Follow-up Activity: For Students

Physics 8: Circuits

This activity is intended for children ages 12 to 14 years and should be completed only under the supervision of a parent or guardian.

Introduction:

In class, we learned that a circuit must be a closed loop in order for electricity flow; this closed loop can be interrupted by an open switch. We the experimented with lamps in series (in a row) and lamps in parallel (next to each other). When in series, the lamps must share the potential energy from the battery, so each lamp is dimmer than a single lamp. Also, disconnecting one of the lamps in the series opens the circuit much like turning off a switch, and all of the lamps go out.

When identical lamps are in parallel, each lamp receives all of the potential energy from the battery, so these lamps are just as bright as a single lamp. But in this case, the battery drains twice as fast because it must provide energy to twice as many lamps. When one of the parallel lamps is disconnected, the other lamp stays on because the circuit is still closed, but the drain on the battery is the same as for a simple circuit.

Activity: Batteries in Series vs. Parallel

Lamps are not the only devices that can be included in series or parallel in a circuit. Batteries can also be hooked up in a row (series) or else next to each other (parallel)! In the following activity, you will build a circuit to test what happens when batteries are hooked up in series or parallel.

Materials:

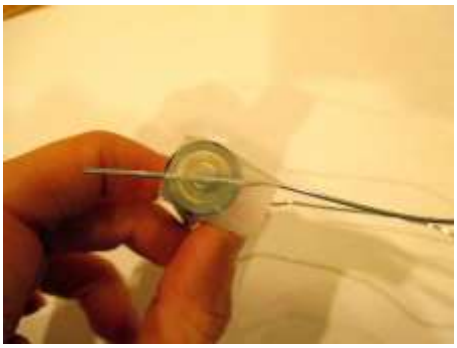
- 2 metal paperclips
- Scotch tape
- A rubber band
- A flashlight
- 2 AA batteries

Procedure:

1. Straighten out the paperclips
2. Take apart the flashlight and remove the lamp from the base (see the picture below):

Single battery:

3. Use tape to attach the straightened out paperclips to the battery terminals. The paperclip should be touching the button on the positive terminal like in the following pictures:

Once the paperclips are attached to the battery, make sure not to let the two paperclips touch; that would be a short circuit!

4. Now touch one free end of the paperclip to the button on the bottom of the flashlight lamp and touch the other end anywhere on the metal jacket, as in the following picture. You may need someone's help to hold everything in place.

5. Observe how bright the lamp is when attached to a single battery. Just like in class, we will be scoring the brightness of the lamps on a scale of 0-10, where a score of 0 means the lamp is turned off, and a score of 10 is the brightest. This time, we will give the lamp connected to a single battery in the simple circuit a brightness score of "5" (see Table 1, below). This score will give you a baseline for comparison with the complex circuits.

Batteries in Series

6. Take apart the paperclip/battery setup and use Scotch tape to connect two batteries in a row, making sure that the positive terminal (the end with the button) of the first battery touches the negative terminal (the flat end) of the second battery.
7. Use Scotch tape to attach the straightened paper clips to the ends of the batteries, making sure once again that the paperclip on the positive terminal touches the button on the battery's positive terminal (see the picture below).

8. Using the same scale as with the single lamp, predict how brightly each lamp will shine when the switch is on and fill in your hypotheses on Table 1, below. In other words, if the lamp is just as bright as the single lamp in the

simple circuit, give it a score of "5." If it is brighter, give it a score higher than 5. If it is dimmer, score it less than 5. If it is off, score it as 0.

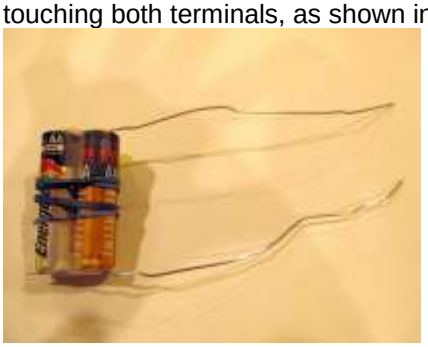
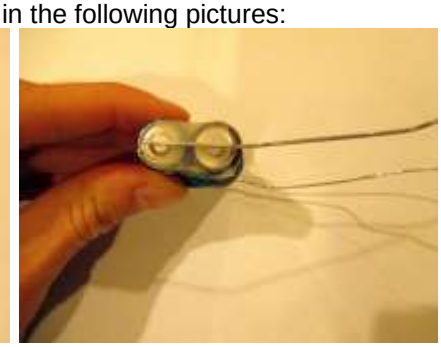
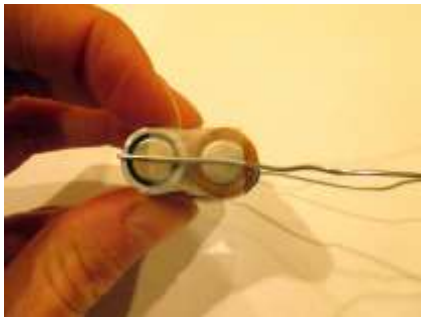
9. Repeat step 4 and test your hypothesis. Enter the actual brightness score on Table 1.

Table 1: Lamp brightness

	Predicted brightness score	**Actual brightness score**
Single battery	n/a	5
Two batteries in series		
Two batteries in parallel		

Batteries in Parallel

10. Take apart the series battery and use the rubber band to hold the batteries next to each other, making sure this time that both of the batteries are pointing the same way.
11. Use Scotch tape to attach the straightened paper clips to the battery terminals. Make sure that the paperclips are touching both terminals, as shown in the following pictures:

12. Repeat steps 8-9, filling in your hypothesis and results on Table 1.

Discussion

1. How does the brightness of the lamp connected to the batteries in series compare to the lamp connected to the single battery?
2. What happens to the lamp brightness when you connect the batteries in parallel?
3. Why do you think parallel batteries may be used in some circuits?

Additional Resources:

- Building a battery bank (video, 4:53): https://www.youtube.com/watch?v=w1Mqn6Ewvio
- Parallel circuits (video, 4:36): https://www.youtube.com/watch?v=YaBdEvJpvMk