



## Sliding Light: How to Make a Dimmer Switch

[https://www.sciencebuddies.org/science-fair-projects/project-ideas/Elec\\_p056/electricity-electronics/dimmer-switch-basic-circuits](https://www.sciencebuddies.org/science-fair-projects/project-ideas/Elec_p056/electricity-electronics/dimmer-switch-basic-circuits) ([http://www.sciencebuddies.org/science-fair-projects/project-ideas/Elec\\_p056/electricity-electronics/dimmer-switch-basic-circuits](http://www.sciencebuddies.org/science-fair-projects/project-ideas/Elec_p056/electricity-electronics/dimmer-switch-basic-circuits))

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### Experimental Procedure

1. Watch this video for an introduction to your Basic Circuits Kit.

Basic Circuits Kit: Pencil Dimmer Switch

<https://www.youtube.com/watch?v=nwfwqTo3K0g> (<https://www.youtube.com/watch?v=nwfwqTo3K0g>)

2. Set up your test circuit, as shown in Figure 4.
  - a. Insert three AA batteries into the battery holder (your kit comes with one extra battery). Make sure the "+" symbols on the batteries line up with the "+" symbols inside the battery holder.
  - b. Connect a red alligator clip to the exposed metal part of the red wire from the battery holder (in electronics, red wires are usually used for the "positive" connection).
  - c. Connect a black alligator clip to the exposed metal part of the black wire from the battery holder (in electronics, black wires are usually used for the "negative" connection).
  - d. Attach the other end of the black alligator clip to one of the screws on the lightbulb holder. If necessary, use a small Phillips head screwdriver to loosen the screw slightly so it is easier to clip to.
  - e. Screw the lightbulb into the bulb holder.
  - f. Attach one end of the green alligator clip to the other screw on the bulb holder.
  - g. You will connect your pencil resistors to the free ends of the red and green alligator clips.
  - h. Test your circuit by touching the exposed metal ends of the red and green alligator clips together. This creates a closed circuit and your lightbulb should light up. If it does not light up, then check the following:
    - i. Make sure the lightbulb is screwed tightly into the base.
    - ii. Make sure none of your alligator clip connections are loose.
    - iii. Make sure none of your batteries are backwards.
  - i. **Important:** throughout the project, only connect the lightbulb for long enough to assess its brightness, then disconnect it when not in use. Leaving the lightbulb connected for a long time can cause it to burn out prematurely.



**Figure 4.** The test circuit for this experiment. The twist ties are not required, but bundling up the alligator clip leads can help keep your circuit neat.

3. Ask an adult to whittle away the wood on the side of a number 2 pencil with a pocket knife to expose the graphite core, as shown in Figure 5. This may take a couple of tries (with a fresh pencil each time) to get it right.
4. Using a ruler and a fine-tip permanent marker, start at the tip of the pencil and make marks every 1 cm along the length of wood.



**Figure 5.** Whittling away one side of a wooden pencil to expose the graphite core.

5. Connect the pencil dimmer switch to your circuit.
  - a. Take the free ends of the red and green alligator clips.
  - b. Clip one of them onto the tip of the pencil, as shown in Figure 6. Make sure the metal jaws of the alligator clip make contact with the graphite, and not just the wood.
  - c. Use the other alligator clip as a "slider" by pressing it onto the graphite core at different points along the length of the pencil.
  - d. Experiment with how you can use the slider to control the brightness of the lightbulb.
  - e. If your lightbulb does not light up at all, press down more firmly on the graphite with the alligator clip, or try scratching the surface of the graphite with the clip (graphite can oxidize when exposed to air, which will prevent electricity from flowing).



**Figure 6.** Use alligator clips to connect to the graphite core of the pencil.

6. Make a data table, like Table 1, in your lab notebook. You can record the brightness of the lightbulb using a 0–5 scale (where 0 is "off" and 5 is "very bright"). Or, if you purchased the lux meter, you can measure the brightness of the bulb in lux (read the operating instructions that came with the lux meter).

Core Length (cm)	Brightness			
	Trial 1	Trial 2	Trial 3	Average
0 cm				
1 cm				
2 cm				
3 cm				
4 cm				
5 cm				

**Table 1.** Example data table for recording brightness of the lightbulb.

7. Start out with your slider at the 0 cm mark so the two alligator clips are actually touching each other. Record the brightness of the lightbulb in your data table.

8. Move the slider down to the next centimeter mark and record the brightness of the bulb.
9. Repeat this for each mark down the entire length of the pencil.
10. Start over at the tip of the pencil and repeat two more trials of the experiment. Record all your results in your data table.
11. Analyze your results.
  - a. Calculate an average brightness for each distance. Do this by adding up the brightness for each trial and dividing by 3, the total number of trials. For example, say you recorded brightnesses of 4, 4, and 5. The average is  $(4+4+5)\div3=4.33$ . Ask an adult if you need help calculating an average.
  - b. Make a graph of your results, with graphite core length on the horizontal (x) axis and bulb brightness on the vertical (y) axis.
  - c. How does lightbulb brightness change as the length of the graphite core changes? Does this make sense based on what you know about resistance? Remember from the **background** (#background) that higher resistance makes it harder for current to flow, and the bulb will be brighter when more current flows through it.

## Frequently Asked Questions (FAQ)

FAQ for this Project Idea available online at [https://www.sciencebuddies.org/science-fair-projects/project-ideas/Elec\\_p056/electricity-electronics/dimmer-switch-basic-circuits#help](https://www.sciencebuddies.org/science-fair-projects/project-ideas/Elec_p056/electricity-electronics/dimmer-switch-basic-circuits#help) ([http://www.sciencebuddies.org/science-fair-projects/project-ideas/Elec\\_p056/electricity-electronics/dimmer-switch-basic-circuits#help](http://www.sciencebuddies.org/science-fair-projects/project-ideas/Elec_p056/electricity-electronics/dimmer-switch-basic-circuits#help)).