# Project: Edge-Lit Cards Pittsburgh Community Science Workshop

Use the science behind fiber optic communication to light up your drawings!

#### Materials needed:

Small square of plexiglass Piece of cardstock paper or file folder Black paper LED light (3mm RGB auto-changing) Coin-cell battery (CR 2032) Electrical tape Something to scratch with (cork tool with pointy tip included in kit)



🔼 YouTube

# **VIDEO INSTRUCTIONS** at SciWorkshop.org/KITS

1. Slide the LED light onto



the battery, with the longer leg on the positive side (the side with the plus sign) and shorter leg on the other side. If the LED doesn't light up, try

**2.** Go in a dark room and point the LED light towards a white surface. Can you see three separate colors of light? What

colors do you see where they overlap and mix together?



it the other way around!



 Peel the plastic sheet off the plexiglass. Shine the LED light through the thin edge of the plexiglass sheet. Where does it light up?



4. Use the scratching tool to draw a picture on the plexiglass. Push *hard* to make a deep scratch. You will not be able to erase, so be careful...but remember, mistakes are okay!

Questions about the project or kit? Reach out to team@sciworkshop.org

**5.** Take the sheet of cardstock, and fold it in half, and then in half again. Your paper should form a double-layer card. Draw a small X in the center of the front of the card.





7. Cut a square out of the paper *that is a little bit smaller than the square you traced* so that the opening is *smaller* than your piece of plexiglass.



**9.** Place the black paper over the plexiglass. Tape all four sides down to the inside of the card with the black electrical tape. Make sure the battery is taped firmly so it doesn't fall out of the card.

6. Unfold the paper and turn it over, finding the spot on *the other side of the paper* from the X that you drew. Place the plexiglass in the center and trace around the outside.



(Confused? Read "Tips and Tricks" or watch the video at sciworkshop.org/kits)



 Place the plexiglass over the opening. Tape the LED and battery on one side making sure there is enough room. The tip of the LED bulb should be touching the edge of the plexiglass.



10. Re-fold the cardstock so that the back of the plexiglass and battery are sandwiched inside the front of the card. You can write a message inside and draw on the paper border if you want to – and you're done!

Questions about the project or kit? Reach out to team@sciworkshop.org

## Tips and tricks

Your card does not need to be on all the time. You can create a simple on/off switch in a few different ways. Tape the LED to the battery more loosely and bend one LED leg away from the battery a little bit, so you must push on it to turn it on. Or, cut a strip of cardstock to slide in between one LED leg and the battery to turn it off.

If you don't have scissors, or you get frustrated with the folding and cutting, you can make it a flat art piece instead of a card. Simply tape your plexiglass scratch-drawing onto the cardstock, with the black paper behind the plexiglass, and tape the light to one side shining in.

## To do and to notice

The light you are using is called an "RGB" LED because it emits **R**ed, **G**reen, and **B**lue light. What color do you see when Red light mixes with Green light? What about Green + Blue? Or Red + Blue? All three colors together? Your Phone, Computer, and TV screens mix colored light in the same way to create all the colors of the rainbow.

How long does the battery last for? Notice what happens to the colors of light when the battery starts to run down. Why do some of the colors of light stop working before others? Why do you think that red lasts the longest?

If you look closely, the little battery cell you used says "3 V", which means it has three Volts. How many volts does a new AA or AAA battery have?

### **Deeper Dive**

The physics phenomenon highlighted here is called *total internal reflection*, where a ray of light traveling through a material like plexiglass or water (at certain angles) will reflect off the inside surface. When you scratched the surface of the plexiglass you made an edge for the light to pass out of. Total internal reflection is used in fiber optic communication. The internet depends on huge data centers interconnected by thin strands of very pure glass (nearly as thin as a strand of your hair!) with light reflecting inside to carry high-bandwidth data rapidly over long distances.



Questions about the project or kit? Reach out to team@sciworkshop.org

Volts are named after the person who invented the first true battery, Alessandro Volta. Voltage is the 'push' that makes charged particles move and produce electric current. The little battery in this science kit uses Lithium, a light-weight element that is highly reactive and can produce more than 3 Volts per cell. Most common AA batteries use a chemical reaction between Zinc and a Manganese compound that produces only 1.5 Volts per cell. Electric cars use Lithium batteries. Making better batteries (and figuring out the best way to recycle them!) will be big science in the years ahead.

Light is energy that travels in electromagnetic waves. Different colors of light have different wave lengths. Waves that are closer together (short wavelengths) carry more energy. Blue is a higher energy than red and requires more voltage in an LED. Red has long wavelengths and is lower energy. A 3V battery that is running low still has enough electrical potential to power red a LED.



### CC By-SA 3.0

The electromagnetic spectrum carries energy in invisible waves that can be as tall as a building or as small as the nucleus of an atom! In between are the wavelengths that humans can see with our eyes, that we identify as color.

#### Resources

Original idea for the edge-lit holiday card came from Evil Mad Scientist Labs https://www.evilmadscientist.com/

Questions about the project or kit? Reach out to team@sciworkshop.org