



Electric Play Dough Project 1: Make Your Play Dough Light Up, Buzz, & Move!

Kit Contents

QTY	ITEM DESCRIPTION
1	Conductive play dough recipe
1	Insulating play dough recipe
1	DC hobby motor
1	Piezoelectric buzzer
1	Mechanical buzzer
1	4 AA Battery Pack
25	Jumbo LEDs (5 each in red, green, white, yellow, and blue)

You will also need from home:

- AA batteries (4)
- Mixing bowl
- Measuring spoons
- Measuring cups
- Spoon or spatula
- Pot and stovetop
- Ingredients to make conductive and insulating play dough:
 - Tap water
 - Distilled water
 - Vegetable oil
 - Cream of tartar
 - Flour
 - Salt
 - Sugar
 - Food coloring
- Airtight food storage bags or containers

Summary

Prerequisites	None
Safety	Ask for an adult's help when using the stove to make the conductive play dough. Never connect the battery pack's terminals directly to each other; this is called a short circuit and can make the batteries and wires get very hot. Do not connect the LEDs directly to the battery pack without using play dough; this will burn out the LEDs.

Frequently Asked Questions



http://www.sciencebuddies.org/science-fair-projects/project_ideas/Elec_p073.shtml#help

Abstract

Do you like playing with squishy play dough or modeling clay? Wouldn't it be cool if you could add *lights*, sound, or even motion to your play dough creations? In this science project, you will make play dough that conducts electricity, which will allow you to connect lights, motors, and buzzers!

This science project is the first in a three-part series on "squishy circuits," which can all be done with the same materials. We recommend doing the science projects in order.

Objective

Make conductive and insulating play dough and use it to create a simple squishy circuit that lights an LED (light-emitting diode), buzzer, or motor.

Introduction

Do you like making things with play dough or modeling clay? Then this science project is perfect for you! You will learn how to make play dough that conducts **electricity**. Electricity powers many of the things you use every day, like the lights in your house, and the computer you are reading this on. Once you learn more about this simple electric circuit, you can add cool things like lights, buzzers, or motors to your artistic creations. To get started, watch this video:

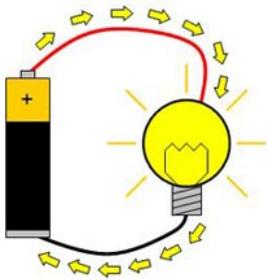
Watch this Squishy Circuits introductory YouTube video http://www.youtube.com/watch?feature=player_embedded&v=lq2TECG6DHQ (http://www.youtube.com/watch?feature=player_embedded&v=lq2TECG6DHQ)

The idea of adding electricity to play dough in order to make play dough creations with light, sound, and motion was invented by Samuel Johnson and Dr. AnnMarie Thomas. They called the invention **squishy circuits**. The squishy part is obvious; play dough is easy to mold and squish. But what is a circuit (pronounced "ser-kit")? A **circuit** is like a path through which electricity flows. A circuit needs to be made out of a **conductor**, which is a material that electricity can flow through easily. Conductors are usually made out of metals like copper. An **insulator** is the opposite of a conductor; electricity cannot flow through it. Many everyday materials—like wood, plastics, and rubber—are insulators. In this science project, you will make two different kinds of homemade play dough: one conductive and one insulating.

All circuits need to get their electricity from somewhere. Many appliances in your house (like your TV, computer, and lights) get electricity from plugs in the wall, which are connected to wires that deliver electricity to your house from power plants. Many smaller, portable circuits (such as electronic toys and cell phones) are powered by **batteries**, which store electricity. Batteries have two ends; one is called **positive** and is marked with a plus sign symbol (+). The other is called **negative**, and the symbol for negative is a minus sign (-), but this symbol is usually not printed on batteries.

In order for electricity to flow, there needs to be a conductive path connecting the positive end of a battery to the negative end. This is called a **closed circuit**. Along the way, the electricity can flow through things like lightbulbs (to make them light up), or motors (to make them spin). The left side of Figure 1 shows a diagram of a circuit with a battery that powers a lightbulb. The right side of Figure 1 shows a photo of a squishy circuit powering an **LED** (which stands for "light-emitting diode" and is a type of tiny lightbulb found in many electronic devices) with a battery pack.

Closed circuit



Closed circuit

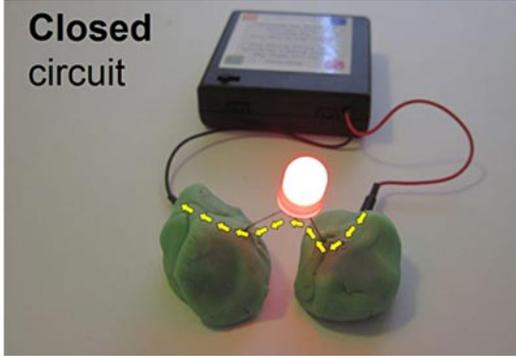
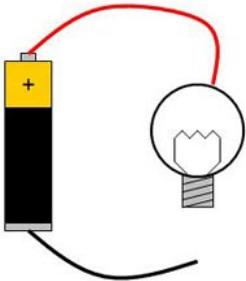


Figure 1. (Left) A diagram of a simple closed circuit with a battery and a lightbulb. The yellow arrows represent the flow of electricity. (Right) A picture of a squishy circuit using a battery pack, an LED, and conductive play dough. Again, the yellow arrows represent the flow of electricity through the play dough.

If there is *not* a complete path through which electricity can flow, it is called an **open circuit**. In an open circuit, the path that electricity follows has been broken somehow. This means that there is no way for electricity to flow in a complete loop, and the lightbulb does not light up. Figure 2 shows a diagram of an open circuit on the left, and a picture of an open circuit on the right.

Open circuit



Open circuit

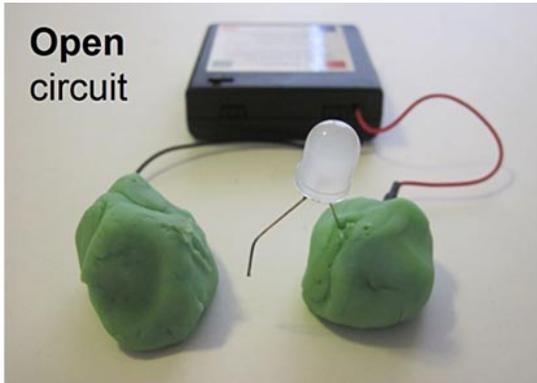
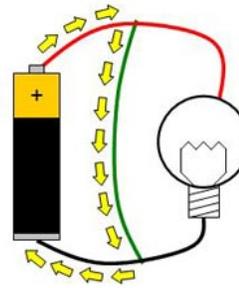


Figure 2. (Left) A diagram of an open circuit and (right) a picture of an open circuit using squishy circuits. Notice how wires have been disconnected in both pictures, which prevents electricity from flowing, so the lightbulbs do not light up.

Electricity likes to take the "easiest" possible path, so if you add an easier conductive path to the circuit than the one that was already there (such as squishing the play dough into one ball instead of two), the electricity will flow through *that* conductive material instead of through the lightbulb, and the bulb will not light up. This is called a **short circuit**. Figure 3 shows a diagram of a short circuit with wires and a picture of a short circuit using conductive play dough instead of wires.

Short circuit



Short circuit

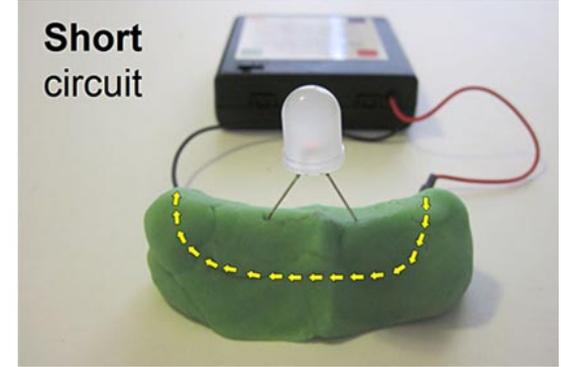


Figure 3. Electricity is lazy and likes to take the "path of least resistance." It is easier to just go straight through a wire (or conductive play dough) than it is to go through a lightbulb. So, if possible, the electricity will just take the easiest path and the lightbulb or LED will not light up. *Note:* It is very important to avoid accidentally creating short circuits in your squishy circuit, as this could damage your materials.

If you watched the introduction video, you may remember that there were two different kinds of play dough: conductive and insulating. You can use insulating dough to help prevent short circuits by putting it in between your two lumps of conductive dough. This is shown in Figure 4.

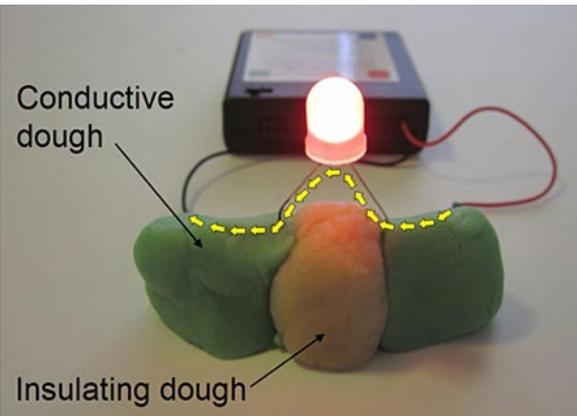


Figure 4. Insulating play dough (white) can be used to help prevent short circuits by keeping clumps of conductive play dough (green) from touching each other. This ensures that the electricity *has* to flow through the LED.

Now that you know all about squishy circuits, you are ready to start building your own! Once you have finished this electricity and electronics science project, you may be inspired to try even cooler things with your electric play dough with these science projects:

- Electric Play Dough Project 2: [Rig Your Creations with Lots of Lights!](http://www.sciencebuddies.org/science-fair-projects/project_ideas/Elec_p074.shtml) (http://www.sciencebuddies.org/science-fair-projects/project_ideas/Elec_p074.shtml): You will learn to build slightly more complicated circuits that allow you to hook up multiple lights.
- Electric Play Dough Project 3: [Light Up Your Sculptures!](http://www.sciencebuddies.org/science-fair-projects/project_ideas/Elec_p075.shtml) (http://www.sciencebuddies.org/science-fair-projects/project_ideas/Elec_p075.shtml): You will use your knowledge from the first two projects to build a light-up three-dimensional sculpture.

Terms and Concepts

- Electricity

- Squishy circuit
- Circuit
- Conductor
- Insulator
- Battery
- Positive
- Negative
- Closed circuit
- Open circuit
- Short circuit

Questions

- What are some examples of objects that are powered by electricity?
- What are some examples of conductors and insulators?
- Which ingredients determine whether homemade play dough is conductive or insulating?
- What is the difference between closed, open, and short circuits?
- What artistic play dough creations do you think you can make that involve a light, motor, or buzzer?

Bibliography

The developers of Squishy Circuits have some great resources and videos that you can check out if you need more help with your circuits.

- University of St. Thomas Squishy Circuits Program. (n.d.). *Making Squishy Circuits*. Retrieved February 8, 2013, from <http://courseweb.stthomas.edu/apthomas/SquishyCircuits/buildingCircuits.htm> (<http://courseweb.stthomas.edu/apthomas/SquishyCircuits/buildingCircuits.htm>)
- University of St. Thomas Squishy Circuits Program. (n.d.). *Squishy Circuit Videos*. Retrieved February 8, 2013, from <http://courseweb.stthomas.edu/apthomas/SquishyCircuits/videos2.htm> (<http://courseweb.stthomas.edu/apthomas/SquishyCircuits/videos2.htm>)
- Squishy Circuits Store. (2011, Dec. 21.). *Squishy Circuits Kit Introduction*. Retrieved February 8, 2013, from http://www.youtube.com/watch?feature=player_embedded&v=lq2TECG6DHQ (http://www.youtube.com/watch?feature=player_embedded&v=lq2TECG6DHQ)

If you want to learn more about circuits, here are some additional resources.

- California Energy Commission. (n.d.). *Circuits*. Retrieved February 8, 2013, from <http://www.energyquest.ca.gov/story/chapter04.html> (<http://www.energyquest.ca.gov/story/chapter04.html>)
- The Physics Classroom. (n.d.). *Requirements of a Circuit*. Retrieved February 8, 2013, from <http://www.physicsclassroom.com/class/circuits/u9l2b.cfm> (<http://www.physicsclassroom.com/class/circuits/u9l2b.cfm>)

Experimental Procedure

Making the Electric Play Dough

Follow the directions in your Squishy Circuits Kit to make conductive and insulating play dough. The directions are written on the inside of the lid of your Squishy Circuits Kit, and we have reproduced them here for convenience. You can also watch videos, below, of how the conductive and insulating play doughs are made. *Important:* Ask an adult to help you use the stove to make the play doughs.

Conductive Play Dough

Step	Ingredients	Procedure
1	1 cup (C.) water 1 C. flour ¼ C. salt 3 tablespoons (tbsp.) cream of tartar or 9 tbsp. lemon juice 1 tbsp. vegetable oil Optional: food coloring (a few drops)	<ul style="list-style-type: none"> • Mix all the ingredients in a clean mixing bowl. • Note that you are only including 1 C. of flour for now.
2	None in this step.	<ul style="list-style-type: none"> • Transfer the mixture to a pot. • Stir the mixture from step 1 continuously over medium heat until a dough ball forms.
3	½ C. flour	<ul style="list-style-type: none"> • Turn off the stove. Carefully remove the pot from the heat and dump the play dough back into your mixing bowl. • Wait several minutes for the mixture to cool. Once it has cooled down, knead (mix the dough with your hands) in additional flour until desired consistency is formed.

Table 1. Directions for making conductive play dough.

This [video](http://youtu.be/cpUFL5LZpv4) (<http://youtu.be/cpUFL5LZpv4>) is a step-by-step tutorial on making the conductive play dough. It should help answer any questions you have about how to judge the consistency of your play dough at each step.

Insulating Play Dough

Important: We found that adding the full ½ C. of distilled water to the insulating dough in step 2 was too much (the dough became too sticky). Be sure to add small amounts of water slowly as you stir, and stop when the dough has reached a good consistency.

Step	Ingredients	Procedure
1	1 C. flour ½ C. sugar 3 tbsp. vegetable oil	<ul style="list-style-type: none"> • Mix all the ingredients in a clean mixing bowl (especially if you used food coloring to make your conductive play dough). • Note that you are only including 1 C. of flour for now.
2	½ C. deionized or distilled water	<ul style="list-style-type: none"> • <i>Slowly</i> add small amounts of water as you continuously knead the dough. • Do <i>not</i> add the whole 1/2 C. of water at once or your play dough may become too sticky. You might not need to use the whole ½ C.
3	½ C. flour	<ul style="list-style-type: none"> • After a dough ball has formed, knead in additional flour to remove stickiness.

Table 2. Directions for making insulating play dough.

This [video](http://youtu.be/Wz8rGNHIEQ) (<http://youtu.be/Wz8rGNHIEQ>) is a step-by-step tutorial on making the insulating play dough. It should help answer any questions you have about how to judge the consistency of your play dough at each step.

Building Play Dough Circuits

1. Insert the four AA batteries into the battery pack that came with your kit. Make sure the "+" signs on the batteries line up with the "+" signs inside the battery pack. Ask an adult if you need help making sure they are in the correct way.
2. Make two lumps of conductive play dough and one lump of insulating play dough. Stick them together, with the insulating dough in the middle; make sure the two lumps of conductive play dough are not touching each other.
3. Stick each metal rod from the battery pack (there should be one attached to a black wire, and one attached to a red wire) into its own lump of *conductive* play dough.
4. Pick an LED from your kit. The two pieces of metal sticking off the LED are called "leads" (pronounced "leeds"). Insert one lead into each lump of conductive play dough. **Important:** Electricity can only flow through LEDs in one direction. The LED has one lead that is slightly longer than the other one; this is the **positive** lead, and it should be inserted into the lump of dough with the **red** wire. The shorter lead should be inserted into the lump of dough with the **black** wire.
5. Use the built-in switch to turn on your battery pack. Your LED should light up! If it does not, do not worry; you probably just plugged your LED in backwards. Flip your LED around and try again (if it still does not light up, open your battery pack and make sure you inserted each battery facing the correct direction, paying attention to the "+" symbols). If you are still having trouble, read the [FAQ](http://www.sciencebuddies.org/science-fair-projects/project_ideas/Elec_p073.shtml#help) (http://www.sciencebuddies.org/science-fair-projects/project_ideas/Elec_p073.shtml#help) section for help.
6. Congratulations! You have made your first squishy circuit. It should look similar to the one in Figure 5.

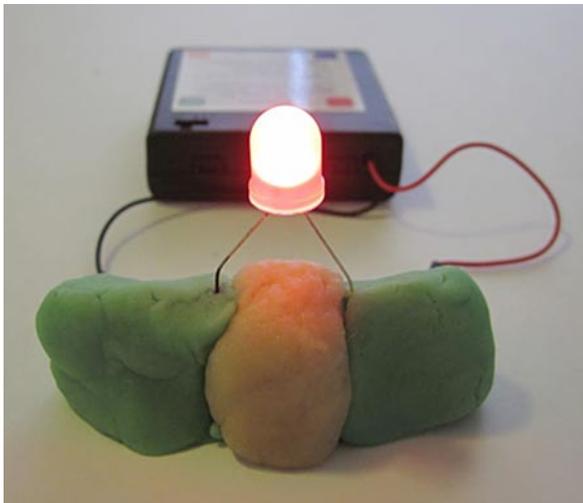


Figure 5. Your first squishy circuit should look like this.

7. Now it is time to get creative! The *shape* of the play dough lumps does not matter, as long as there is a **closed circuit** for electricity to flow. Figure 6 shows two play dough "people" holding hands with an LED; can you come up with your own fun designs for your own circuits?



Figure 6. The *shape* of the play dough pieces does not matter; as long as there is a closed circuit for electricity to flow (and no short circuit), the LED will still light up.

8. Now, try using the buzzers and motor that came with your kit instead of the LED. Does it matter which way you connect the red and black wires, or do they work in both directions? You can use a table like this one to keep track of your results, and check the appropriate box for each item:

Circuit Part	Only Works in One Direction	Works in Both Directions
LED		
Motor		
Piezoelectric buzzer		
Mechanical buzzer		

Table 3. An example data table to help you keep track of which items from your Squishy Circuits Kit only work when plugged in in the correct direction, and which ones work in either direction. The "piezoelectric buzzer" and "mechanical buzzer" have different shapes; they are labeled on the inside of the lid of your Squishy Circuits Kit.

9. If you want to store your play dough to work with another day, put it in a tightly closed container or plastic bag. If you did not use food coloring, be sure to keep them separate and label the containers *Conductive* and *Insulating*. The [FAQ](http://www.sciencebuddies.org/science-fair-projects/project_ideas/Elec_p073.shtml#help) (http://www.sciencebuddies.org/science-fair-projects/project_ideas/Elec_p073.shtml#help) section has more information about how long it will last.

Variations

- This science project is the first in a three-part series on "squishy circuits," which can all be done with the same materials. The next two science projects are

- **Electric Play Dough Project 2: Rig Your Creations with Lots of Lights!** (http://www.sciencebuddies.org/science-fair-projects/project_ideas/Elec_p074.shtml) : You will learn to build slightly more complicated circuits that allow you to hook up multiple lights.
- **Electric Play Dough Project 3: Light Up Your Sculptures!** (http://www.sciencebuddies.org/science-fair-projects/project_ideas/Elec_p075.shtml): You will use your knowledge from the first two science projects to build a light-up three-dimensional sculpture.
- Curious about the chemistry behind electric play dough? Research what ingredient or ingredients make the play doughs conductive or insulating, then try changing the recipes to see what it does to the conductive and insulating properties of the play dough. For instance, how much salt do you need for the play dough to conduct electricity?

Related Links

- **Science Fair Project Guide** (http://www.sciencebuddies.org/science-fair-projects/project_guide_index.shtml)
- **Other Ideas Like This** (http://www.sciencebuddies.org/science-fair-projects/search.shtml?v=solt&pi=Elec_p073)
- **Electricity & Electronics Project Ideas** (http://www.sciencebuddies.org/science-fair-projects/recommender_interest_area.php?ia=Elec)
- **My Favorites** (http://www.sciencebuddies.org/science-fair-projects/recommender_show_favorites.php)
- **Squishy Circuits Project Page** (<http://courseweb.stthomas.edu/apthomas/SquishyCircuits/index.htm>)

If you like this project, you might enjoy exploring these related careers:



Electrical & Electronics Engineer

Just as a potter forms clay, or a steel worker molds molten steel, electrical and electronics engineers gather and shape electricity and use it to make products that transmit power or transmit information. Electrical and electronics engineers may specialize in one of the millions of products that make or use electricity, like cell phones, electric motors, microwaves, medical instruments, airline navigation system, or

handheld games. **Read more** (http://www.sciencebuddies.org/science-fair-projects/science-engineering-careers/Elec_electricalandelectronicsengineer_c001.shtml)



Electrical Engineering Technician

Electrical engineering technicians help design, test, and manufacture electrical and electronic equipment. These people are part of the team of engineers and research scientists that keep our high-tech world going and moving forward. **Read more**

(http://www.sciencebuddies.org/science-fair-projects/science-engineering-careers/Elec_electricalengineeringtechnician_c001.shtml)



Electrician

Electricians are the people who bring electricity to our homes, schools, businesses, public spaces, and streets—lighting up our world, keeping the indoor temperature comfortable, and powering TVs, computers, and all sorts of machines that make life better. Electricians install and maintain the wiring and equipment that carries electricity, and they also fix electrical machines. **Read more** (http://www.sciencebuddies.org/science-fair-projects/science-engineering-careers/Elec_electrician_c001.shtml)



Robotics Engineer

Have you watched "The Transformers" cartoon series or seen the "Transformers" movies? Both shows are about how good and evil robots fight each other and the humans who get in the middle. Many TV shows and movies show robots and humans interacting with each other. While this is, at present, fantasy, in real life robots play a helpful role. Robots do jobs that can be dangerous for humans. For example, some

robots defuse landmines in war-stricken countries; others work in harsh environments like the bottom of the ocean and on the planet Mars. At the heart of every robot is a robotics engineer who thinks about what a robot needs to do and works with several engineering disciplines to design and put together the perfect piece of equipment. **Read more**

(http://www.sciencebuddies.org/science-fair-projects/science-engineering-careers/ApMech_roboticsengineer_c001.shtml)

Credits

Ben Finio, PhD, Science Buddies

This Project Idea is based on the Squishy Circuits project originally developed at St. Thomas University.

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Contact Us

If you have purchased a kit for this project from Science Buddies, we are pleased to answer any question not addressed by the FAQs on our site. Please email us at help@sciencebuddies.org

(<mailto:help@sciencebuddies.org?subject=Electric%20Play%20Dough%20Project%201:%20Make%20Your%20Play%20Dough%20Light%20Up,%20Buzz,%20&%20Move!>) after you have checked the Frequently Asked Questions for this PI at http://www.sciencebuddies.org/science-fair-projects/project_ideas/Elec_p073.shtml#help

In your email, please follow these instructions:

1. What is your Science Buddies kit order number?
2. Please describe how you need help as thoroughly as possible:

Examples

Good Question *I'm trying to do Experimental Procedure step #5, "Scrape the insulation from the wire. . ." How do I know when I've scraped enough?*

Good Question *I'm at Experimental Procedure step #7, "Move the magnet back and forth . . ." and the LED is not lighting up.*

Bad Question *I don't understand the instructions. Help!*