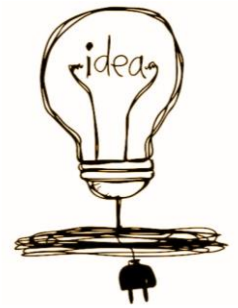
Watt +[even is this]- ?

Mini-Challenge: Circuit Basics



Objective: You will be able to identify all of the aspects of an electric circuit, and analyze its individual function to create electrical energy. You will also apply the Law of Conservation of Energy to determine where electrical energy can come from or be transferred to.

Relevant terms: conductor, insulator, power, resistant, voltage, current, chemical energy, electric energy, thermal energy, radiant energy, acetic acid, and Ohm's Law.

Materials:

- 1 9 Volt or D cell Battery
- Aluminum Foil (Tin Foil, for a substitute)
- Copper wire/metallic wire
- Wood
- Plastic
- Glass
- 1 Small light bulb
  - LED light bulb, preferably
  - Christmas Light bulb
  - Flashlight bulb (that can run 1.5 V)

(For more options, look for the possible substitutions in the materials list on the STEM Interactive: Watt are Circuits? webpage)

Safety:

- Do all experiments with adult supervision.
- Only **use the batteries and items listed in the experiments.** Electricity can be very dangerous. **DO NOT**, under any circumstance, stick anything into a wall outlet that is not specifically designed for that electrical outlet. The electrical outlets and fixtures in your house have electrical energy that is **EXTREMELY DANGEROUS**. The energy is high enough to kill you or start a fire! **DO NOT PLAY OR EXPERIMENT WITH ELECTRICAL OUTLETS OR FIXTURES.**
- Read all instructions carefully before attempting any experiment.
- Make sure to use the scissors carefully when cutting down your wire.
- Avoid contacting circuits with wet hands or wet materials.
- Use batteries that are in working condition/new.
- Light bulbs can get hot. Secure the bulb in a safe manner to avoid being burned.
- **CAUTION**: Only use a hot glue gun with adult permission and supervision. Review the following safety guidelines prior to use: http://safety.ucanr.edu/files/3260.pdf

Mini-Challenge: Try to light the light bulb using the battery and any of the other materials listed. Write down which materials you used to connect the light bulb to the battery, which resulted in the light bulb lighting up, and which ones did not result in the light bulb lighting up. Draw in the space provided diagrams that illustrate those setups that resulted in lighting the bulb and those that did not. HINT: There is more than one way to light up the bulb!

In the space provided, list which materials are able to light up the light bulb and which materials do not.

Conductor - materials that __________ let the electron travel freely.	**Insulator** - materials that __________ __________ let the electron travel freely.
• • • • •	• • • • •

In the space provided which setups were are able to light up the lightbulb and which ones did not.

Set-ups that are able to light up the light bulb:	**Set-ups that are NOT able to light up light bulb:**

Questions:

1. Refer to the sketches you provided. Can any object or material be used to connect the battery to the light bulb and cause illumination? Why or why not?

2. Does it matter which part of the battery objects or materials are connected to in order for the light bulb to be illuminated? Why or why not?

3. What is the common feature/aspect that all of the items that can light up the light bulb have? Why do you think that is?

WARNING: Your light bulb may not be lighting up because...

- Your battery might not have enough voltage.
- You did not connect the battery source to the light bulb properly.
- The “wiring” for your circuit might not conduct electricity.
- The light bulb requires more voltage than what your circuit has.

You can continue playing the video after completing this section!

Circuits don't Play-doh

Play-doh Design Challenge

Based on what you learned from the last section of the lesson and the introduction video, IT'S YOUR TURN to design a circuit! Create a unique design with your Play-Doh, and see if your circuit generates enough voltage to light up the same light bulb! You can even incorporate other household items that you think would be benefit your design!

Materials:

- Play-Doh or Conducting craft dough
  - 1 cup of water
  - 1 ½ cup flour
  - ¼ cup salt
  - 3 tbsp. Cream of tartar or 9 tbsp. of Lemon juice
  - 1 tbsp. Vegetable oil
- Insulating craft dough
  - 1 ½-2 cups flour
  - ½ cup sugar
  - 3 tbsp. Vegetable oil
  - ½ cup of water (distilled, preferably)
  - Food coloring
- 9 V Battery or D cell battery
- Small light bulb

Safety:

- Use a standard 9 volt battery, D cell battery, or smaller. DO NOT use a wall outlet, wall fixture, or larger battery. Larger batteries and wall outlets can provide dangerous voltages and currents.
- Make sure to have adult supervision while doing this experiment.
- Be sure not to use a battery that may look "dirty" or "old"; this battery might be worn out, and the chemicals might have already seeped out.
- DO NOT eat the Play-Doh, or ANY of the ingredients you used for making the homemade craft doughs.
- Have fun and share your findings with us on Facebook!

Guiding Questions:

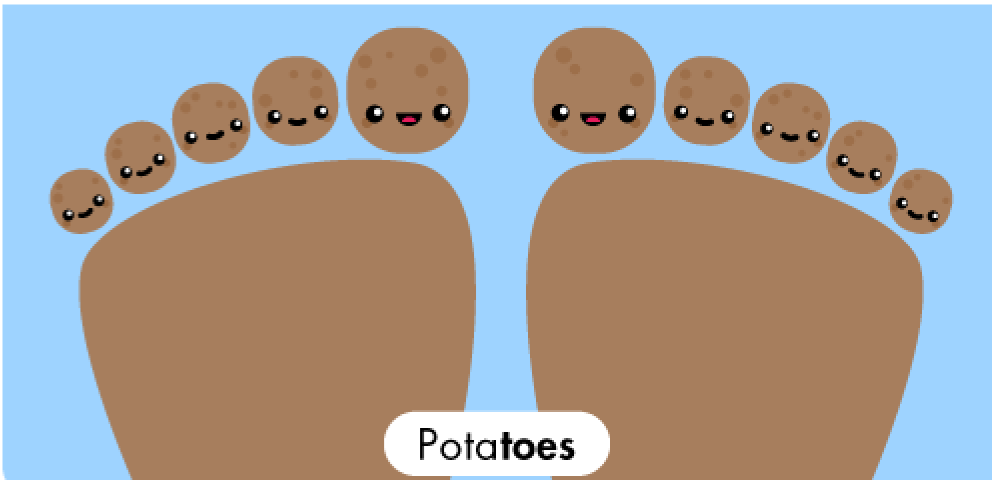
1. Look at the materials needed to make the "Conducting" craft dough vs. the "Insulating" craft dough. What materials are different between the two doughs? Does this make a difference in their ability to light up the light bulb?

2. Would changing the size of craft dough used for the experiment impact the amount of electricity going into the light bulb?

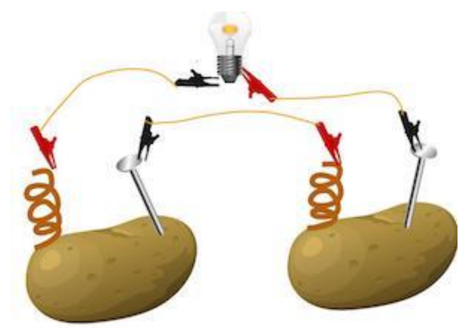
3. What will we need to do to our circuit if we want to make the light bulb dimmer? What will you need to do to make the lightbulb brighter? Why do you think that these actions will result in a dimmer or brighter lit lightbulb?

Po-ta-toe

Demo: Potato Battery



Materials:

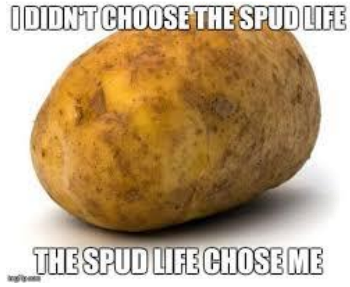


- 5 Copper wires
- 4 Pennies or copper coins
- 4 Small potatoes
  - Limes or Lemons work as well
- Galvanized nails (zinc) (4)
- Alligator clips
  - With some conductive paper clips, tie the copper wire on to the paper clips, and secure both the copper wire and paper clips using electrical tape
- Small light bulb

Instructions:

1. With the alligator clips/hot glue, make sure to attach one end of wire #1 to the bottom of the light bulb.
2. Next, attach one end of wire #2 to the silver coil part of the light bulb.
3. Use one of the alligator clips for the bottom of the light bulb on to your table, in order for it to stay upright and not fall down.
4. Pierce both of the potatoes with a nail in each of them. Make sure the nail is screwed in tightly.
5. Now, you will take the other end of both wires, and wrap it around the nail of each potato (Wire #1 end goes to potato #1, wire #2 end goes to potato #2).

6. Record any observations that you see, as well as any potential inferences!



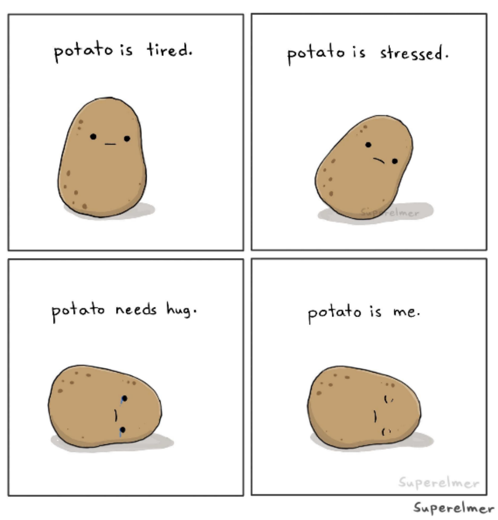
Questions:

1. Does the type of material used for the wire matter in causing the light bulb to illuminate? Why or why not?

2. Consider the configurations of your circuit that caused the light bulb to illuminate. Do the potatoes/fruits need to be organized in a specific way? Does the placement of the penny and nail on the potato/fruit matter? Why or why not?

3. Would there be a change in our experiment if one wire end was on the top of the light bulb?

4. Recall the Law of Conservation of Energy from the last two experiments. Does it still apply in this experiment? If so, describe the energy transformation occurring in the circuit.



I just flipped the switch

Extra Challenge: Other Edible Batteries

Now that you know that potatoes can be used as a battery to power an electrical circuit, you are NOW ready to explore other battery substitutes using other food items that you have in your kitchen! Additionally, you can test the conductivity of other materials in your new circuit design.

Possible Fruits/Vegetables to try:

- Lemons
- Oranges
- Bananas
- Carrots
- Pickles

Three Important Aspects of Circuits (Ohm's Law):

When talking about circuits there are 3 words that always come up. These words represent the components in a circuit that you can manipulate to determine how much electricity will reach your light bulb. These three components are:

Voltage, Current, & Resistance

Ohm's law relates these three components together into the formula V=IR or Voltage=Current x Resistance. Ohm's law is deceptively simple looking but the relationships are actually complex. Therefore, to understand Ohm's law more clearly we use analogies like the one below.

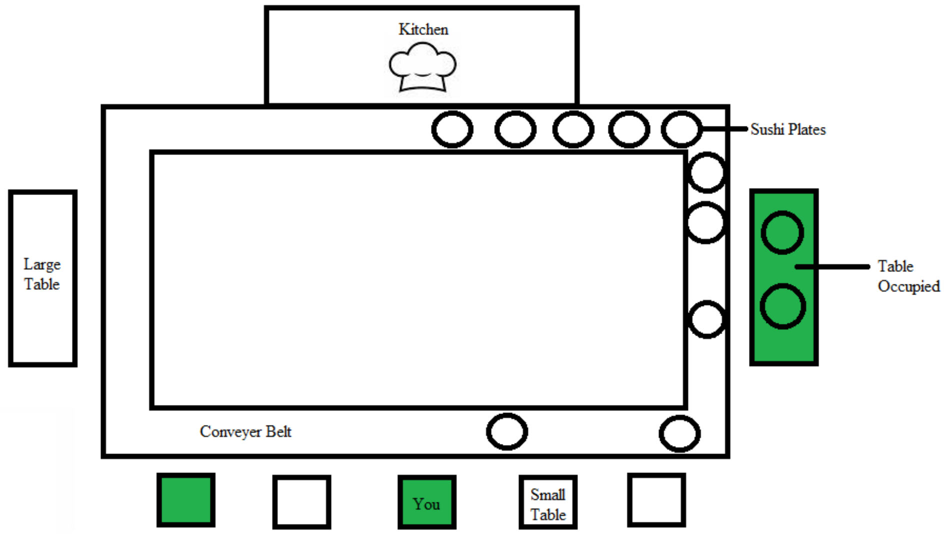
THINK of a revolving sushi bar when talking about Ohm's Law. The **Voltage, or V,** for this restaurant would be *the chef preparing the sushi.* The **Current, or I,** would be *the speed of the sushi plate as it travels on the conveyor belt*. Lastly, the **Resistance, or R,** would be *the other diners around you that are taking the plates from the belt to eat their sushi.*

<u>Questions</u>:

1. What would happen if there were more chefs in the kitchen? What would happen to the rate that sushi comes out of the kitchen?

2. What does this mean in term of the relationship between Voltage and Current?

3. What would happen if there was a large family of diners ahead of you?



4. What does that mean in terms of the relationship between Resistance and Current?

5. Can electricity come JUST from a battery? If not, then list some other sources that can produce electricity.