Teaching Tips | Keep It Simple, Circuit

Essential Question

How do switches work in electrical circuits, and why are they useful?

Before Viewing

Distribute the following materials, and have students follow the printed instructions to build their circuits and complete their truth tables.

Materials

- Small pronged LED light bulb (reuse for each circuit)
- Coin battery (reuse for each circuit)
- Copper tape
- Scissors
- “Keep It Simple, Circuit” Activity Sheet

Instructions

The students will see the following instructions for building their circuits in their activity sheet:

1. Grab your lightbulb and extend both legs outwards.
2. Place your lightbulb on top of the yellow oval marked “Bulb.” Make sure:
    - The longer positive (+) leg is on top of the + sign and pointing upwards.
    - The shorter negative (–) leg is on top of the – sign and pointing downwards.
3. Place copper tape that starts on top of the lightbulb’s positive leg and ends on top of the dark orange region.
4. Place copper tape on top of the rest of the dark orange region, completely covering it with no gaps.
5. Grab your battery and orient it so that the positive (+) side is facing upwards, and the negative (–) side pointing downwards.
6. Place the battery on top of the gray-outlined region labeled “Battery.” Make sure it is lying on top of some of the tape you put down in Step 4.
7. Place a strip of copper tape that starts on top of the battery and ends on top of the leftmost light orange region.
8. Place a strip of copper tape that starts on top of the lightbulb’s negative leg and ends on top of the rightmost light orange region.
9. Place copper tape on top of all of the light orange regions, completely covering them. There should be one, two, or three gaps marked with a letter (A, B, or C).
10. Take your scissors and cut along all the dotted black lines. You should now have one, two, or three small paper “switches.”
11. Fold each switch upwards along the dashed blue line, forming a crease for each.

12. Now, you should be able to complete the circuit and cause the lightbulb to light up by folding one or more switches upwards to lie directly on top of the paper. Experiment with different combinations, and record your results in the corresponding truth table!

If students are having trouble with building their circuits, make sure:

- All orange regions are covered by copper tape, with no gaps apart from the switch[es].
- The lightbulb and battery are oriented correctly and connected to the copper tape.
- The switch has been cut out and folded along the dotted lines as indicated.

Students will also fill out their truth tables based on their observations for the circuits that they built, and they will see the following instructions in their activity sheet:

- <u>Simple Circuit:</u>
    1. Use the Simple Circuit template and the Circuit Instructions to build a simple circuit. You should have one “switch” under the letter A, which can be left unfolded (disconnected) or folded up (connected).
    2. This truth table will help you record how your circuit works, and which switch position(s) will complete the circuit and cause the lightbulb to light up.
    3. First, leave switch A unfolded, in the disconnected position. Observe whether the lightbulb lights up or not. Circle either Y (yes) or N (no) in the first row based on what you see.
    4. Now, fold switch A upwards into the connected position, so that it lies flat on top of the letter “A”. Observe whether the lightbulb lights up or not. Circle either Y (yes) or N (no) in the second row based on what you see.
    5. Your truth table is now complete! Make sure your circled responses match the results you observed; feel free to double-check using your simple circuit.
    6. Hint: for a simple circuit, you should end up circling Y for one row, and N for the other row.
- <u>Series Circuit:</u>
    1. Use the Series Circuit template and the Circuit Instructions to build a series circuit. You should have two “switches” under the letters A and B, each of which can be left unfolded (disconnected) or folded up (connected).
    2. Since each switch has two positions, there are four (2 x 2) possible combinations of switch positions. You’ll be testing each combination to see if it causes the lightbulb to light up, and recording your results in this truth table.
    3. Start at the first row. Put your switches into the specified combination (for the first row, both disconnected). Observe whether the lightbulb lights up, then circle either Y (yes) or N (no) in the third column of that row.
    4. Repeat Step 3 for each of the remaining three rows.
    5. Your truth table is now complete! Make sure your circled responses match the results you observed; feel free to double-check using your series circuit.
    6. Hint: for a series circuit, you should end up circling Y for at least one row.

While Viewing

Have students observe the outcomes of the *Chip Kids* experiment, and see if it matches what they recorded in their truth tables.

After Viewing

Have your students discuss the following questions, in small groups and/or as a class:

1. How does an electrical switch work?
2. What is the difference between a simple and series circuit?
3. (SPOILER) In a series circuit, why do both switches need to be connected/pressed down for the bulb to light up?
4. Can you think of any devices or technology that uses circuits with on/off switches? Why do they need those switches?