

**Chemistry Craze
Girl Scout Junior Badge
Girl Scouts of Wisconsin - Badgerland Council**



Complete 6 of the 7 activities to earn the Chemistry Craze Girl Scout Junior Badge

1. Safety

Working with chemicals can be fun and exciting but caution is **always** necessary. Discuss the following important aspects of safety when working with chemicals with your troop, your leader, or an expert in the field.

- Proper attire for working in a laboratory and working with chemicals - what should and shouldn't you wear?
- Chemical safety such as proper disposal and clean up
- Common accidents that can happen and how those can be prevented

2. Density

Density is described as units of mass per unit of volume. A good way to think of it is how heavy something is compared to how much space it occupies or how big it is. Here are two activities to demonstrate this concept. Do *at least* one of them.

Experiment 1

This experiment can be done in small groups or as a large demonstration.

Materials:

- 2 clear, colorless containers of identical size, such as:
 - Florence flasks
 - Gas collection bottles
 - Short, narrow-necked bottles like small flower vases or ketchup bottles
- Index card
- Food coloring
- Hot water
- Cold water

Procedure:

1. Add 5 drops of food coloring to one bottle, and then fill with hot water
2. Fill the other bottle with cold water. Make sure both bottles are completely full.
3. Cover the bottle of cold water with the index card.
4. Invert the covered bottle of cold water over the bottle of colored, hot water. Place in front of a white background so that the result will be easy to see.
5. Carefully remove the index card between them. Hold the bottles together if necessary, so that they remain balanced.
6. Repeat the procedure putting the hot water bottle on top and the cold water bottle on the bottom.

Discuss:

Why does the hot water rise to the top? What happens when the cold water is on the bottom?

Experiment 2

This can be done as a hands-on demonstration.

Materials:

1. 3 bowling balls of different masses, 10 pounds, 12 pounds and 14 pounds work the best.
2. A large tub filled with water.

Procedure:

1. Ask three girls to pick up one ball of their choice.
2. First ask the group to guess whether the bowling ball will float or sink, then ask the girl to gently drop her ball in the water.
3. Repeat with the second ball and then with the third.

Discuss:

Why did one ball sink, one ball float and one ball bob when all three of them are bowling balls?

3) Acids and Bases

An acid is a compound that has extra hydrogens it is willing to give up. A base is a compound that is willing to accept extra hydrogens. That is why acids and bases react very easily with each other. pH is a scale used by scientists to determine whether a chemical is an acid or a base and how strong of an acid or base it is. If a compound has a pH higher than 7 it is considered a base and if a compound has a pH lower than 7 it is considered an acid. For an acid, the lower the number the stronger it is and for a base the higher the number the stronger it is. A compound that has a pH of exactly 7 is considered neutral (neither an acid nor a base). Here are two activities to demonstrate this concept. Do *at least* one of them.

Experiment 1

This experiment can be done as a hands-on activity.

Materials:

1. 15 cm³ (1 tablespoon) of baking soda (sodium bicarbonate)
2. 15 cm³ (1 tablespoon) of laundry detergent
3. about 180 milliliters (3/4 cup) of water
4. about 60 milliliters (1/4 cup) of vinegar
5. several drops of food coloring (optional)

6. a 400-milliliter (12-ounce) drinking glass
7. a waterproof (plastic or metal) tray
8. a teaspoon

Procedure:

1. Place the drinking glass on the tray.
2. Put 15 cm³ baking soda and 15 cm³ laundry detergent in the glass.
3. Add 180 mL of water and a few drops of red cabbage juice (made by blending pieces of cabbage in water and then straining the solution). Gently stir the mixture to mix the contents of the glass.
4. To display and observe the fizzing and foaming, quickly pour the vinegar into the glass. The mixture will foam up and over the top of the glass, covering the tray with a froth of tiny bubbles.

Discuss:

What happens to the solution when the vinegar is added? Why does this happen?

Experiment 1b

Materials:

1. Fresh lime or lemon
2. knife to cut fruit
3. 10 drops liquid dishwashing soap
4. 20 cm³ (1 heaping tablespoon) of baking soda (sodium bicarbonate)
5. soda glass
6. shallow pan, such as pie tin
7. tablespoon

Procedure:

1. Cut the lemon or lime in half and squeeze its juice into the soda glass.
2. Add the 10 drops of liquid dishwashing soap to the juice in the glass.
3. Hold the glass over the pan and add the tablespoon of baking soda to the glass.
4. Stir the mixture till you see a thick white foam form.

Discuss:

What kind of acid is in lemons and limes? Why did this foam form?

4) Food and Chemistry

Chemistry is involved in a lot of our everyday lives including food. Here is one experiment to show how food and chemistry are related:

Experiment

This experiment can be done as a hands-on activity.

Materials:

1. A nonmetallic container, about 500-mL
2. Stirring rod or pencil
3. Magnet, donut or bar shaped
4. 2 plastic bags with ties
5. 1 cup of breakfast cereal with 100% of the minimum daily requirement of iron

6. Rolling pin
7. Water

Procedure:

1. Tape the magnet to the pencil. Insert into a plastic bag and fasten with a tie.
2. Place the cereal in a plastic bag.
3. Crush the cereal with the rolling pin.
4. Pour the crushed cereal into the container and cover with water.
5. Use the magnet- pencil stirrer to stir the cereal slurry for about 10 minutes.
6. Remove the stirrer from the container and observe the fine black iron filings on the outside of the plastic bag.
7. Return the stirrer to the plastic bag and continue stirring for 5 minutes.
8. Remove the stirrer from the plastic bag and observe again the iron filings.

Experiment 1b

This experiment can be done as a hands-on activity.

Materials:

1. 1 cup of breakfast cereal with 100% of the minimum daily requirement of iron (Total, CoCo Wheats)
2. 8.5 x 11 office paper
3. Rolling Pin
4. Magnet, preferably strong

Directions:

1. Crush cereal with rolling pin on top of paper
2. Move paper, with cereal, on top of the magnet so the paper and magnet are in contact with one another.

Discuss:

Many cereals are fortified with iron. To fortify is to strengthen or improve by adding extra of an ingredient. In this case the cereal is fortified with iron, which is essential in maintaining a healthy body. The abundance of iron in the cereal causes the pieces of cereal to be attracted to the magnet.

5) Water Chemistry

Static electricity is the accumulation of an electrical charge in an object. The electrical charge forms when two objects are rubbed together. The electrons jump from one surface to the other. In this first experiment we see the interaction between static electricity and water.

Experiment 1**Materials:**

1. A dry plastic comb
2. A water faucet
3. A wool cloth or a head of hair.

Procedure:

1. Rub the comb with the wool cloth or on your head to create a charge on the comb.

2. Turn the faucet on (not very strong) and bring the comb close to the faucet. Does the water bend? Why does this happen?

In this second experiment we learn about the heat capacity of water. Heat capacity is the amount of heat an object, or solution can hold as the temperature increases or decreases.

Experiment 2

Materials:

1. A half and half solution of rubbing alcohol and water.
2. A dollar bill
3. A flame
4. A pair of tongs

Procedure:

1. Soak the dollar bill in the water and ethanol solution.
2. Remove the dollar bill with a pair of tongs and light on fire.

Discuss:

Why doesn't the bill burn? What property of water is this?

6) Physical Chemistry

Physical chemistry is the branch of chemistry that studies the relationships between physical properties and chemical compositions of chemistry. In general physical chemists study chemistry where it and physics meet. They study molecules, their interactions and bonds on microscopic level.

These two experiments demonstrate key concepts in physical chemistry.

Experiment 1

Concept: Surface Tension

This experiment can be done in small groups or as a large demonstration.

Materials:

1. Aluminum Pie Tin
2. Milk
3. Food coloring
4. Dish soap

Procedure:

1. Fill the pie tin half way with milk.
2. Ask girls to add food coloring drop by drop sporadically over the milk.
3. Once finished, add the dish soap drop by drop on top of the food coloring.
4. You should see the drops of food coloring expand immediately after contact with soap.

Experiment 2

Concept: Chemiluminescence

This experiment should be done as a large demonstration.

Chemiluminescence is the release of energy in the form of a photon of light. This occurs when a molecule that is in an excited state, a state with excess energy, returns to its ground state, a state of lowest energy.

Materials:

1. 3 light sticks
2. 3 same size containers that can hold hot water
3. Hot water
4. Room temperature water
5. Ice water

Procedure:

1. Fill the three containers, one with hot water, one with room temperature water and the other with ice water.
2. Drop one light stick into each container.
3. Leave for 5 minutes then take out and crack the light stick.

Discuss:

Is there a difference between the three? Does one glow brighter than the other two?

7) Careers in Chemistry

Careers in chemistry are almost limitless. Many jobs in manufacturing require chemistry, such as making products out of paper or metal or even making food. You can have a chemistry career where you work to keep the environment clean or keep people healthy. A career in chemistry does not always mean working in a laboratory. Learn about the many possibilities through at least one of the following activities.

1. Have a professor or a chemist from the industry come and talk about their job. Find out what they do on a daily basis, what they like best and least about their job, and what kind of schooling and job experience they needed to get there.
2. Using the internet or other sources, find out about the variety of careers possible in the field of chemistry. Find out about at least 6 different chemistry careers. Create a booklet of career information or a collage or some other way to present your findings to others.

To order badges and patches from Badgerland Council Contact the Madison Girl Scout Center Trefoil Shop at 608.237.1173 or 800.236.2710 x 1173.

**Girl Scouts of Wisconsin - Badgerland Council
Chemistry Craze Badge Booklet
For Girl Scout Leaders**

The following information is designed to give troop leaders and other adults' additional information to help Junior Girl Scouts complete the requirements for Badgerland Council's Chemistry Craze Girl Scout Junior Badge. Each section corresponds to the Badge requirement.

1) Safety –

Make sure you have proper approval from an adult before starting any experiment.

- Proper attire for working in a laboratory and working with chemicals - what should and shouldn't you wear?
 1. Goggles are the number one item that must be worn in a lab. Wearing goggles will protect your eyes and prevent any chemicals from splashing into them.
 2. Wear gloves to protect you hands from any chemicals you are working with.
 3. Do not wear shorts or open-toed shoes. This makes it really easy for chemicals to harm your skin if they fall on you.
 4. Do not wear short with wide sleeves. Your sleeves might get caught on something, get dragged through chemicals or might catch on fire if you are working with it.
 5. If you have long hair, make sure it is tied back and out of the way because it could also catch on fire or get into chemicals if it is let loose.

- Chemical safety such as proper disposal and clean up
Each chemical has a material safety data sheet (MSDS). On this sheet is listed all the potential hazards and what to do with the waste chemical. It is best to read through the MSDS of any chemical you are working with before working with it.

- Common accidents that can happen and how those can be prevented (see proper attire above for some additional accident prevention).

Accident:	Prevented by:
Cutting yourself with glassware	Be extremely careful when handling glassware. If you break something do not try and clean it up yourself, ask an adult to do it for you.
Burning yourself	Be sure you are aware of objects that are hot around you. Hot and cold glass look alike so be extra careful with working with glass. If you are working with fire or a hot plate make sure you are careful and have proper protection on your hands, such as oven mitts.
Spilling dangerous chemicals on yourself or someone around you	Do not make any sudden movements around the laboratory, such as running or jumping. Make sure you are aware of your surroundings and carry all you chemicals with two hands.

****For the experiments required to earn this badge, materials and procedures are listed in the badge requirement section. Answers to the discussion questions are listed below.**

2) Density

Experiment 1: Density of hot and cold water

Why does the hot water rise to the top?

Solutions with a higher density sink to the bottom of a container, while solutions with a lower density sink to the bottom. The molecules in hot water have a little more kinetic energy due to the heat of the solution. This causes the molecules to spread out a little more and therefore has less mass for a given volume. This also means that the hot water has a lower density compared to the cold water. Therefore the hot water moved to the top and the cold water moved to the bottom of the container.

What happens when the cold water is on the bottom?

When the cold water is on the bottom, the more dense solution is already on the bottom so there is no change in the two bottles.

Experiment 2: Floating Bowling Balls

Why did one ball sink, one ball float and one ball bob when all three of them are bowling balls?

This is because of their different densities. Objects with a lower density float and objects with a higher density sink. In this case the bowling balls all had the same volume, however their masses were different. This gave the bowling balls different densities. The bowling ball with the largest mass and highest density will sink; the one with the middle mass and density relatively equal to water will bob, and the one with the lowest mass and density will float.

3) Acids and Bases

Experiment 1: Reaction of Vinegar and Baking Soda

The reaction carried out in this experiment is an acid base reaction. The vinegar, also known as acetic acid, reacts with the sodium bicarbonate (the base), also known as baking soda. The fizz and bubbles that are formed are a result of carbon dioxide gas that is released when the reaction occurs.

What happens to the solution when the vinegar is added? Why does this happen?

The color of the solution changes from a blue-green to a bright pink. This happens because the solution is going from basic with just the baking soda and soap, to acidic with the addition of vinegar. The color change also indicates that the pH of the solution is changing.

Experiment 1b: Another Acid and Base Reaction

What kind of acid is in lemons and limes? Why did this foam form?

In this experiment we carried out another acid base reaction, where carbon dioxide gas was formed. However this time instead of acetic acid from vinegar we used citric acid from the lemon or lime. The foam that formed was the release of carbon dioxide gas.

4) Food Chemistry

Experiment: Iron Fortified Cereal
(explanation is given in badge).

5) Water Chemistry

Experiment 1: Bending Water

Does the water bend? Why does this happen?

The stream of water should bend toward the comb. This is due to static electricity, a build-up of charge on an object. When rubbing the comb with the wool cloth, or running it through your hair a charge is formed on the comb by electrons jumping between your hair or the wool cloth and the comb. When you bring the comb close to the water, the water molecules are attracted to the charge on the comb, so the stream bends toward the comb.

Experiment 2: Burning a Dollar Bill

What property of water is this?

It is the property of heat capacity. Water has a high heat capacity because it has a lot more molecules for a given mass than other liquids with the same given mass.

Why doesn't the bill burn?

The bill does not burn because the solution that the bill is dipped in contains 50% water. Since water has a high heat capacity, it is able to withstand a lot of heat before it starts burning. So what is actually burning is the alcohol, while the dollar is protected by a layer of water.

6) Physical Chemistry

Experiment 1: Surface Tension

Surface tension is a property of liquids that allows the surface to behave like a flexible sheet of plastic or glass. This occurs because of the forces between the liquid molecules at the surface of a container.

In this experiment the dye is stuck in droplet form on the surface of the milk, due to surface tension. However, once the soap is added the surface tension is disrupted to the food coloring is free to expand and mix with the milk.

Experiment 2: Chemiluminescence

Is there a difference between the three?

In this experiment you will see the effect of temperature on the rate of reaction. (see below for further explanation)

Does one glow brighter than the other two?

The light stick in hot water glows much more brightly than the other two light sticks. Raising the temperature of the light stick causes the reaction within the light stick to occur much faster so the glow is much more intense, but only lasts for a short period of time. The light stick in room temperature water will not glow as bright as the one in hot water, but it will keep glowing for a longer period of time. Lastly, the light stick in cold water will have the lowest glow intensity. However, it will keep glowing for an incredibly long period of time. In fact, one scientist has observed a glow from a light stick that was kept in the freezer for six months after it was activated.

7) Careers in Chemistry

A real effective way to complete this requirement would be to have several people from varied chemistry careers come talk to the girls at one time. Each could give a 5-10 minute talk on their career then the girls could ask questions of all participants at the same time.