STEM ON A DIME

GLOWING CHROMATOGRAPHY FLOWERS

Activity Adapted from STEAM Powered Family: Circuit Flower

Activity Updated August 2021

SKILL LEVEL

Ages 6- 18

KEY TERMS

Chromatography, Solution, Solvent, Solute, Rate, Circuit, LED, Semiconductor, Diode, Leads, Terminals

EDUCATION STANDARDS

South Dakota Science:

- 4-PS3-2

TIME NEEDED

Part I: 20 minutes + dry time

Part II: 20 minutes

MATERIAL LIST

Materials needed per circuit:

- One Coffee Filter
- One Paper Plate
- One tsp Water
- One Water Dropper (optional)
- One LED (5mm-10mm)
- Two 8-inches Copper Wires (18-22 gauge)
- One Clothespin
- One Coin Battery
- One Pipe Cleaners (optional)

Materials to be shared by group:

- Washable Markers
- Electrical Tape
- Wire Stripper
- Jewelry Pliers

EXPECTED LEARNER OUTCOMES

OBJECTIVE 1 – Youth will observe the process of chromatography.

OBJECTIVE 2 – Youth will learn the basics of electrical wiring and complete an electrical circuit that will power an LED.

BACKGROUND

In this lesson, youth will explore the basics of chromatography (Part I) as well as learn how to build a basic circuit (Part II).

Have you ever looked at a bubble and seen different colors? The bubble acts as a prism separating the color components that make up light. Like sunlight, chemical mixtures can be separated into their individual components through a process called chromatography. Chromatography physically separates a solution by passing it through a medium. The various solutes in the solution move at different rates which encourages the separation. The medium used for this activity is a coffee filter, the solution is the marker ink and the solutes are the various components that make up the markers color. The coffee filter separates the marker components using water to mobilize the solutes.

While electricity is part of daily lives, seldom do we stop to think about how it works. An electric current passes through a conductive material (most often copper wire) from an energy source to something that uses the energy and then back to the energy source. In this activity youth will create a circuit so electrical current can make their flower glow.

VOCABULARY

Chromatography - A process in which a chemical mixture carried by a liquid or gas is separated into individual components as they flow around or over a stationary liquid or solid material.

Solution - A liquid mixture made of a uniform mixture of solute in solvent. (e.g. salt water = salt (the solute) + water (the solvent)

Solute – The substance dissolved in another substance (solvent).

Solvent - The liquid part of a solution.

Rate - How quickly or how slowly something moves in relation to another object.

Circuit – The pathway that allows electricity to flow from the power source (out of the + side) to the item being powered (light, motor, etc.) and then back to the power source (into the – side).

LED (Light Emitting Diode) – A semiconductor diode which glows when voltage is applied. Unlike a traditional light bulb, an LED only allows electrical flow in one direction.

Semiconductor – A material that has a conductivity value falling between those of conductors (like metal) and insulators (like glass).

Diode – A one-way switch that allows current to easily flow in one direction but resists its flow in the opposite direction.

Leads – Every LED has two legs. These legs are called leads. The longer lead is generally the positive lead, while the shorter lead is generally the negative lead. This however is NOT always true as it is NOT an industry standard.

Terminals – The ends of a battery; one is always positive and one is always negative.

ACTIVITY PREPARATION

1. Gather the materials needed for each youth
   a. Clothespin (one for every flower) – These will serve as the base for the flower as well as be used to hold the battery in place.
   b. Coin Battery (one for every flower)
   c. LEDs (one for every flower) – For ease of distributing these to youth, you may want to tape them to a small piece of paper, note card or something similar. For introductory purposes, a 5 mm or 10 mm LED will suffice. The LEDs can easily be purchased through Amazon.

5 mm LED

   d. Copper Wire – For each flower you will need two wires, approximately 8-inches in length — 18- to 22-gauge insulated copper wire works well for this. Depending on the ability of your youth, you may choose to strip the ends of these wires prior to the activity.
   e. Coffee Filters – The coffee filters will serve as the medium for separating out the pigments in the marker. A minimum of one coffee filter is needed for each flower; but if you want, multiple filters can be combined to create a fuller flower. If you are limited on time and won't be able to dry the flowers between the chromatography portion and the creation of the flower, you may choose to use colored tissue paper and skip Part I of the lesson. The tissue paper will need to be cut into a circular shape.

f. Paper Plate – These will be used to help contain water spills and keep marker from leaking onto the work surface.
g. Pipe Cleaners – This is an optional addition to the flower, and is used to cover the stem (clothespin) of the finished flower. You may choose to use floral tape or something similar for this as well. Another option would be to use green colored clothespins.
h. Water – It will require approximately a teaspoon of water for each flower. If you have access to a pipette or small syringe that youth can use to add water a few drops at a time, this is ideal. If not, they can slowly pour the water on to the coffee filter; however, if water is added too fast it can hinder the pigment separation.

2. Gather materials for youth to share
   a. Washable Markers – The darker colors will work best for this activity as they are generally comprised of more pigments.
   b. Electrical Tape – If you don't have access to electrical tape, masking tape could be used. This will be used to hold wires to the clothespin and keep wires from touching each other.
   c. Wire Stripper – Make sure that the wire stripper can easily strip the wire without cutting through it. If you are short on time, or your youth don't have the hand-eye coordination, you may want to strip your wires in advance.
   d. Jewelry Pliers – These will be used primarily for connecting the wires to the LED leads. This can be done without pliers, but it can be a challenge even for youth who have good hand-eye coordination.

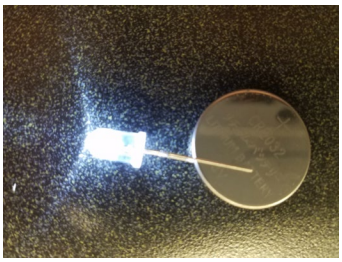
ACTIVITY INSTRUCTIONS

1. Part I.
   a. Provide each youth with a coffee filter and paper plate.
   b. Have them flatten out the filter on the paper plate.
   c. Allow youth to select a minimum of one marker color. If they want more than one color limit them to two or it may be hard for them to distinguish what colors are being separated.
   d. Instruct them to draw a thick circle halfway between the middle and the edge of the filter. They can use multiple colors as long as they leave enough white space for the colors to move.

   e. Place coffee filter on plate and then SLOWLY add a teaspoon of water in the center of the coffee filter (if you have a dropper add one to three drops at a time). Do not use too much water or all of the pigment will wash out of the filter and puddle on to the plate. It may take five to 10 minutes for the pigment to reach the edge of the filter.

f. Have the youth make observations about what is happening:
    i. What do they notice?
    ii. Are different colors emerging? What are they?
    iii. Have them compare with one another. What do they notice is different between colors?
    iv. Why do they think that this might be?
g. Introduce Chromatography to explain what has happened.
    i. Chromatography is a process in which a chemical mixture (in this case the marker ink) is carried by a liquid or gas (in this case the water) and is separated into individual components (the different pigments that make up the marker ink) as they flow around or over a stationary material (the coffee filter).
h. Make sure to let it dry completely before continuing. The dry time will vary depending on the amount of water applied as well as the atmospheric conditions.

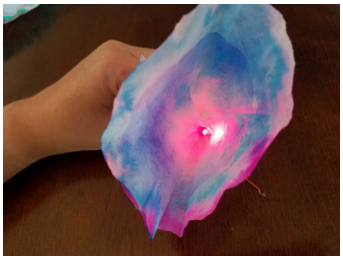
2. Part II.
    a. Introduction to LEDs
        i. Based on youth background knowledge, you may want to provide some insight on what a circuit is.
        ii. Instruct them that they will be creating a circuit utilizing an LED and the battery and ask if they can identify how these two objects can create a circuit. (You may want to talk about conductors and insulators here depending on youth interest. For more information on this topic, see the STEM on a Dime Robo Art lesson.)
        iii. Have the youth try and make these simple circuits with their LEDs. They will place one lead on either side of the battery and hold in place.



            1. Do some of the LEDs light up while others don't?
            2. Have youth compare their set ups. If one LED lights up and the other doesn't, can they identify what is different?
            3. Are the long and short leads on different terminals of the battery?
        iv. After a few moments of letting them compare and identify the differences, have them share back what they noticed. Most likely they will note that the one lead (depending on your LEDs this will be the longer lead) needs to be on the positive terminal while the other should be on the negative terminal.
    b. Provide the definition of an LED and diode to solidify what they have discovered about the LEDs.
    c. Have youth fold the filter not quite in half.

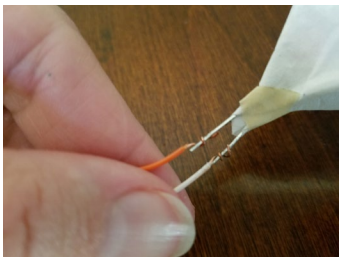
d. Flip the filter over and poke the leads of the LED through the filter.

e. Fold or roll the filter around the LED to create the flower, you may want to put a bit of tape on the bottom of the filter to hold it together. The center of the filter will serve as the stalk of the flower, and the exterior edges of the filter will serve as the petals.

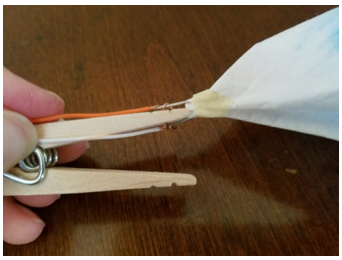
Fold			
Roll			

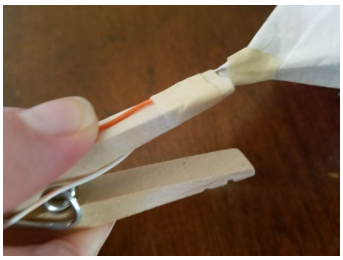
f. If you didn't prep the 8-inch wires, have the youth strip a small portion (¼ - ½ inch) of each end.

g. Wrap each LED lead with the exposed portion of a wire. Each lead should have its own wire. You may need to use a plier to get them secure. You may also want to use tape to hold them in place.

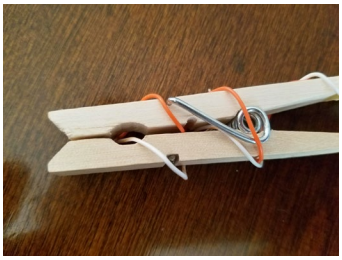


h. Take the leads and place them on opposing sides of the end of a clothespin and secure with tape.

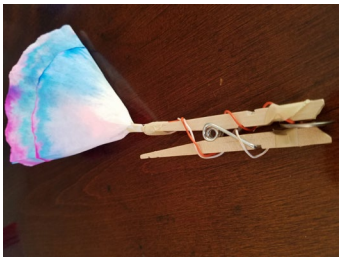




i. Start wrapping wires around the clothespin, separate wires when you get to the spring and wrap them on opposite parts of the clothespin base.



j. Be sure the stripped ends of wire are on the inside of the clothespin and place the battery between the clothespin legs. You may need to use tape to secure these in place; however, be sure to not cover the exposed wire or they won't be able to connect with the battery.



k. If it doesn't light up:
   i. Make sure the battery is making contact with both bare wires.
   ii. Flip the battery.
   iii. Make sure the bare wires are not touching.
l. Once you have been successful in lighting up you flower, wrap your clothespin in pipe cleaners for additional décor and enjoy your chromatography flower. When wrapping, be sure to leave room to remove your battery. You do not want to light the flower continuously.
m. Have youth share and compare their creations with one another and reflect.
   i. What similarities do they see? What differences?
   ii. What was the most challenging part of the activity?
   iii. What was the most fun part of the project?
   iv. What might they do differently if they were to do it again?

EXTENDED LEARNING

Once youth have the basics of building a simple circuit mastered, they can begin creating various works of art with built-in circuits. Consider some of the ideas shared by the following sources:

Maker Ed (http://makereducation.weebly.com/circuits--led-projects.html)

Makerspaces.com Simple Circuit Projects (https://www.makerspaces.com/25-makerspace-projects-for-kids/)

These ideas and skills can be further developed through the exploration of other electricity-based STEM on a Dime lessons like Circuit Bugs, Robo Art, Introduction to Paper Circuits and Basic Bread Boards; as well as through exploring the South Dakota 4-H Electricity Project (https://extension.sdstate.edu/4-h-electricity-project).