

## OVERVIEW

All materials exhibit conductive properties, but some substances are more conductive than others. In this project, makers will use conductive and insulated playdough to make their own circuits and see the flow of electricity in action. Since the playdough is not extremely conductive and is malleable, students can make a range of circuits without worrying about including additional components.

Makers will also learn what makes a substance conductive on a chemical level to see that with some creativity, experimentation, and research, different materials can be used to construct circuits. The difference between the conductive and insulated dough is a result of the different ingredients used. The conductive dough is made with salt while the insulated dough is made with sugar. Salt helps the electrons move through the playdough. This is because it is an electrolyte, a substance containing free ions that allow electrical current to flow through the substance easily. This makes the substance a good conductor of electricity. Sugar is not an electrolyte and does not allow current to pass through. This makes it a good insulator.

## LEARNING OBJECTIVES

Makers will be able to...

- 1) Use the playdough to create basic circuits.
- 2) Describe how the circuit works
- 3) Understand polarity in a circuit
- 4) Compare the properties of the conductive and insulated dough and identify the difference between them.
- 5) Understand what makes a substance conductive at a chemical level.
- 6) Demonstrate their understanding of basic circuitry through the design of their circuit.

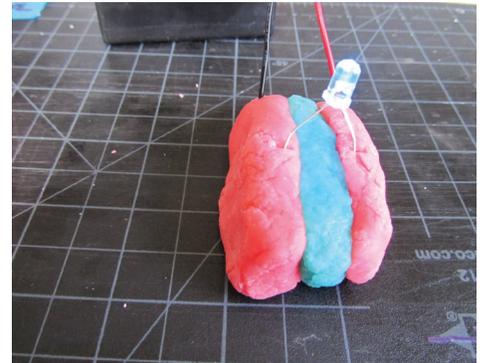
## KEY TERMS

**CIRCUIT** - a closed path that electric current flows through from a power source. Electrons always move in one direction from the power source back to ground, the point where electrons leave or enter back into the circuit.

**CONDUCTIVE** - a property of a material that allows current to flow through it easily

**INSULATED** - a property of material that does not allow current to flow at all. This is the opposite of conductive.

**ELECTRICITY** - a type of energy resulting from the flow of electrons from a positive to a negative pole. Electricity has three important components that help people measure and use this invisible force: voltage, current, and resistance.



## MATERIALS

Conductive and Insulating Playdough  
LEDs  
9 Volt batteries and cases

## FURTHER RESOURCES

For more squishy resources and recipes to make your own conductive and insulated dough, visit the project site from Thomas Lab at University of St. Thomas:

<http://courseweb.stthomas.edu/apthomas/SquishyCircuits/>

**CURRENT** - the flow of electrons through a conductive material or object. It is the same at all points in a similar circuit. Current is measured in amps. You can think of this as the water flowing out of the tank.

**VOLTAGE** - electrical pressure that causes electricity to flow. It is measured in volts. You can think of this as the height of the water tank. There are 2 types: direct current (a battery) and alternating current (electricity from the wall). We are using direct current from a battery - DO NOT try these projects with alternating current from the wall.

**BATTERY** - one or more cells that convert chemical energy into electrical energy. Chemicals in the battery free electrons so they can move from one terminal to the other. This movement creates electrical energy that you can use to power the electronics you use every day.

**POLARITY** - in a circuit electrons move in one direction from the positive pole (power) to the negative pole (ground). When constructing a circuit, all components must be aligned properly so electricity can move through them.

**INPUT** - information received by a system from an external or internal source. In this case, input can be clapping your hands to close a circuit, pressing a button, etc.

**OUTPUT** - information sent from the system. In this case, an output might be an LED lighting up or a sound from the Noisemaker.

**SHORT CIRCUIT** - a direct connection between two sides of a power source. A short circuit can destroy your circuit and the components in it. Most importantly, this can be dangerous with high voltages, especially with electricity from the wall, and can electrocute or burn you.

## CURRICULUM CONNECTIONS

### Salt vs. Sugar

The difference between the conductive and insulated dough is a result of the different ingredients used. The conductive dough is made with salt while the insulated dough is made with sugar. Salt helps the electrons move through the playdough. This is because it is an electrolyte, a substance containing free ions that allow electrical current to flow through the substance easily. This makes the substance a good conductor of electricity. Sugar is not an electrolyte and does not allow current to pass through. This makes it a good insulator.

## NYS STANDARDS

### STANDARD 4—The Physical Setting

Students will understand and apply scientific concepts, principles, and theories pertaining to the physical setting and living environment and recognize the historical development of ideas in science.

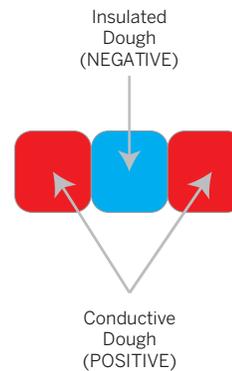
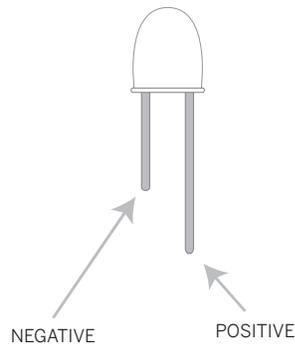
Key Idea 4: Energy exists in many forms, and when these forms change energy is conserved. (4.1d, 4.4d, 4.4e, 4.5a)

How does a circuit transfer energy? What type of energy runs through a circuit? Where does energy change form in this project? What form does it change to?

What is electricity? What are the fundamental concepts of electricity?

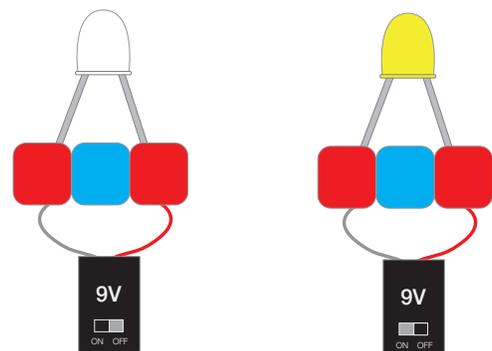
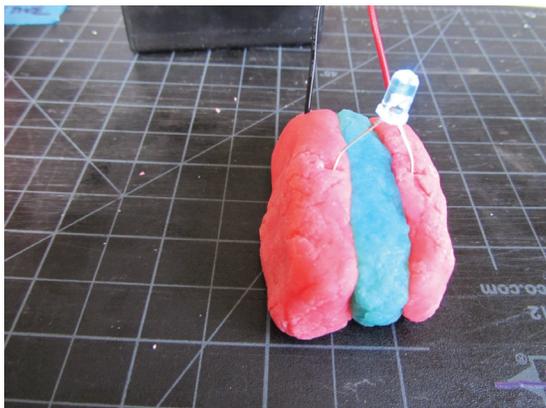
How can we measure electricity? What is voltage, current, and resistance? What is the basic relationship between them?

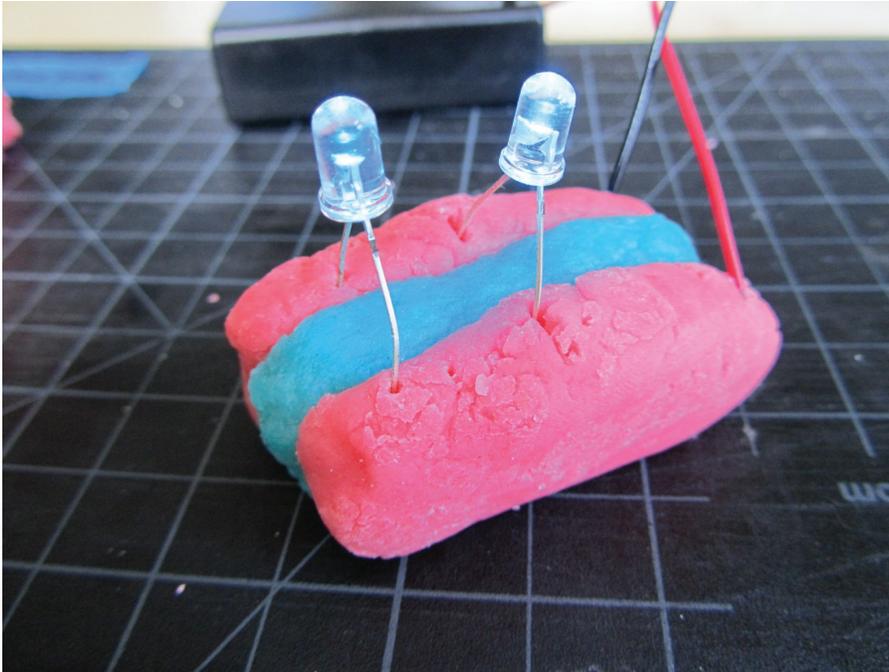
How is energy transferred in a circuit?



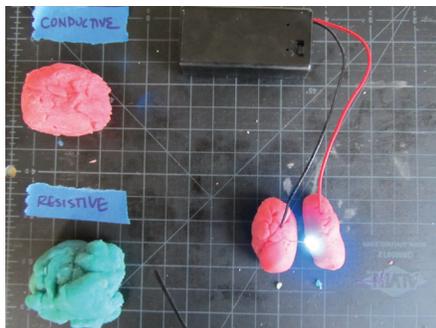
## MAKING

- 1) Let's make a circuit! First, take a ball of conductive dough and roll it into two coils.
- 2) Take a ball of insulated dough and roll it into a coil.
- 3) Place the coils of conductive dough on either side of the insulated dough.
- 4) Take the **red** wire from your battery case and put it into one roll of the conductive dough. This is the power or POSITIVE side.
- 5) Next, take the **black** wire and put it into the other roll of the conductive dough. This is the ground or NEGATIVE side.
- 6) Take one Light Emitting Diode or LED. You can think of this as a small lamp, but we need to give it power to light it up.
- 7) LEDs have 2 "legs" or metal leads coming out of them. One is negative and one is positive. The shorter leg is negative and the longer leg is positive. Remember: electricity, or more specifically current, only flows in one direction: from positive to negative so we need to make sure that the negative leg of the LED is in the negative dough and the positive leg is in the positive dough.

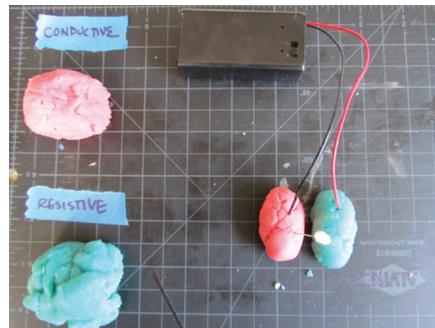




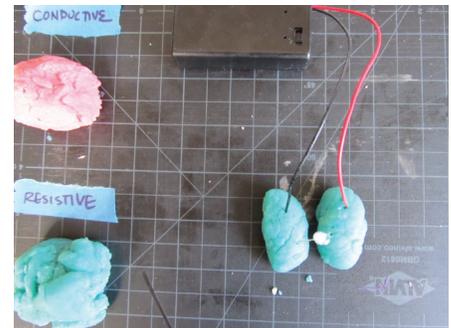
Try different ways of combining the insulated and conductive dough to make your circuits.



If you use conductive dough for both sides of your circuit, your LED will light up to full power.



If you use conductive and insulated dough for your circuit, your LED will light up to about half power.



If you use insulated dough for both sides of your circuit, your LED will light up to only about 15% power.

## DEBUGGING

### POWER?

Is the battery turned on? Sounds obvious, but sometimes we forget!

### CONNECTIONS?

Are the wires connected securely? Both for the wires twisted together and in the terminal? You should check this first. If they are not, or if they are loose, the circuit will not close and as a result cannot produce sound.

### SHORT CIRCUIT?

Are wires touching that shouldn't be? This will send too much current (electricity) to your circuit and could even break it.