

CIRCUITS & HARDWARE



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THINKit



A Bright Idea Activity

Grades

K-12

Career Pathways

Electrical Engineer
New Media Artist
Designer
Inventor

Academics

Math: Spatial Reasoning, Equations, Measurement
Science: Circuits, Electricity

Professional Career Skills

Communication
Logical Reasoning
Creativity
Perseverance

Materials

Conductive Connections Kit:
(Conductive Tape, Coin Batteries, LEDs, Resistors)
Multimeter
Craft Supplies: Scissors, Tape, Glue, Markers, Cardstock

Team Goal

Level 1

Use a blueprint to create an interactive card with a circuit that turns an LED on and off.

Level 2

Use a blueprint to create an interactive card that varies the brightness of LEDs using resistors in a circuit that can turn on and off.

Level 3

Create your own blueprint and build an interactive card with circuit that can turn on and off using LEDs and resistors.

STEM
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Think like an Inventor with Conductive Connections



Iterative Design

As you create your interactive card, continue to think of new ideas and make improvements so it works and looks great! You do this through cycling through the engineering design process.



Product

When you decide to create or build a prototype or model, you are producing a product. Your interactive card is a product that can be shared with other people.



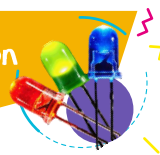
Fabrication & Manufacturing

When your invention is ready to be mass produced, many people might help to create your product.



Precision

Engineers pay attention to the details in how components are put together. They need to be precise in measurements and make sure they sequence construction in a specific order.



Criteria

You will know your card design is successful by how well it works with your audience. Criteria for success include: a clear message and circuits that turn on.



Constraint

All engineers are limited by resources or time. To create your interactive card, you may have a limited number of supplies or time create your product. Engineers work with what they have to make the best product possible. It is very creative work!



Scheme, Blueprint or Diagram

You may use a premade plan to help create your interactive card. Often these plans come with labels or directions that help you put it together.



Prototype or Model

Before putting too many resources, like time or money, into a final product, you should build a less refined version of your product first. You might have a few drafts of your card before making the final version.



Troubleshoot

As you assemble your card, it may not work as well as you expected it would! You might need to test, modify and refine your design so it works.



Component

Your interactive card, or model has many parts that are needed to make the whole product work. There are wires, batteries, LEDs, and resistors. The paper and artwork is also a component that helps to communicate a message in your product.



Modular

Many engineers are designing products that have components that can be fixed or replaced without having to throw away everything. Designing modular products is good for the environment and your budget!



Assembly

You need to be precise when you put all the components together in your card. It is helpful to assemble a model in a certain order otherwise putting it together may be difficult or even impossible!



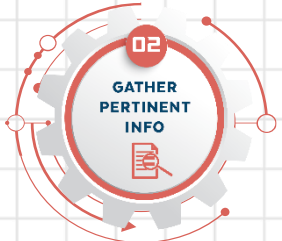
Engineering Design Process Directions:

Getting Started with
Copper Tape



Define the Problem

Choose a goal to tackle with your team!



Gather Pertinent Information

Explore how to make a circuit. Check out the [Electrical Engineering Tips](#). You will need paper, conductive material, LEDs, batteries and resistors.



Generate Multiple Solutions

Brainstorm greeting card messages that fit with your interactive circuit. Explore the circuit blueprints and discover how the cards are folded and cut.



Choose a Solution

Decide on the message you want to share on your card. Choose a blueprint or use what you learned to create your own scheme for the design of an interactive card.



Design a Culturally Responsive Solution

Design your card to communicate a message. It may be easier to draw and color before wiring your circuit. Share materials and troubleshoot the directions with your team. How has your team been sharing ideas and helping each other?



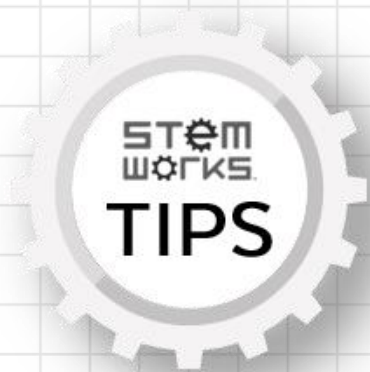
Test and Optimize

Test your circuit. Does it turn on and off? Do you need to rewire for a better connection? Do you need to reverse your LEDs? Use what you learned to modify and improve your interactive solution.



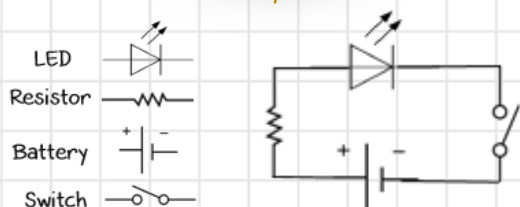
Share & Reflect

How did your team find help each other find solutions? How did you and your team collaborate and practice perseverance? Talk to your team: What went well? What could have gone better?



Electrical Engineering Tips

Electrical Symbols



Circuits Drawn with Electrical Symbols

A circuit needs a path where electrons, from a source of voltage, can flow. Conductive material, like wires or copper tape, can provide the path for electrons. A battery or solar panel can provide a source of voltage. Voltage will push the electrons to flow in a circuit.

Multimeter



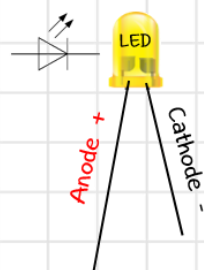
A multimeter can be used to measure the voltage drop across each LED as well as the voltage produced by a battery.

Common LED Voltages



LEDs (Light Emitting Diodes) and Voltage

LEDs use electric power and is an example of an electric load. Different colors of LEDs have different voltage ratings. LEDs rate between 1.8 to 3.6 volts. Most new coin batteries measure 3 volts. Over time, energy in the batteries decrease and so will the voltage. Measure them to find out!



LEDs and Current

LEDs need a flow of electrons, called electrical current, to create light. Electrical current is the flow of electrons in a circuit. The greater the flow of electrons, the brighter the LED. If the flow of electrons is reduced, the LED will be less bright. Every light has a current rating. Too much current will burn out a bulb!

Maximum Current 20mA



LEDs and Polarity

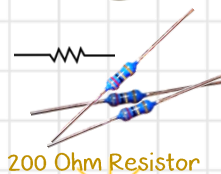
LEDs and batteries have polarity. This means they have a positive and negative side and are not reversible in a circuit. The LED's longer wire is the anode and connects to the positive side of a battery. The shorter wire is the cathode and connects to the negative side of a battery. Sometimes the plastic on the LED has a flat side to help you find the cathode.

Resistors

Resistors reduce the flow of electrons. Adding a resistor to a circuit can make an LED less brighter. Every resistor has a color code that shows the resistance value.

$$\text{Current (I)} = \text{Voltage (V)} \div \text{Resistance (R)}$$

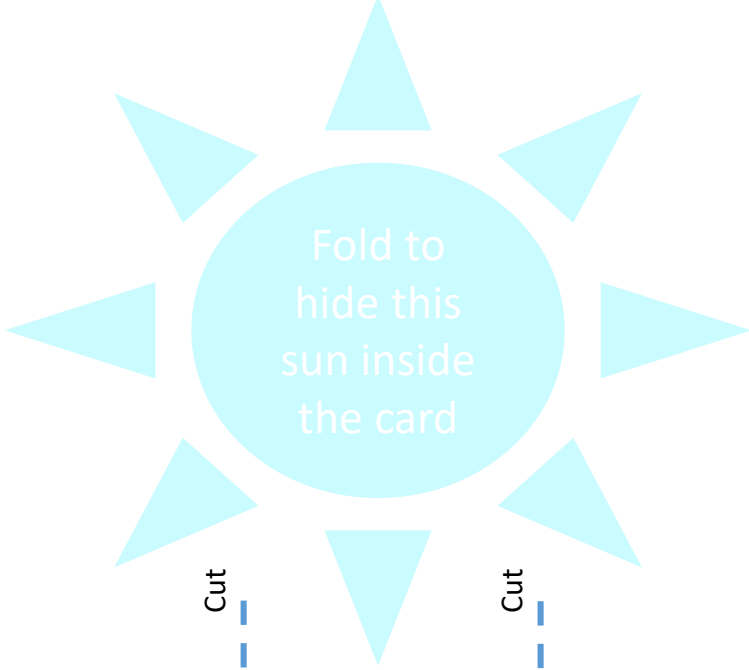
If there is more resistance than the current, or flow of electrons, the voltage is smaller. Resistors do not have polarity and are reversible.



Fold



Fold



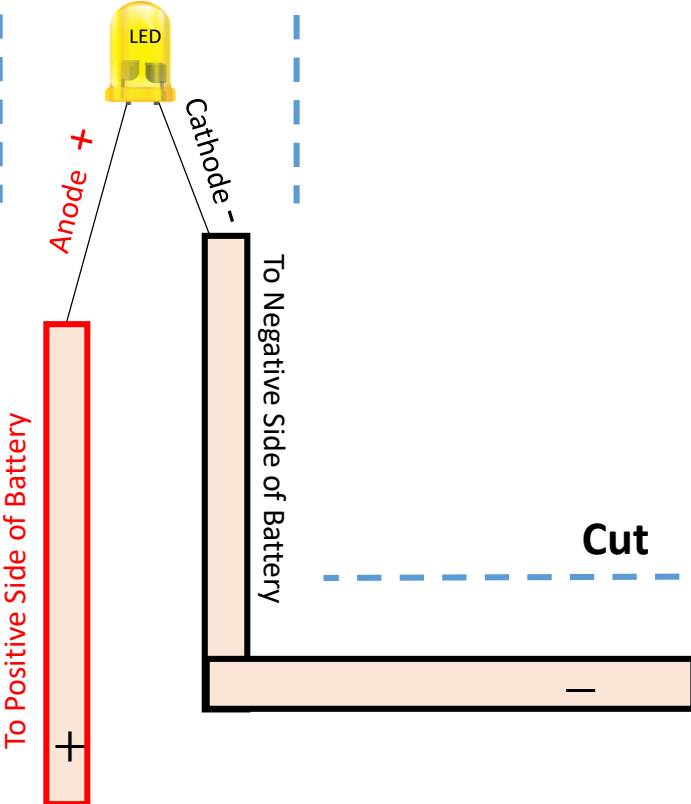
Fold



Fold

Cut

Cut



BATTERY
Negative
Side Faces
DOWN



Fold Me!

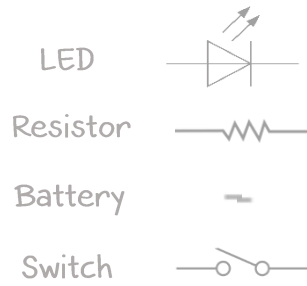


Glue
Picture
Here

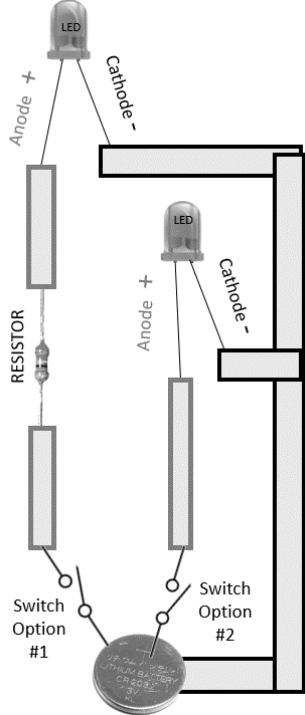


Electrical Engineering Blueprint:

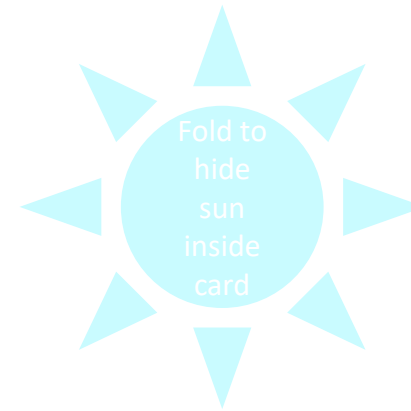
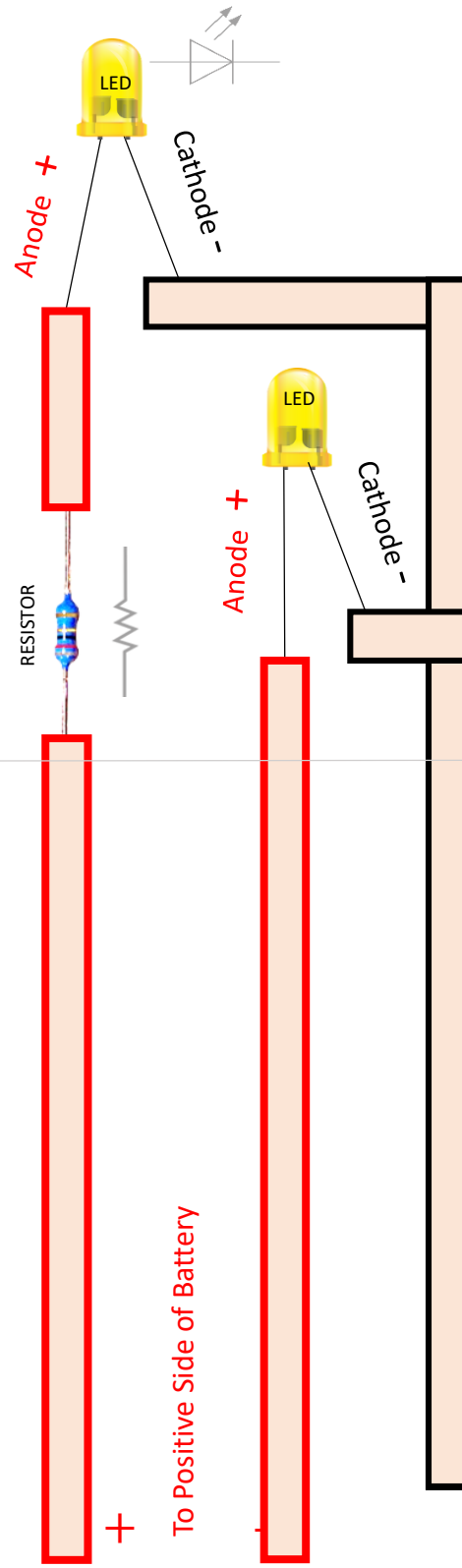
Draw a blueprint for the circuit in this card using electrical engineering symbols.



Electrical Blueprint:

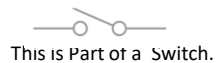


Fold



Fold

Cut



Battery:
Negative
Side Faces
Down

Fold Me!

