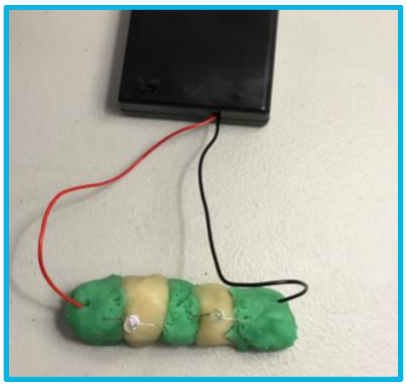
For Students: Student Resource

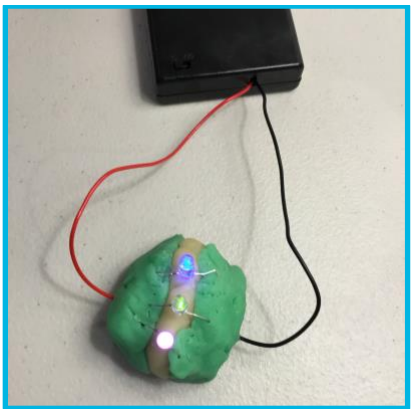
◆ Circuits

A circuit is a loop through which electricity flows. A circuit begins at a power source, such as a battery, and flows through wires and electrical components (such as lights, motors, etc.). There are two kinds of circuits—series circuits and parallel circuits.

Series circuits only allow one path for electricity to flow through. In a series circuit with LEDs, the LEDs farther from the power source will appear dimmer, because less electricity is available to power them. If a LED were to burn out or be removed in a series circuit, all the lights following it would go out as well, because the one path to the remaining lights would be disconnected.



Parallel circuits allow multiple paths for electricity to flow through. In a parallel circuit with LEDs, each LED has electricity flowing directly to it along its own path. Each LED can shine brightly no matter where it is, because the electricity is reaching each LED directly. Also, in a parallel circuit, if one light burns out or is removed, the others will continue to shine.



For Students: Student Resource

◆ Conductivity and Insulation

Materials that conduct electricity—allowing electricity to flow through them—are called conductive. Conductive materials can be used to create circuits. That can mean using metal wire or more unusual things like fruit, potatoes, and even dough. In the conductive dough you'll be using, the salt in the dough helps move the electricity through it by dissociating into Na+ and Cl- ions.

Materials that don't allow electricity to flow through them are called insulating. Insulation is measured in resistance. The more insulating a material, the more resistance it has. The insulating dough you will be working with is resistive, meaning little electricity can flow through it.

Insulators act as a wall to electricity. Electricity is either stopped by an insulator or has to find a way around it. Since the insulating dough doesn't conduct electricity, it can be used to separate the conductive dough and to force the electricity to flow through other electrical components, such as LEDs and motors.

Resistance is also important in helping to slow the flow of electricity to a certain component. For instance, the conductive dough allows electricity to flow through it, but also offers some resistance. This helps to slow the flow of electricity from the battery pack to the LEDs. If the LED were to be connected directly to the battery pack, the LED would burn out.

◆ Short Circuit

Electricity always takes the path of least resistance. Rather than slowly flow through a resistant material, electricity will take a path through something more conductive, like a LED, motor, wire, or other more conductive material. This is how insulating materials can be used to make electricity change course and move through the components you want it to flow through.

If there is a path around an electrical component, such as a LED, that offers less resistance, the electricity will bypass the LED, taking the path of least resistance. This is called a short circuit. This is why a LED inserted into a single piece of conductive dough or into two pieces of conductive dough that then touch one another, the LED will not light up.

◆ Polarity

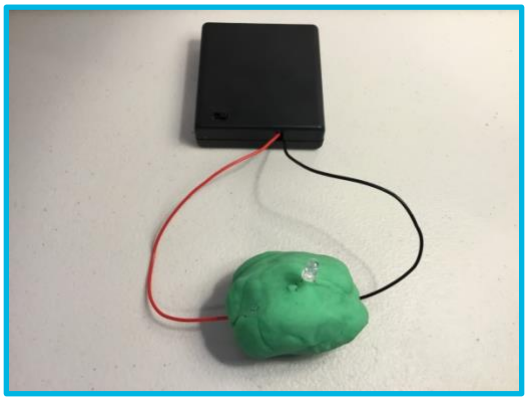
Electrical current flows from the positive pole of an energy source to the negative pole. The direction of current flow in a circuit is called polarity. In this activity, the red wire from the battery pack is the positive pole and the black wire is the negative pole. Some electronic components also have a positive and negative side and must be attached in the correct direction in order to work. The LEDs you will be working with each have two leads, one short, and one long. The longer lead goes to the positive side and the shorter lead goes to the negative side. If the LED is attached in the wrong direction, it won't light up until it has been turned around. Motors will work when attached in either direction. However, the direction in which the electricity flows will determine the spinning direction of the motor's shaft.

For Students: Student Worksheet

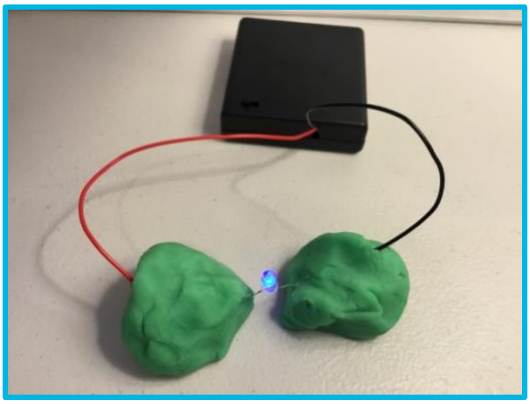
In this activity, you will be building creations out of dough, just like you did when you were younger. Only these creations can conduct electricity, allowing you to create circuits and add features such as lights, motors, and more. You will be working with two types of dough. One dough (colored) is conductive and will allow electricity to flow through it. The other (white) is insulating and does not allow electricity to through it. You will begin by exploring the two types of dough and how they work together to create circuits. Then, you can have fun getting creative.

◆ Practice Circuits/Getting to Know Your Dough

1. Start with a ball of the conductive dough. Insert the battery pack's wires into opposite sides of the dough. Insert a LED into the dough. What happens?



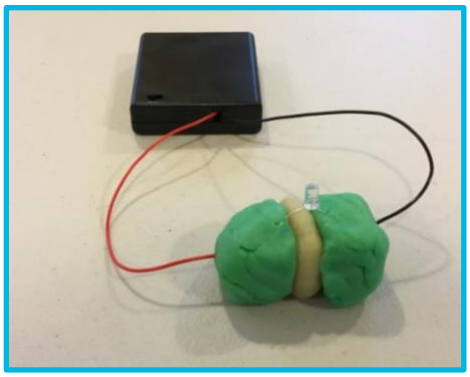
2. Next, separate the conductive dough into two pieces. Insert one battery pack wire into one piece of dough and the other into the other piece of dough. Now insert the LED with one lead in one piece of the dough and the other lead in the second piece of dough. What happens?



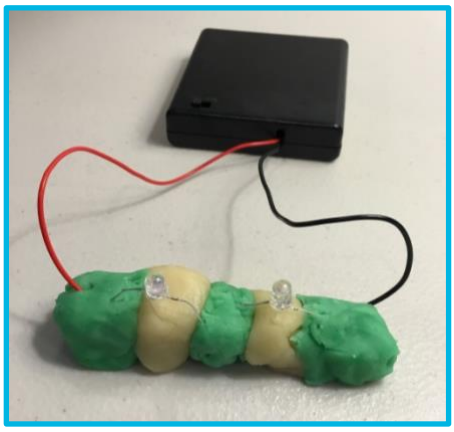
3. Next, remove the LED and turn it around, then insert it back into the two pieces of dough with the leads in the opposite direction from how they were before. What happens? Why do you think it happened?

4. With the LED in the lighted position, touch the two pieces of dough together. What happens? Why do you think it happened?

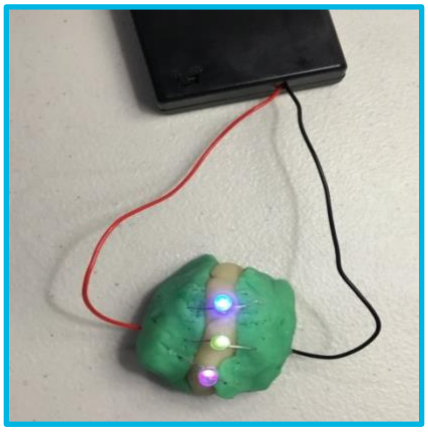
5. Next, add a piece of insulating dough in between the two pieces of conductive dough and attach them so they are touching. With the LED straddling the insulating dough, inserted in the two sections of conductive dough, you have one solid object. The LED is lighting up, however, because there's no short circuit happening. Since the insulating dough does not allow the electricity to flow through it, the electricity goes through the LED instead, lighting it up.



6. Use the conductive and insulating dough to create a series circuit with two or more LEDs. What do you notice about the lights? Why do you think that is?



7. Use the conductive and insulating dough to create a parallel circuit with three LEDs. What do you notice about the lights? How are they different from the lights in the series circuit? Why do you think that is?



◆ Get Creative

Now that you understand how to use the two types of dough to power a LED and run a motor try building something creative. You can use LEDs, motors, buzzers, fans, or any other materials your teacher has provided. You could make an animal with light-up eyes, a helicopter with a spinning propeller, or anything else you can imagine. Once you've finished, share your creation with the rest of the class and see what you classmates thought up. Here are some creations other students have made: