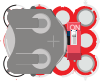
# Circuit Craft Pack Guide

## GETTING STARTED:

The Circuit Craft Pack is great for open exploration and circuit crafts. The pack comes with 20 battery packs, 20 white LEDs, 10 color changing LEDs, extra batteries, copper tape, conductive thread and conductive ink. It serves about 20 students, but can serve more by purchasing battery extension packs available on our website.



The battery will power your circuit. It stores electricity that makes your circuit light up. The battery pack has a positive side marked in red and a negative side marked in white. The on/off switch can help you control when your circuit is powered on.

LED stands for Light Emitting Diode and they turn electricity into light. These components allow you to light up your projects. They have a positive (red) and negative (white) side.

This pack includes color changing and white LEDs.

Copper tape is conductive and can be used on LEGO and paper circuits. The tape can easily tear, so be sure to patch up any gaps.

Conductive thread is great for sewable projects. Loop the thread the metal sides and tie off to make a tight contact.

Conductive ink can be used to make paper circuits.

We've included extra batteries in case they need to be replaced. Insert the battery into the battery pack with the positive side up.

## PREPARE ADDITIONAL CRAFT MATERIALS:

We recommend placing components and additional materials in labeled bins. This makes them more accessible to students. You may want to provide regular craft materials (felt, paper, LEGOs) along with a few of these conductive materials for students to experiment with.

Paper Clips

Brass Brads

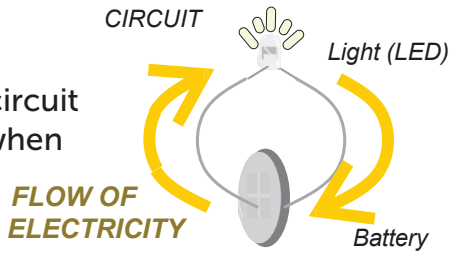
Aluminum Foil

Pipe Cleaners

Remove fuzz to expose wires

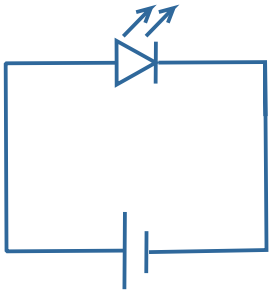
# WHAT IS A CIRCUIT?

A circuit is a closed path through which electricity flows. The simplest circuit we can work with is a battery connected to a light. The light turns on when electricity flows from the battery, through the light and back to the battery.

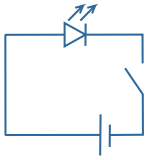



A common way of drawing circuits is called a circuit diagram. In a circuit diagram, a battery is shown as two parallel lines and an LED as a triangle and line with arrows representing the light.

*CIRCUIT DIAGRAM*



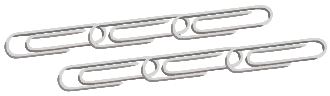
In this circuit, the light is always on until the battery runs out of energy. When you add a switch to the circuit, you can control when the light is on or off. The switch is drawn as a 'door' that open and closes the circuit. Switches come in many forms and are in almost any device with electricity.



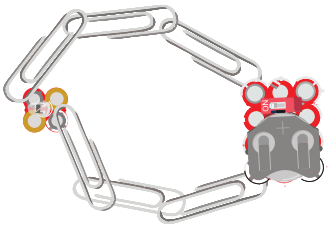
*Simple Circuit with 1 Switch*

# CREATE A BASIC CIRCUIT:

In order to create a working circuit, you must create a complete loop using conductive materials. Connect the components by attaching the conductive sides which are color coded. Red indicates positive, white is negative and blue indicates that the component does not have a positive or negative side. The part of the component without metal aren't conductive but they can be used to secure your circuit in place.



Start by creating a simple circuit using paper clips. Link the paper clips into two chains.



Hook them the tinned components. Remember to turn it on using the on/off switch!

Experiment with copper tape. In this circuit, the paper clip functions as a switch when it touches both pieces of copper tape.

# TEACHABLE MOMENTS:

**Conductive** materials allow the flow of electricity. Conductors are usually made out of metal such as paper clips, copper tape, and aluminum foil. Have students explore to find other conductive materials to build their projects with. Discuss why pipe cleaners are conductive.

**Resistance** is the measure of how difficult it is for electrical current to flow through a material. Higher resistance means less current will flow through a circuit, and low resistance means more current will flow.

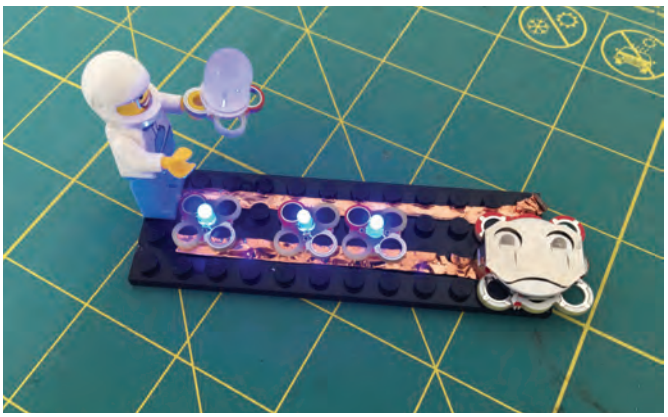
**Engineering Design** is the process of coming up with a solution to a problem. The steps include brainstorming, prototyping and testing your ideas. Students engage in this as they create their projects.

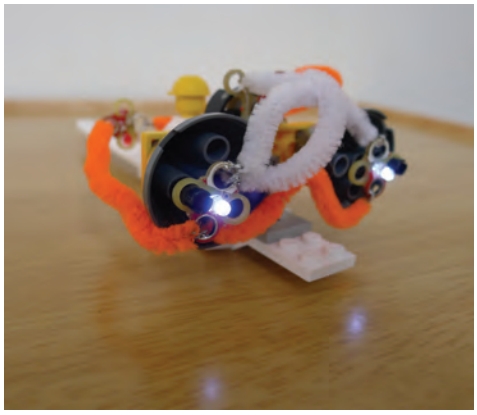
For additional information, visit our website www.lectrify.it/educators

# CIRCUIT CRAFTS:

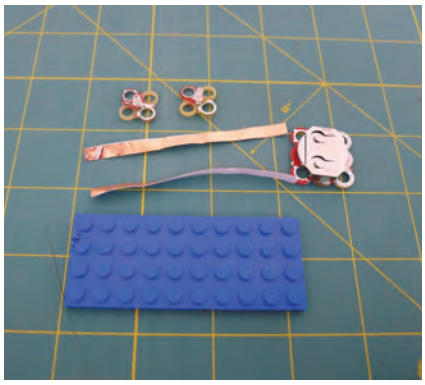
## LEGO Creations

(Concepts: Series & Parallel Circuits, Engineering Process & Design)

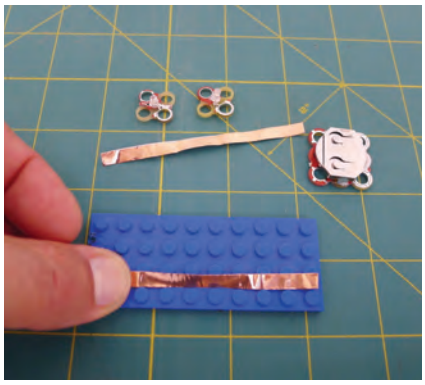




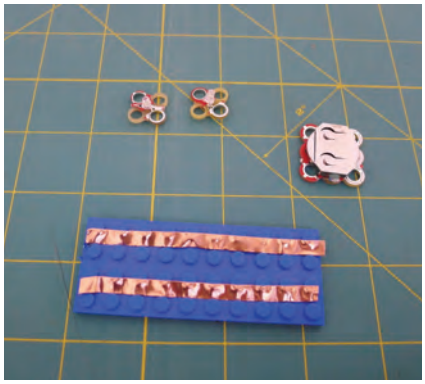
1. Gather materials - copper tape, LEDs, battery pack and LEGOs.



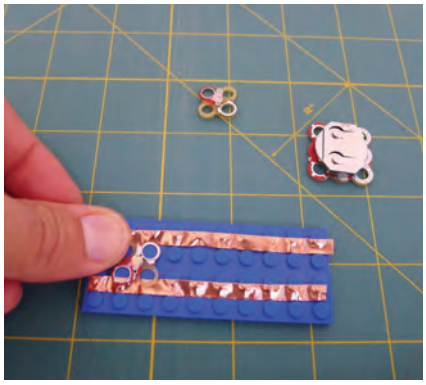
2. Remove adhesive from the back of copper tape and lay it in between LEGO pegs.



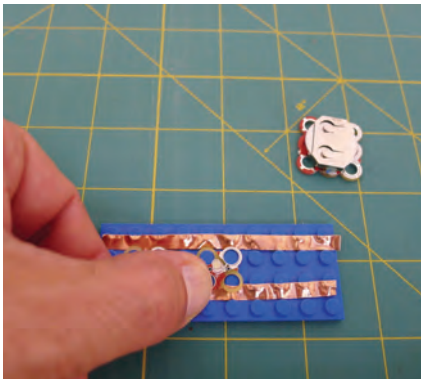
3. Place another strip of copper tape parallel to the first leaving a row in between.



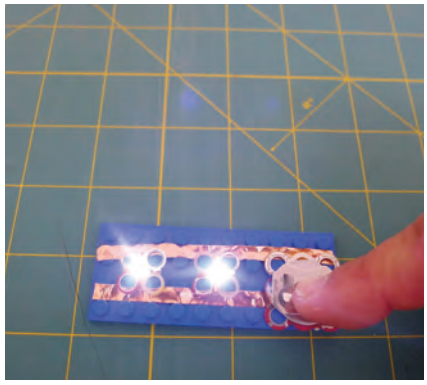
4. Snap components onto pegs. The red side of the component should touch one strip of copper tape and the white side the other.



5. Place the second LED in the same direction.

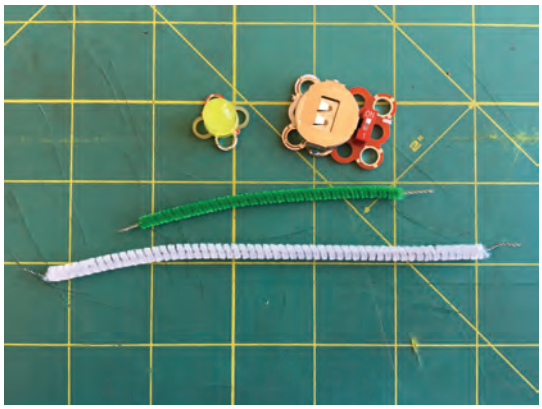


6. Place the battery so the white sides are all along the same copper strip. Push down so the component fits on the copper tape.



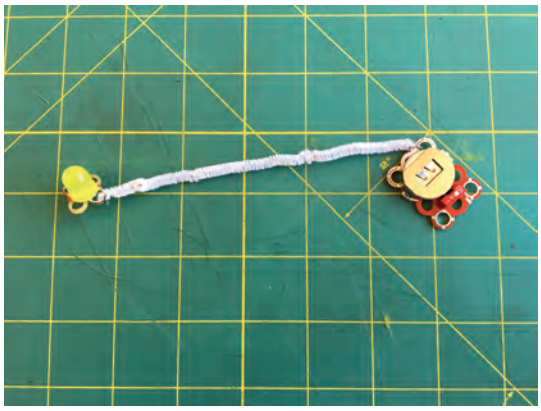
# Pipe Cleaner Crafts

(Concept: Conductivity, Insulation, Series & Parallel Circuits)

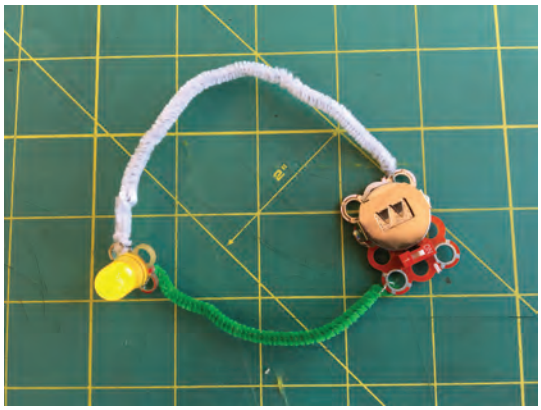


1. Gather materials - pipe cleaners, battery pack and an LED.

2. Remove fuzz off the ends of the pipe cleaners to expose the metal. Use your fingers or scissors.



3. Twist the exposed wire around the metal sides of the components. Make sure the wires have a secure contact. Connect white to white and red to red.



4. Test your circuit to make sure your light turns on. If you see the LED flicker, double check the connection to make sure it is secure.

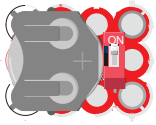
5. Twist the pipe cleaners into the shape of a flower. You may want to use additional pipe cleaners to complete your design.

# Teaching notes

## The switch is an important building block

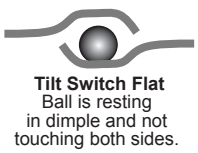
In a circuit diagram, a switch is drawn as a "door" that opens and closes the circuit. Switches come in many different shapes and forms and can be found in every device with electricity.

**BATTERY WITH ON/OF SWITCH**



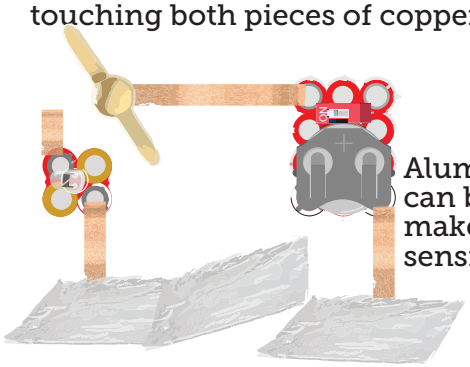
The lectrify kits come with two switches. The battery has an On/Off switch. The tilt switch has a metal ball bearing in it that closes the circuit when the switch is tilted.

**TILT SWITCH**

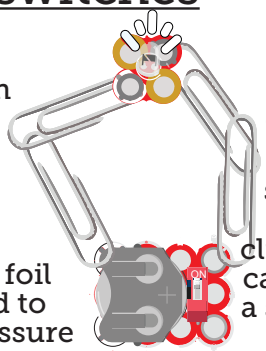



## Get creative with your switches

In this circuit, the brad can function as the switch closing the circuit when touching both pieces of copper tape.



Aluminum foil can be used to make a pressure sensitive switch

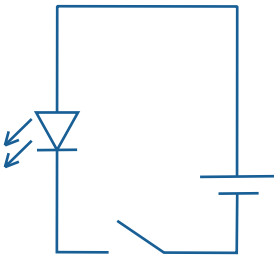


This paperclip bracelet does not look like it has a switch but the air gap between the clips when it is loose can be thought of as a switch. Tight= On, Loose=Off

**Prompt**

Ask students to look around the room and see how many switches they can see from their seats

## Advanced: Explore how switches enable logic



In a simple circuit, the switch is the part of the circuit we control and is our INPUT, and the light is the OUTPUT, (what the circuit does). Even a simple circuit allows us to collect data as in the following table.

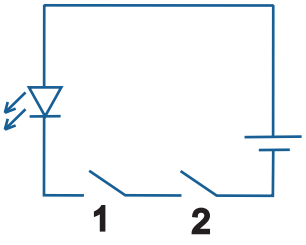
| INPUT (Switch) | OUTPUT (Light) |
|---|---|
| OFF | OFF |
| ON | ON |

We shorten ON/OFF to I/O

| INPUT (Switch) | OUTPUT (Light) |
|---|---|
| O | O |
| I | I |

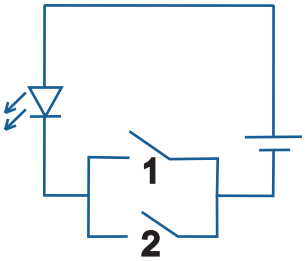
When we use two switches, we now have two inputs and this allows us to explore the most common logic circuits in computers: AND and OR. An AND circuit is done when we put two switches in series and the OR when they are done in parallel.

2 Switches in series




| INPUT | | OUTPUT |
|---|---|---|
| Switch 1 | Switch 2 | Light |
| O | O | O |
| I | O | O |
| O | I | O |
| I | I | I |

2 Switches in parallel




| INPUT | | OUTPUT |
|---|---|---|
| Switch 1 | Switch 2 | Light |
| O | O | O |
| I | O | I |
| O | I | I |
| I | I | I |

When the switches are in series, both switches must be on for the light to turn on. We call this an AND circuit because both Switch 1 AND Switch 2 need to be on for the light to turn on.

When the switches are in parallel, we observe that the light turns on when Switch 1 OR Switch 2 or both switches are on. This is called an OR circuit.

AND and OR are building blocks for many programming ideas and important circuits to learn.

**Student Worksheet**

Name: _____

1. Describe what will happen in this circuit. Why?

2. List 10 materials you think might be conductive. Then, test your hypothesis and document your findings.

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

3. Draw a sketch of a project you'd like to make. Make sure to include how you'd wire up your circuit and which connectors you will us.