

Squishy Circuits Activity

Purpose

Students learn about electricity and circuits using dough, various voltage sources, and electronic components.

Audience

This content is suitable for middle school through secondary.

Time

The activity, as is, requires at least 25 to 35 minutes, although this doesn't leave much time for exploration and experimentation. It can easily be extended to 50 or 60 minutes.

Cost

The materials can be purchased for under \$100 and most are highly reusable. Note that the dough is perishable and has a limited shelf life. Refrigerating the dough in sealed containers can extend its life considerably.

Learning Objectives

Upon completing this activity students will:

- Understand the difference between open, closed, short, series, and parallel circuits.
- Understand how resistance works in a series circuit and a parallel circuit.
- Understand how voltage works in series.
- Understand how to make a battery with dough.
- Have experience with different components and voltage sources.

Materials

The most fundamental materials for making circuits are:

- Dough (conductive and insulating, visit the website for recipes)
- Battery Packs and Batteries (4 AA packs)
- LEDs (should be appropriate for the source voltage) (3 ea.)
- Zinc Galvanized Nails (4 ea.)
- Copper Wire (bent appropriately and not too short) (4 ea.)

Also available are:

- The Squishy Slides

- The Squishy Worksheet

Consider projecting the demo board on an overhead projector.

The following may also be considered depending on time and audience:

- Multimeters
- Sunlight or a bright light (Something other than incandescent is best)
- Photo-Diodes
- LEDs of various colors
- Buzzers
- Motors
- Solar Panel Voltage Sources
- Prepared Arduino boards.
- Anything else you can think of!

More ideas and information are available at

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

Safety and Precautions

Batteries should always be removed from the battery packs before they are stored to avoid risk of fire. Less emphatically, students should never connect the LEDs directly to the voltage source. There should always be resistance in the circuit in the form of the dough or a resistor or similar. It is also important that the students do not ingest the dough because it may be contaminated. Also note that LEDs are easily bent to the point where they break.

Background

Students need not be familiar with circuits. The lesson is sufficiently simple that they can participate in it as is. In any case, it can be tailored to the target audience by addition or omission. And the presenter should be able to communicate to the students facts about voltage, current, and resistance in terms appropriate for their level. The presenter or any assistants should also be prepared to help the students construct circuits of different topologies (i.e. series and parallel) and battery components, if necessary, as students may have trouble comprehending the topologies or shaping the dough.

Procedure

1. Tell the group about the conductive and insulating dough.
2. *Tell the group about the dough recipes.
3. Ask the group connect an LED to two pieces of conductive dough.
4. Ask the group why the LEDs do not light up.

5. Ask the group to connect their batteries to the circuit.
6. *Explain closed circuits.
7. Ask the group why some of the LEDs still do not light up.
8. *Explain what diodes are.
9. Ask the groups whose LEDs did not light up to reverse their LED.
10. Ask the group why the LED lights up.
11. *Explain what LEDs are and how they work.
12. Ask the group to touch the conductive dough pieces together.
13. *Explain short circuits and introduce resistance.
14. *Ask the group to place insulating dough between the two pieces of conductive dough.
15. *Discuss the resistance in the circuit paying special attention to the insulating dough.
16. Ask the group to disconnect one battery lead from the circuit.
17. *Talk about open circuits and compare to switches.
18. *Ask the group to assemble a circuit using only the insulating dough and ask them what they think will happen. Ask them if the LED will light up.
19. Have the group assemble the circuit with the conductive dough again.
20. *Ask the group about ideas of how the LEDs might be assembled into a circuit.
21. Ask the group to make a parallel circuit with three LEDs.
22. *Ask the group about their observations of the LED light.
23. *Ask the group about other ways to arrange the LEDs in a circuit.
24. *Ask the group to make a series circuit with two LEDs.
25. Ask the group to make a series circuit with three LEDs.
26. Ask the group about their observations of the LED light. Ask the group about any differences in LED brightness that they might observe.
27. *Explain what resistance is and how it works in parallel vs series circuits.
28. *Demo the solar panel for the group.
29. *Use the solar panel with the buzzer.
30. *Explain how the buzzer works.
31. *If available, use a bright light to form a gradient and show them how the sound increases and decreases.
32. Talk about the battery 4-packs and how voltage sums in batteries in series.
33. Have each group make 4 conductive rectangles and 4 insulating rectangles.
34. Have each group assemble these into a battery.
35. Have the groups measure and record the voltage of each individual battery (part).
36. Have the groups measure and record the total voltage of their battery (whole).
37. Relate the result back to how voltage sums for batteries in series.

** Starred items may be shortened or skipped or even elaborated upon depending on the level of the audience and the time available.*

Extension

If you have lots of time you might demo, explain, and/or let the students play with additional

components such as the buzzers or solar panels or squishy sound (refer to the website). You can even allow them access to additional components on the side as you progress, especially if you have assistants and/or the groups are advancing at different rates.