

Flat Flashlight

Category: Physics: Electricity & Magnetism

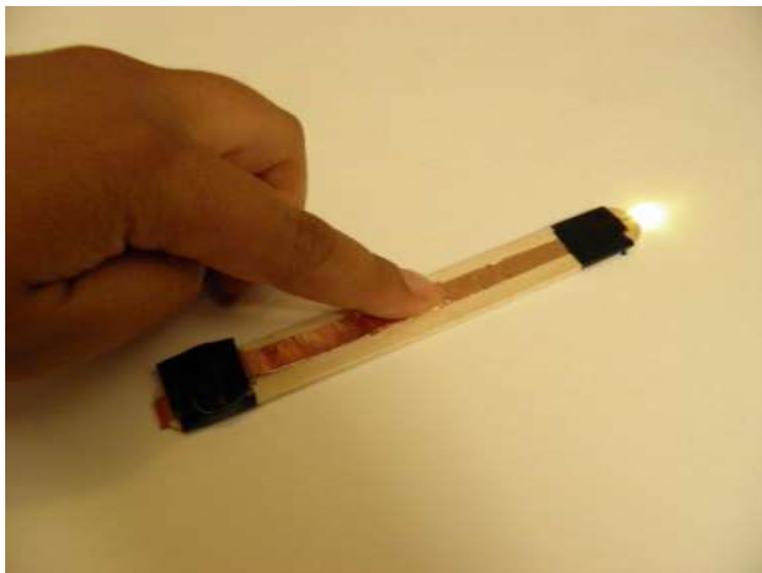
Type: Make & Take

Rough Parts List:

1	5 mm LED light bulb
1	3 V lithium button battery
1'	Copper tape, sticky on one side (sold at hardware stores as a snail and slug repellent). Strips of aluminum foil can also be taped down
1	Wide popsicle stick

Tools List:

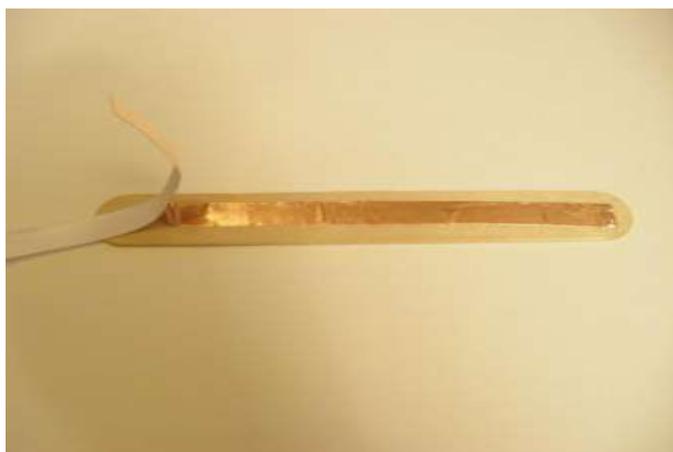
Scissors
Electrical tape



Video: <http://youtu.be/eFPhtPwWcjk>

Blog Link: www.oaklanddiscovery.blogspot.com

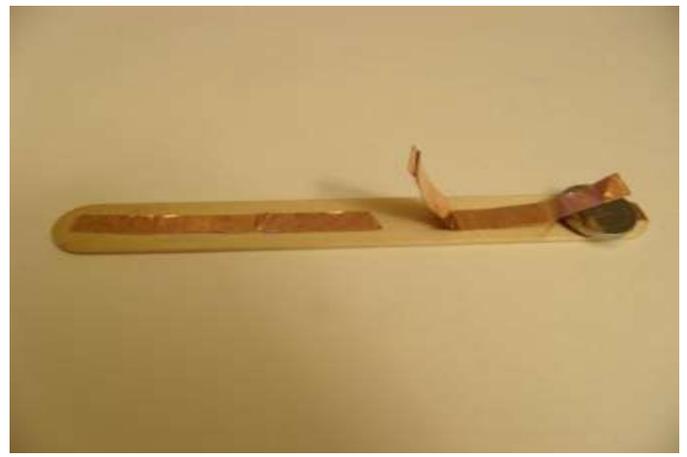
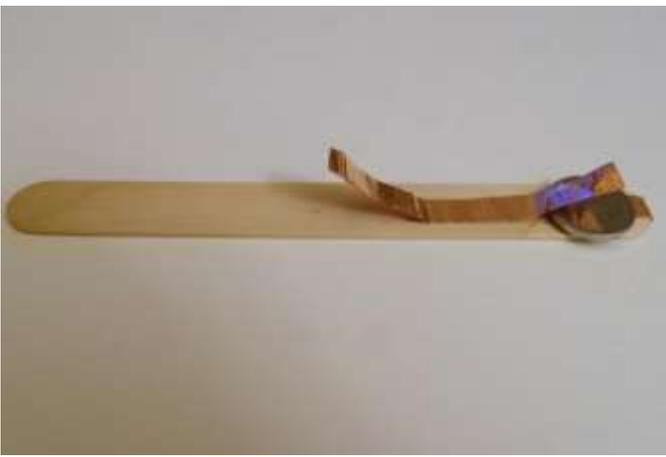
How To:



Attach the copper tape down the length of the popsicle stick leaving one extra inch on one end.



Wrap the extra inch around to the other side.



Place the button battery on top of the extra inch of copper tape. Take a short piece of copper tape and fold each end over about an inch to create a switch. Place the switch onto the popsicle stick over the battery.

Take a third piece of copper tape and place it under the switch and on down the length of the popsicle stick.



Attach the LED light to the other end of the popsicle stick. Make sure the LED leads are in contact with the copper tape.

Use electrical tape to secure the battery, LED light, and copper tape. Now press down on the switch, and watch your flat flashlight turn on!

Fine Points:

- Making sure that the switch is folded correctly is very important. The glue on the copper tape isn't conductive so you have to double the tape up to allow the electricity to flow.
- If you are having trouble folding the copper tape switch, you can try using aluminum foil and tape instead.
- The long lead of the LED is the positive lead. If you install the battery as shown, this positive lead should go on the switch side of the flashlight.
- Make sure to test the flashlight before taping things down with electrical tape.
- If the LED light is too bright, try attaching a small paper cup to diffuse the light.

Concepts Involved:

- A circuit is a path for electricity to flow through.

- An electric current is the movement of electrically charged particles, often electrons.
- Conductors are materials that allow electrons to flow freely in an electric current, and insulators are materials that impede the flow of electrons.
- An electrical circuit is a circular pathway of wires that electrons can flow through.

Focus Questions:

1. What is the power source in this circuit?
2. Why do you need to press down on the copper switch to turn on the flashlight?
3. In this project, which materials are the conductors, and which materials are the insulators?
4. What other materials would make good conductors? Insulators?

Elaboration:

In the process of building this flashlight, you have created an electrical circuit. Circuit sounds like the word “circle” for a reason. An electrical circuit is a closed pathway of wires and other conductors that electrons can flow through. The circuit is closed when everything is connected; in other words, when you press down on the copper you are creating a closed circuit. The electrons flow from the power source, the battery, all the way to the LED light to give it the power to turn on. When the copper tape pieces aren’t connected, the circuit is open and the electrons cannot flow to the LED bulb. That’s why the light is off.

The copper tape functions as a conductor. Conductors are materials that allow an electric current to flow freely. Silver, gold, aluminum, steel, and bronze are a few other good conductors. Metals like copper tend to be very good conductors because their electrons are delocalized. This means that the electrons are loosely held to the nucleus of protons and neutrons in the metal atoms. Since an electrical circuit requires electron flow, loose electrons make it easier for the electric current to quickly flow through.

The tape and popsicle stick are insulators. Electrical tape is made of a type of plastic, and the popsicle stick is made of wood. Insulators are materials that do not allow electric charges to flow freely. The electrons are tightly bound to the nucleus. Glass, rubber, paper, cotton, and ceramics are other good insulators. These materials are said to have a high resistance.

We also talk about conductors and insulators in the area of heat flow. In many cases, including most metals, heat conductors correspond with electrical conductors. Think about the types of materials we use for cooking; they are usually made of metal. Likewise, heat insulators, which are good for preventing heat transfer, often correspond to electrical insulators. While you may want to use a metal pan to fry an egg in, you’ll want to be sure to grab that pan by its rubber handle to prevent getting burned! A few exceptions exist to this correspondence. Diamond for example, is an electrical insulator (no free electrons) but it is an excellent conductor of heat.

Links to k-12 CA Content Standards:

Grades k-8 Standard Set Investigation and Experimentation:

Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other strands, students should develop their own questions and perform investigations.

Grades k-12 Mathematical Reasoning:

1.0 Students make decisions about how to approach problems:

1.1 Analyze problems by identifying relationships, distinguishing relevant from irrelevant information, sequencing and prioritizing information, and observing patterns.

1.2 Determine when and how to break a problem into simpler parts.

2.0 Students use strategies, skills, and concepts in finding solutions:

1.1 Use estimation to verify the reasonableness of calculated results.

1.2.2 Apply strategies and results from simpler problems to more complex problems.

1.3 Use a variety of methods, such as words, numbers, symbols, charts, graphs, tables, diagrams, and models, to explain mathematical reasoning.

2.5 Indicate the relative advantages of exact and approximate solutions to problems and give answers to a specified degree of accuracy.

3.0 Students move beyond a particular problem by generalizing to other situations:

3.1 Evaluate the reasonableness of the solution in the context of the original situation.

3.2 Note the method of deriving the solution and demonstrate a conceptual understanding of the derivation by solving similar problems.

3.3 Develop generalizations of the results obtained and apply them in other circumstances.

Grade 3 Standard Set 1. Physical Sciences:

1.d Students know energy can be carried from one place to another by waves, such as water waves and sound waves, by electric current, and by moving objects.

Grade 4 Standard Set 1. Physical Sciences:

1.a Students know how to design and build simple circuits and parallel circuits by using components such as wires, batteries, and bulbs.

1.g Students know electrical energy can be converted to heat, light, and motion.

Grade 5 Standard Set 1. Physical Sciences:

1.a Students know metals have properties in common, such as high electrical and thermal conductivity. Some metals, such as aluminum (Al), iron (Fe), nickel (Ni), copper (Cu), silver (Ag), and gold (Au), are pure elements; others, such as steel and brass, are composed of a combination of elemental metals.