

ACTIVITY 7 - CONDUCTIVITY AND BREADBOARDS

LEARNING OUTCOMES

Students will,

1. Test the conductivity of different materials
2. Map the conductivity between points on a [solderless breadboard](#)

This activity should take **~1 hour** to complete:

- 5m Define conductivity, conductors, and insulators
- 20m students test different materials
- 5m discuss findings
- 10m students map breadboard connections
- 20m reflection and discussion

It assumes free access to a black-and-white printer, and a classroom with a whiteboard, blackboard, or chart-paper. This activity does not require regular access to electricity.

MATERIALS AND COSTS PER STUDENT

Assuming one kit of parts per student:

Item	Qty.	Cost per Student ¹	Expendable ²	Supplier
Piezo Buzzer 5V 12mm	1	0.19		AliExpress
Jumper cables MM MF FF 10cm	3	0.06	y	AliExpress
Breadboard 400 point	1	1.49		AliExpress
Breadboard Power Supply*	1	0.75		AliExpress
9V Ni-Mh 450mAh	1	5.17		AliExpress
Total Cost per Student		\$7.66 CAD		

**This activity can be done just connecting the buzzer directly to the battery, without using a power supply, if you have suitable battery snaps and the buzzers can handle 9V directly.*

1. Currency is CAD, 2017-06-10. Assuming one set of parts per student. ↵
2. Likely to be broken or lost during the activity. ↵

Common household/classroom materials for conductivity testing such as:

- Metal wire
- White-board
- Pencil (wood)
- Pencil (graphite)
- Crayon
- Coin
- Paper clip

LESSON

Before class: gather materials for conductivity testing; build the testing circuits (see Test Materials); print student handouts. The focus of this activity is not on building the testing circuit. The students should understand how it works, but it is best to assemble them for the students in advance to save time for testing/discussion.

Outline:

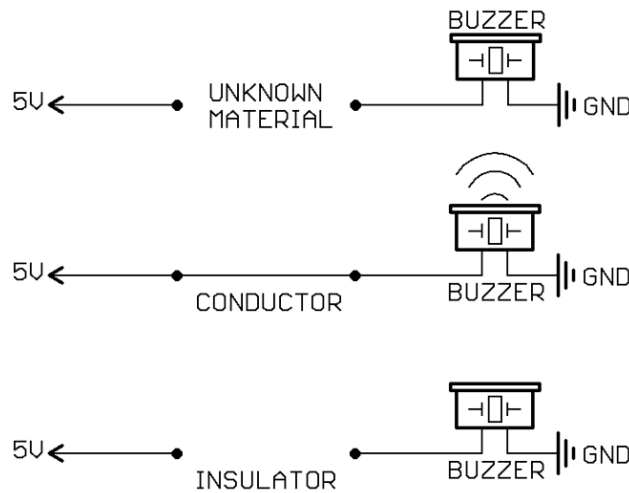
1. Conductivity
2. Test Materials
3. Map Breadboard Connections
4. Breadboard Disassembly
5. Relate to Circuit Diagrams

CONDUCTIVITY

- Conductivity is how easily electric charge can move in a material
- Conductors, such as metal, allow charge to move easily
- Insulators, such as plastic, do not allow charge to move

TEST MATERIALS

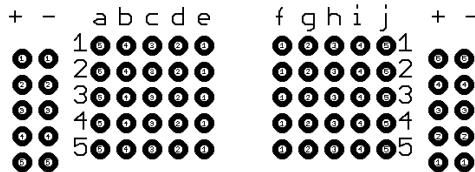
- We are going to use a buzzer circuit to test whether different materials are conductors or insulators
- Draw circuit on the board
- Explain how the circuit is built, and that if a material is a conductor charge will flow and the buzzer will sound



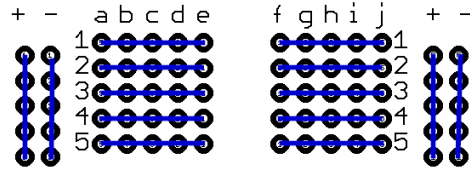
- Ask the students to test different materials, filling in the table on their handouts with the findings. (20 minutes)
- Have the students share their results and write a list of conductors and insulators on the board
- Ask the students if they can spot some similarities among the different conductors (A: mostly metals), and among the different insulators (A: mostly plastic or organic)

MAP BREADBOARD CONNECTIONS

- Draw the top part of the breadboard on the board

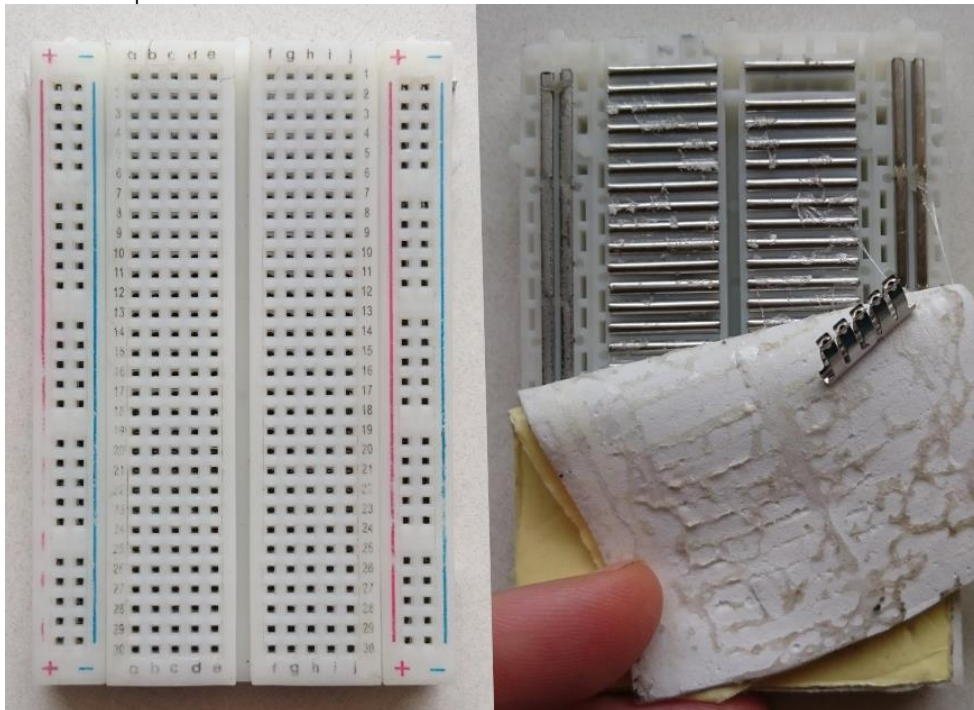


- Ask the students to test which of the holes conduct together
- Show an example testing the conductivity of one hole to the holes surrounding it on the board
- Clarify that the students should use lines to show which of the dots are connected
- When they're done testing, every dot should be connected with a line to show conductivity



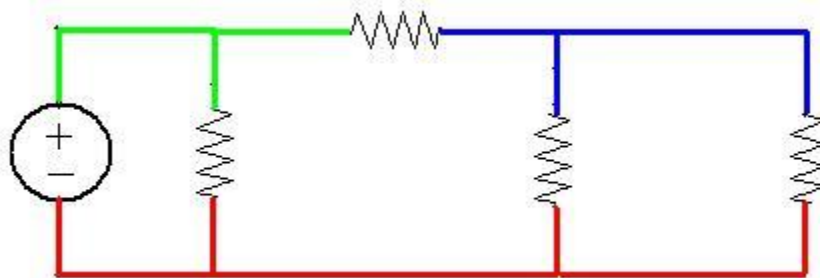
BREADBOARD DISASSEMBLY

- Ask the students how they think the connections are made inside the breadboard. A: metal strips
- Pull the adhesive backing off the breadboard to expose the metal strips
- Pull out one of the metals strips to show the small clips used in each hole
- Pass the opened breadboard around so the students can see

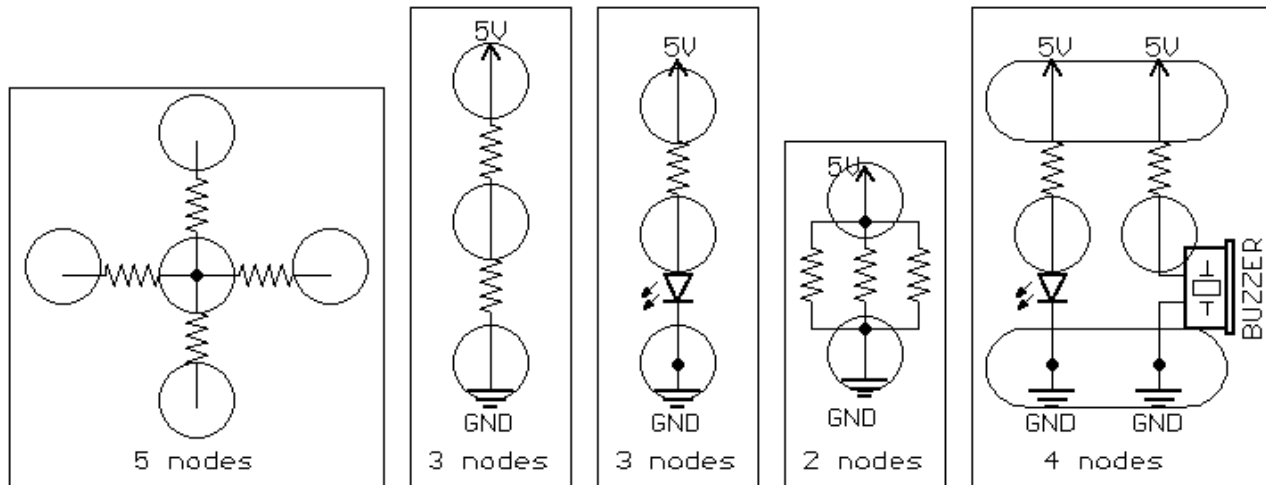


RELATE TO CIRCUIT DIAGRAMS

- Define a node: one point that is all connected electrically (each colour in the image below is a separate node)



- Draw examples and ask the students how many nodes are present
 - connection of 4 resistors to one point. A: 5 nodes.
 - Two resistors in series. A: 3 nodes.
 - LED circuit. A: 4 nodes.
 - Three resistors in Parallel
 - Two circuits on the same board (LED and Buzzer in parallel). 5V and GND are one node each, despite being drawn twice!



CHALLENGE AND EXPLORE

Evaluate the students' understanding of the learning objectives by asking them to try the following:

- Is there anywhere on the breadboard where it is conductive across a row AND up and down a column? A: no.
 - Skill: differentiating conductors and insulators
- Try rebuilding the testing circuit onto the breadboard
 - Skill: understanding electricity (rock-slide analogy)
 - Skill: breadboard circuit prototyping
 - Skill: reading circuit diagrams

FREQUENTLY ASKED QUESTIONS

- Why does an aluminium pop-can tab conduct electricity, but not the aluminium window frame? A: the window frame is anodized; it's like a thin layer of paint that is an insulator. If you text somewhere where the anodization is scratched, it will conduct like the tab.
- Why isn't my buzzer circuit working? A: check the polarity of the buzzer, and be sure that the (+) side will be connected to the (+) on the breadboard, and similarly for the (-) side. Make sure the power supply is on.