**Materials Needed:**

- 2 large strawberries
- 1 Ziplock freezer bag
- 1 coffee filter
- 1 rubber band
- 1 cup
- 1 clear plastic tube (test tube)
- 1 Popsicle stick
- 90% or higher isopropyl alcohol
- Buffer Solution
- Scissors

**Procedure:**

1. Place the strawberries in the Ziplock. Seal up the bag tightly trying to get out as much air as possible.
2. Gently smash the strawberries. The idea is to get juice so they really need to be smashed up. But just be gentle and careful not to explode the bags.
3. After the berries are pulverized, open the bag and add 2 spoonfuls of buffer solution. Reseal the bags and gently mix. It is important to make sure the kids mix this together gently because you do not want to create too many bubbles, which will slow down filtration.
4. Place a coffee filter over the cup and secure in place with a rubber band. You want to make sure your coffee filter has a nice deep well inside the cup to pour your strawberry slurry into.
5. Cut the tip off the bag and squeeze the strawberry slurry into the filter. Filtering takes some time so this is a good place to talk about DNA and how it might be useful to the police or even just the average person. See DNA cheat sheet below for some ideas and info.
6. Carefully remove the filter and rubber band. I suggest doing this inside the Ziplock bag or directly into the trash to avoid splatter.
7. Pour the red liquid into the test tube. You need at least a half-inch.
8. Slowly pour the ice-cold isopropyl alcohol down the side of the test tube to form a layer about an inch to an inch and a half thick on top of the red liquid. The alcohol will stay suspended on top because it is less dense than the viscous strawberry liquid. A layer of threads will form where the two liquids meet. This is the DNA.

9. Using a popsicle stick, you can reach into the test tube and pull the DNA threads into the alcohol layer. DNA is not soluble in alcohol and therefore is easily visible. You can pull the DNA all the way out but it will then just look like snot. It is most visible as strands when swirled around in the alcohol.

**Explanation:**

DNA – Deoxyribonucleic Acid

DNA is the blueprint of all living things. Every living thing has its own special DNA. It is what tells your cells how to function, what you will look like, and what type of organism you will be Identical twins are the only case where two people have the exact same DNA. DNA is found in every one of your trillions of cells. It is neatly coiled up inside the nucleus of the cell for safekeeping. Forensic scientists can use DNA from hair, blood, skin, saliva, etc to match a victim or perpetrator to a crime. The structure of DNA was discovered by Watson and Crick in the 1950s however, they would not have been able to make this discovery without the important x-rays and work done by Rosalind Franklin. Humans have 46 chromosomes in 23 matching pairs. You get one set of your chromosomes from your mom and the partners from your dad. To use DNA to id people you must put it through a special process called gel electrophoresis. This produces a picture that is a series of bars of varying thicknesses and with varying spaces between the lines. This picture is called a DNA profile.

# Activity 10: Learning from Lipstick

This activity is most appropriate for $6^{th}$-$12^{th}$ graders.

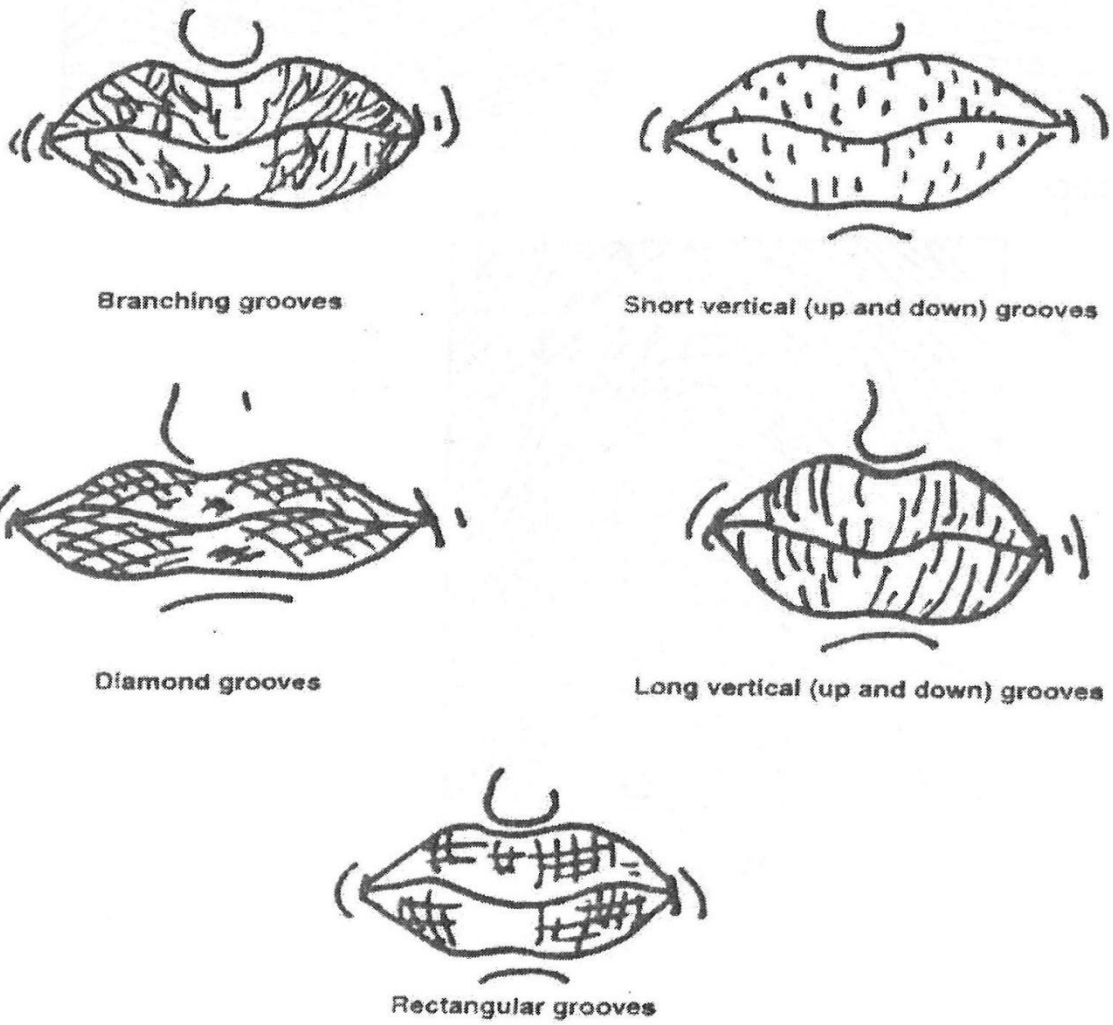
**Introduction:**
You are at the end-of-the-year Girl Scout party. After returning from the washroom, you notice someone has been drinking from your straw, finishing your soda. No one will admit to finishing your drink, but lipstick marks on the straw have been left behind.

**Materials Needed:**
- Index cards
- Lipstick
- Magnifying glasses
- Mirror
- Q-Tips to apply lipstick
- Common Lip Prints

**Procedure:**
1. Provide each girl with two index cards and have them label them; one card "suspect" and the other card "crime scene". Be sure they write their names on the index card labeled "suspect".
2. Discuss the different types of grooves found within a lip print. Use the Common Lip Prints sheet. As with fingerprints, lips have their own prints. The five types of lip prints are:
    a. Branching grooves
    b. Short vertical grooves
    c. Diamond grooves
    d. Long vertical grooves
    e. Rectangular grooves
3. Have each girl apply the lipstick on her lips using a Q-Tip.
4. Next, have each girl press their lips onto both sides of their index cards.
5. Have the girls make two stacks of index cards: one pile of "suspect" cards and one pile of "crime scene" cards.
6. Shuffle through the crime scene lip prints and choose one to be the one found on the straw.
7. Once the "crime scene" card has been chosen, pass out the "suspect" cards. Have the girls examine all lip prints and compare to the "crime scene" lips.
8. Can they figure out which set of lips committed the crime?

**Explanation:**
Our lips, just like our fingers, have prints. There are 5 different kinds of lip prints that someone may have.

**Common Lip Prints**



# Activity 11: Whodunit?

This activity is most appropriate for $6^{th}$-$12^{th}$ graders.

**Introduction:**
Read the following scenario to the girls: Help! Grandma's been arrested! Detectives say she baked a cake with a metal file in it so that someone could use it to break out of jail! But sweet old Grandma would never turn to a life of crime! The cake in question was made with baking soda. Quick! Head to the crime lab to test the powder found on Grandma's apron. If it's something besides baking soda, she's innocent! Today's challenge is to solve the case of the mystery powder-the secret is in the science!

**Materials Needed:**
- Data table
- Pencil
- Purple grape juice
- White vinegar
- Iodine
- 3 cups, each with 1 teaspoon of baking powder
- 3 cups, each with 1 teaspoon of flour
- 3 cups, each with 1 teaspoon of baking soda
- 3 cups, each with 1 teaspoon of the mystery substance
- 3 pipettes or eyedroppers
- Paper towels
- Sticky notes (to use as labels)

**Procedure:**
1. Make labels for the powders and liquids using the example table found below and arrange in a grid on a table.
2. Get 3 cups containing each powder (9 in total), and line them up under their labels (see illustration). Your cups with the mystery substance come later!
3. Put 5 to 10 drops of grape juice in one cup of baking powder. What happens? Record your observations on the data table.
4. Now try the grape juice on the other two powders, recording your observations each time. In some cases, a chemical reaction will occur. Signs of a chemical reaction include foaming, fizzing, or a change in color. But sometimes no chemical reaction can be seen. Can you tell the difference?
5. Test all the liquids with all the powders and write your observations on the data table. Use a new pipette with each liquid.
6. Get 3 cups containing the mystery substance and line them up next to the grape juice, vinegar, and iodine. Test and record your observations. (Hint: the mystery powder is one of the three powders you already tested!)
7. Did your observations about the mystery substance match any of the three powders you tested? By comparing your data, can you figure out what the mystery substance is?

8. Explain your reasons. Did you prove Grandma's innocence? Remember: The cake at the crime scene was made with baking soda. Does the mystery substance found on Grandma's apron match it, or is it different?

**Explanation:**
A chemical will react in the same way every time, as long as the conditions are the same. You set up the experiment so that each powder was tested in exactly the same way. Then you observed the chemical reactions closely and recorded your data. When you drew conclusions about what the mystery substance was, your conclusions were supported by scientific evidence.

| | Baking Powder | Flour | Baking Soda | Mystery Substance |
|---|---|---|---|---|
| Grape Juice | | | | |
| Vinegar | | | | |
| Iodine | | | | |