STEM ON A DIME

CIRCUIT BUGS

Activity Adapted from 4-H at Home: Science Bug

Activity Updated August 2021

SKILL LEVEL

Ages 6 - 18

KEY TERMS

Circuit, LED, Semiconductor, Diode, Leads, Terminals

EDUCATION STANDARDS

South Dakota Science:
- 4-PS3-2

TIME NEEDED

20 minutes

MATERIAL LIST

Materials needed per circuit:
- Two LED Lights
- One Coin Battery
- Three Pipe Cleaners
- Clothespin

Materials to be shared by group:
- Copper Wire
- Pipe Cleaners
- Electrical Tape

EXPECTED LEARNER OUTCOMES

OBJECTIVE 1 – Youth will be able to construct a circuit.

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

OBJECTIVE 3 – Youth will be able to explain how a circuit works and why we use them.

BACKGROUND

How does the light turn on in your room? How does a remote-control car move from place to place? We know they use electricity but how does it get from its power source to where we need it? That's where a circuit comes into play, moving power from a battery to whatever needs power. Circuits can be simple such as one light being powered or large and complex like powering an entire city.

In this activity, youth will learn about the basics of electricity and how if flows through a circuit.

VOCABULARY

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 bug) – These will serve as the body of the bug as well as be used to hold the battery in place.
   b. Coin Battery (One for every bug)
   c. LEDs (Two for every bug) – 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 5mm or 10mm LED will suffice. The LEDs can easily be purchased through Amazon.

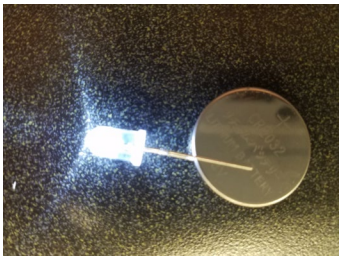
5 mm LED

   d. Copper Wire – For each bug, you will need four, approximately 8-inch wires. It's best to use 18- to 22-gauge insulated copper wire for this. Depending on the ability of your youth, you may choose to strip the ends of these wires prior to the activity. While not necessary, you may consider having two different colored wires to make it easier to distinguish between positive and negative leads.
   e. Pipe Cleaners – These will be used to cover the body of the bug as well as create wings, antennae and other bug features.

2. Gather materials for youth to share
   a. 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.
   b. 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.

ACTIVITY INSTRUCTIONS

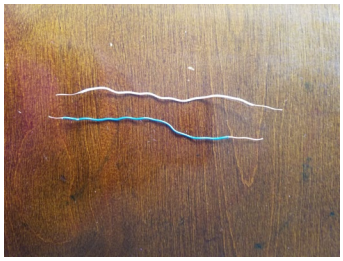
1. Introduction to LEDs
   a. Based on youth background knowledge, you may want to provide some insight on what a circuit is.
   b. Instruct them that they will be creating a circuit utilizing an LED and the battery and ask if they can identify how these two objects can create a circuit. (You may want 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.)



   c. 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.
   d. Do some of the LEDs light up while others don't? Have youth compare their set ups. If one LED lights up and the other doesn't, can they identify what is different? Are the long and short leads on different terminals of the battery?
   e. After a few moments of letting them compare and try to 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.

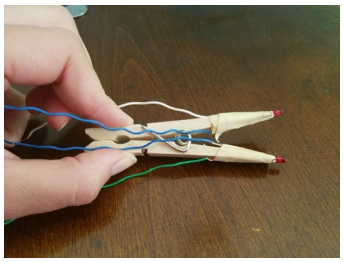
2. Provide the definition of an LED and diode to solidify what they have discovered about the LEDs.

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

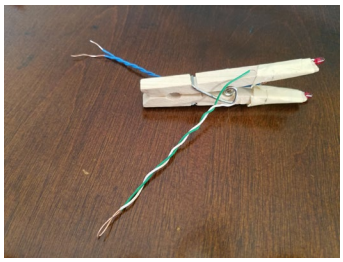
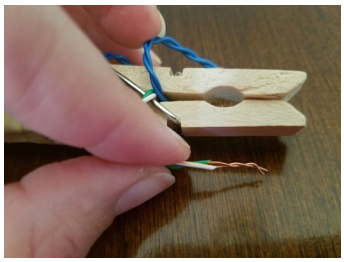


4. Wrap each LED lead with the exposed portion of a wire. Each lead should have its own wire. Be sure to make note of which LED is positive and negative. If your wire is all the same color, you can use a piece of tape to indicate the positive leads.

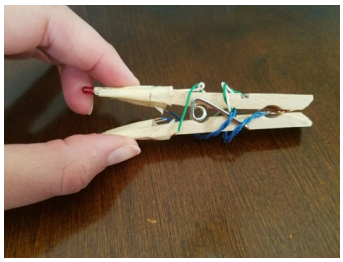
5. Take the leads and place them on opposing sides of the end of a clothespin and secure with electrical tape. There will be one LED on each leg of the clothespin.



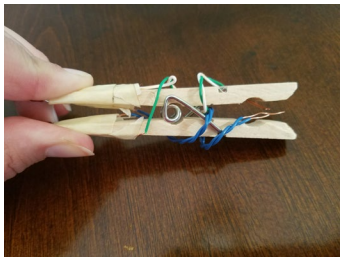
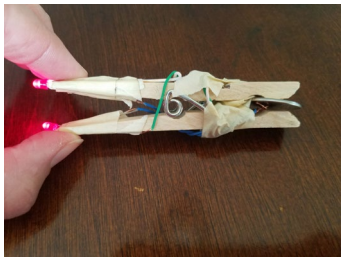
6. Twist the negative leads together and the positive leads together.

7. Start wrapping wires around the clothespin. The positive wires should go to one leg and negative to the other.



8. 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 apply tape to keep the wires in place; however be careful not to cover the exposed wires.

9. If it doesn't light up:
   a. Make sure the battery is making contact with bare wires.
   b. Flip the battery.
   c. Make sure the bare wires from the negative side are not touching those from the positive side.

10. Once you have been successful in lighting up your LEDs, have youth design their bug and wrap the clothespin to create the features their bug exhibits. Be sure to leave room to remove the battery. You do not want to light the bug continuously.

11. Have youth share and compare their creations with one another and reflect.
    a. What similarities do they see? What differences?
    b. What was the most challenging part of the activity?
    c. What was the most fun part of the project?
    d. 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 Glowing Chromatography Flowers, 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).