

Using Stickers and Copper Tape to Prototype and Explore Electrical Circuits (P12 Resource Exchange)

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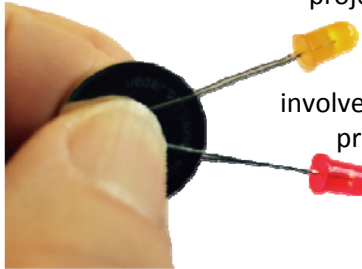
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Grades 5 and higher



The Cyber Resilient Energy Delivery Consortium (CREDC) Education team continues the work of the TCIPG Education project. The team develops interactive lessons and activities designed to link researchers, educators, consumers, and students. The materials illustrate challenges, trade-offs, and decisions required for secure and economical power delivery. The project seeks to involve families learning together while creating interest in STEM disciplines and careers. The project website offers a series of hands-on and virtual energy related activities and challenges.

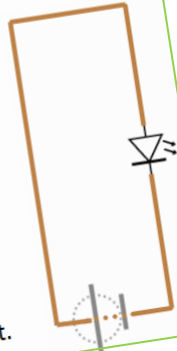
Copper Tape Circuits

Trace the path of the circuit with copper tape, leaving breaks in the tape for the battery and LED.

Both sides of the battery need to be part of the conducting path. Place the battery on the copper tape just before the break.

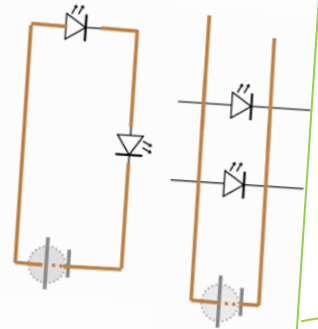
Extend the copper tape from the other side of the break so that it touches the top of the battery.

Tape the LED and battery into the circuit.



Series and Parallel Circuits

- Trace each of these circuits with copper tape. Insert LEDs and a battery into each.
- How many LEDs can you light?
- What colors of LEDs can you light?
- What happens if you put two batteries into a circuit?



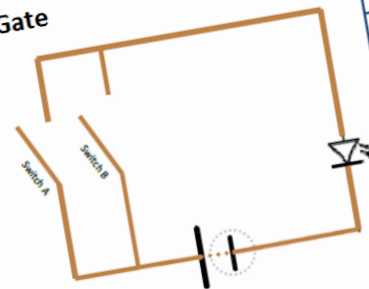
Turn the Lights On

Use copper tape to make the circuit.
Put lights in both of the first floor windows.



Logic Gates

Or Gate



	Switch A IN	Switch B IN	LED OUT
Both switches A and B off	0	0	
Switches A on, B off	1	0	
Switches A off, B on	0	1	
Both switches A and B on	1	1	

Light Up a Whole Town



Investigate Renewable Power Sources

Repurpose the solar panel and rechargeable battery from a solar path light. The path light is designed so that the solar panel charges a battery during daylight hours and the battery powers the LED when it's dark.

- Investigate the components and circuitry.
- Use the solar panel to power the LEDs in the windows of one of the house stickers. Can you light up your whole sticker town? Try two solar panels.
- Reattach the solar panel, PCB, and battery. Use them to light your town when it's dark.

Model an energy delivery system that uses more than one power source. Add a wind turbine or hand crank generator.



Solar Path Light Hack

TCIPG



Solar path lights, similar to those in the photo, use photovoltaic or PV cells, rechargeable batteries, and transistors or other smart switches to produce light at night.

Why are solar panels useful for these lights? Observe how the light operates. When does the light come on? What happens when the sun shines on the solar panel?

MATERIALS NEEDED

- Solar Path Light
- LED
- Copper Tape
- House Sticker
- Wire Cutters
- Tape
- Hair Dryer
- Small Phillips head screwdriver

STEPS

1. Remove the stake and plastic lens, placing it aside.
2. Use a small Phillips head screwdriver to unscrew black plastic bottom. Carefully pry the black plastic away from the solar panel cylinder.
3. You should see a battery and a small circuit board with wires that go through the holder and attach to the solar panel.
4. Use a hair dryer to melt the hot glue on the back of the solar panel, and push the solar panel away from the holder.
5. Two wires connect the solar panel to the circuit board. Clip these wires at a point halfway between the solar panel and the circuit board.
6. Push the solar panel out of the top of the holder so it's fully disconnected. Be careful not to disconnect the wire leads.
7. Unscrew the black battery holder from the printed circuit board (PCB).






The PCB circuitry and components control how the path light functions. The LED driver acts like a switch. If the LED driver detects current from the solar panel, it allows the solar panel to charge the battery. If the solar panel is not producing, the battery powers the LED.

Either the battery or the solar panel could power the LED directly.

What is the purpose of the PCB and its components?

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Curriculum guides, templates, and sources for materials are available at tcipg.mste.illinois.edu/resources