

Activity 3

Dough Creatures



LIGHT UP A ROOM WITH ELECTRIFYING PLAY DOUGH CREATIONS.

You can use anything that conducts electricity to make an electrical circuit—copper, pencil lead, fruit, even play dough! Adding salt to the dough helps electricity move through the material. With enough power, the electrical current can light LEDs and sound a buzzer!



SMART START: Prepare the conductive and insulating dough beforehand, as described below.

Conductive dough

Mix all ingredients except $\frac{1}{2}$ cup flour in a pot and cook over medium heat, stirring continuously. Add food coloring. (This will differentiate the two types of dough.) The mixture will begin to boil and get chunky. Keep stirring until a ball forms in the center of the pot, then remove the saucepan from the heat. CAUTION: The dough will be very hot! Allow it to cool before handling. Once cooled, mix flour into the dough until it is firm, but moldable.

Insulating dough

Mix the oil and solid ingredients (setting aside $\frac{1}{2}$ cup flour) in a bowl. Mix in 1 tbsp. deionized water and stir. Continue to add deionized water 1 tbsp. at a time until the mixture becomes moist and dough-like. Remove it from the bowl and slowly knead in flour until the desired consistency is reached.

Store the dough in an airtight container until needed. It will keep for 3 weeks.

You'll Need (per small group):

- ◆ conductive and insulating dough (See Smart Start for directions.)
- ◆ 4 AA batteries (or one, 9 V)
- ◆ battery holder or connector
- ◆ 4-8 LEDs, 1.9–2.4 V / 20 mA–40 mA (from RadioShack or digikey.com)
- ◆ paper and pencil
- ◆ optional: electric buzzers (2 V), aluminum foil, switch, wire terminals, soldering iron, assorted craft supplies (straws, sticks, etc.)

For dough preparation:

- ◆ mixing bowl
- ◆ wooden mixing spoon
- ◆ saucepan
- ◆ hot plate or stove
- ◆ 2 airtight containers
- ◆ measuring cups/spoons



For conductive dough (makes enough for 3-4 girls):

- ◆ $1\frac{1}{2}$ cups flour
- ◆ 1 cup water
- ◆ $\frac{1}{4}$ cup salt
- ◆ 3 tbsp. cream of tartar
- ◆ 1 tbsp. vegetable oil
- ◆ food coloring

For insulating dough (makes enough for 3-4 girls):

- ◆ $1\frac{1}{2}$ cups flour
- ◆ $\frac{1}{2}$ cup sugar
- ◆ 1 tsp. granulated alum
- ◆ 3 tbsp. vegetable oil
- ◆ $\frac{1}{2}$ cup deionized or distilled water
- ◆ optional: food coloring

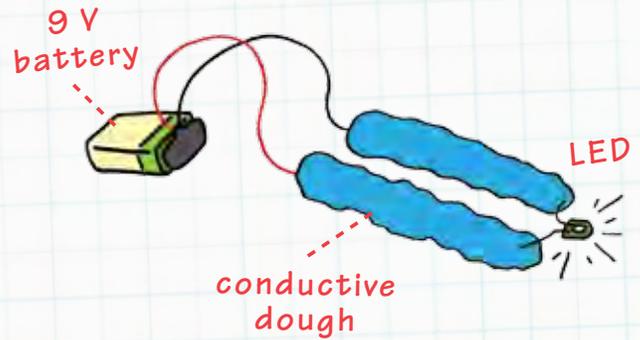
Dough Creatures continued

Here's how:

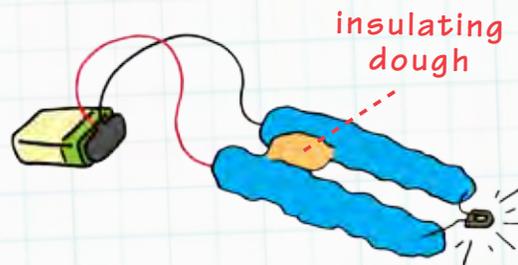
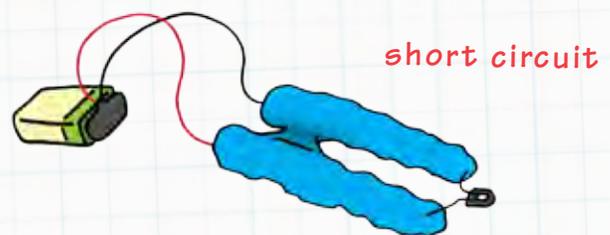
1. Introduce insulators and conductors. Ask girls if they know what a conductor is. (A material that allows energy, such as heat, electricity, light or sound, to pass easily through it.) What types of materials make good electrical conductors? (salt water, metals such as copper, gold, aluminum) What is an insulator? (A material that does not allow energy to pass through it easily.) What types of materials make good electrical insulators? (glass, rubber, plastic, cotton) Why might electric circuits include insulating materials? (Insulation protects us from electrical wires that might give us a shock and helps direct the flow of electricity.)

POINTER: If the girls have never worked with LEDs before, see the Smart Start on page 9.

2. Build a simple circuit. Break into small groups¹ and pass out some conductive dough, batteries, battery holders, and LEDs. Have girls brainstorm and sketch how to make a simple circuit using the materials provided. (A circuit is a closed loop, allowing electricity to flow in a complete circle.) Insert the two terminals from a battery holder or connector into two pieces of conductive dough. Insert an LED into both pieces of dough, so the positive lead (longer leg) is in the dough attached to the positive terminal of the battery and the negative lead (shorter leg) is in the dough attached to the negative terminal of the battery. (See above, right.) Have girls discuss why the LED lights up.⁶ (For current to flow, there must be a complete path from one pole of the battery, through the wire, to the light, and back to the other pole of the battery.)



3. Experiment. What happens if two pieces of conductive dough touch? Have girls test this by connecting them with a third piece of conductive dough. (The bulb will not light because you created a short circuit.) What happens if insulating dough is placed between the two pieces of conductive dough? (See below.)



Dough Creatures continued



4. Brainstorm.

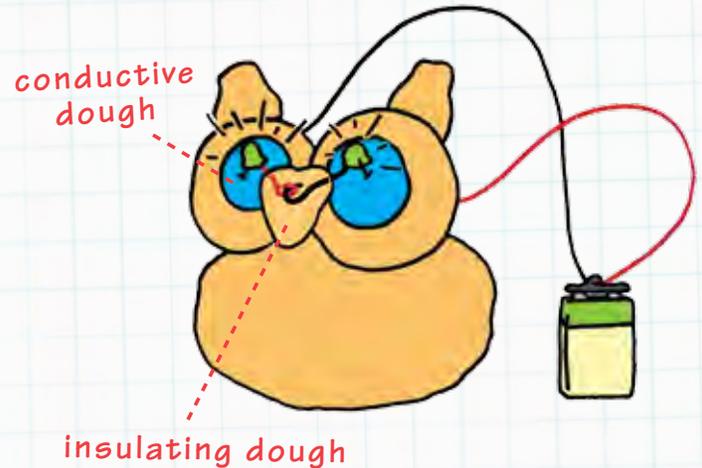
Introduce the **SciGirls Challenge**: Use conductive and insulating dough to make battery-powered creatures that light up and/or buzz. Ask each group to brainstorm possible creature designs. What do they want the creature to do? ⁴ (have glowing eyes, make a noise when pressed) They should consider using sticks, straws, or other materials as supporting structures.

5. Sketch and build.

Have groups draw sketches and then agree on one design to build. ³

6. Test.

If girls are having problems getting the creature to perform a complicated task, encourage them to start small. ⁵ Suggest they first try to achieve a simpler function, such as getting one eye to light up, and then, once they have accomplished this, move on to a more complicated task, such as getting two eyes to light. (See right for examples.)



Special thanks to AnnMarie Thomas, an engineering professor at the University of St. Thomas in Minnesota, for contributing her ideas and expertise. Dr. Thomas is co-director of the Center for Pre-Collegiate Engineering Education. She worked with engineering student Samuel Johnson to develop this activity.

POINTER: Remind girls that dough does not conduct as well as metal. They may find it helpful to use short thick chunks of the dough (to reduce resistance) or to increase the surface area of the electrical contacts by wrapping the ends of the battery wire in aluminum foil or crimping or soldering on wire terminals.

7. Share.

When everyone is done, have groups demonstrate their creations and discuss. Talk about possible real world uses for the creatures. ² If they could design an enhanced creature, what would they have it do?

