

# Circuitry Tutorial

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## Introduction

This tutorial discusses the types of circuits, where you might see those circuits, and how those circuits are used in the Pictronics kits.

## What is a Circuit?

An electric circuit is a path along which electrons flow. This flow is called an electric current. A circuit is a continuous loop of conductive material.

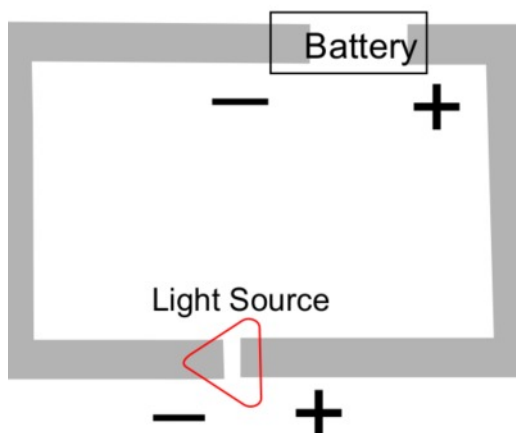
## Types of Circuits

There are 3 types of circuits: simple circuits, parallel circuits, and series circuits. Let's take a look at each:

### Simple Circuits

Simple circuits are the easiest circuit to examine when you are learning about conductivity and how to get electricity to flow. The downside of a simple circuit is there are very few ways to use it because it is so simple. A simple circuit looks like this:

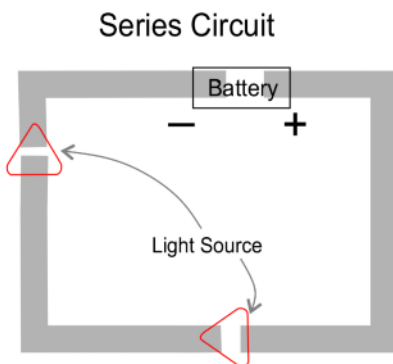
### Simple Circuit



This circuit has a power source, a complete path that flows from positive to negative, and a light source. The electrons flow from the positive side of the battery to the negative side of the battery. The light source is polarized, so it must be connected with the positive side attaching to the side of the flow closest to the positive side of the battery. If it is reversed, the LED will not light up. If the power source to it is too great, it could short out the LED but we will only use a 3 volt battery so it should not damage your LEDs.

## Series Circuit

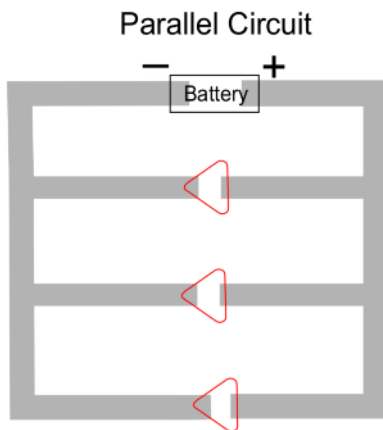
The key feature of a series circuit is that the LEDs are in a line, one after the other. So the electric current must flow through the first LED in line to get to the second, the second LED to get to the third, and so on. Here is a picture of a series circuit:



After the circuit passes through each LED, the amount of positive charge left drops quite a bit, but there are still positively charged electrons. This means that it might be able to power another light, depending on the strength of the battery. It also requires every LED to be working for the circuit to be closed. Series circuits are often used in Christmas tree lights. That is why, when one light goes out, the whole string goes out. This drop makes the series circuit

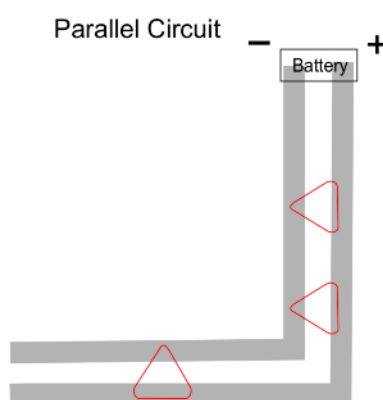
## Parallel Circuit

In the last two examples, there has been just one continuous path along which the electrons flow and the LEDs are placed. The parallel circuit has more than one continuous path along which electrons can flow, but they have the same power source. Here is an example of a parallel circuit:



In this example, there are three different paths, each having a LED that closes the circuit. All three of those paths share a single source from the battery and a single source back to the battery. The lights themselves do not need to be parallel to each other.

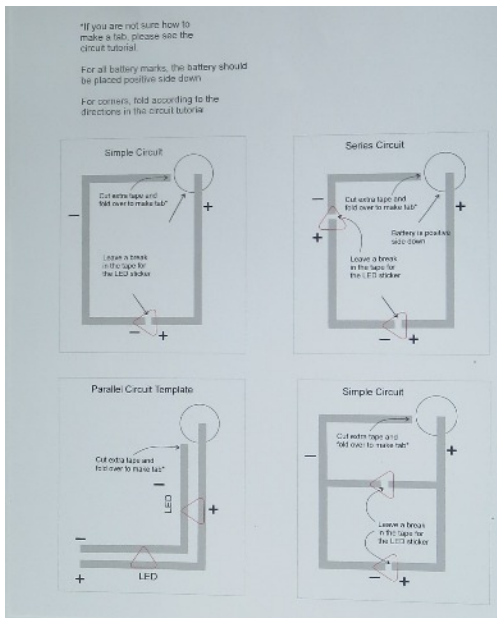
Here is another example of a parallel circuit:



This is another example. In this case, the positive and negative connections are close enough together that the lights themselves are the path.

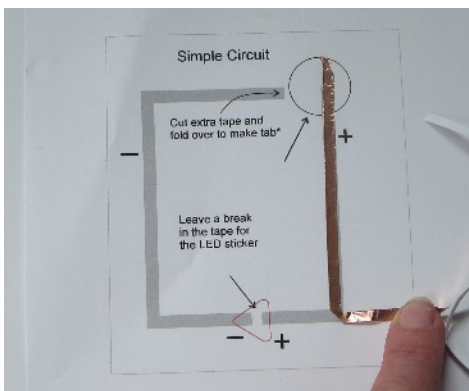
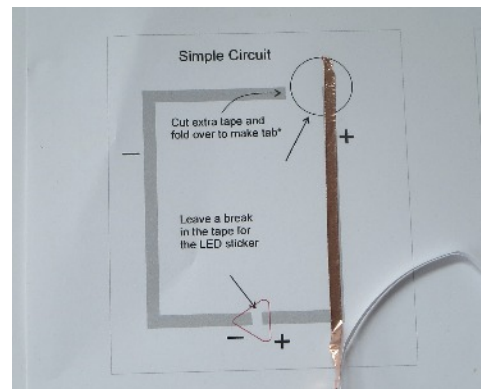
## Directions for building circuits

This section will walk you through the basics of building the [example circuits available on the website](#).

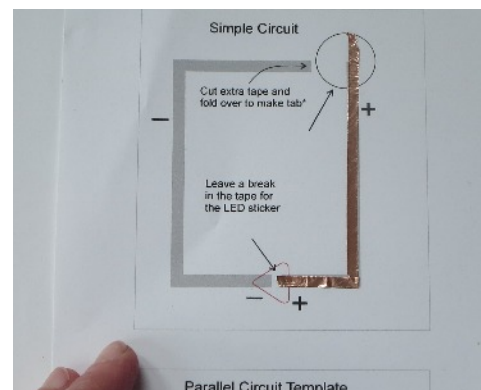


### Building the Simple Circuit

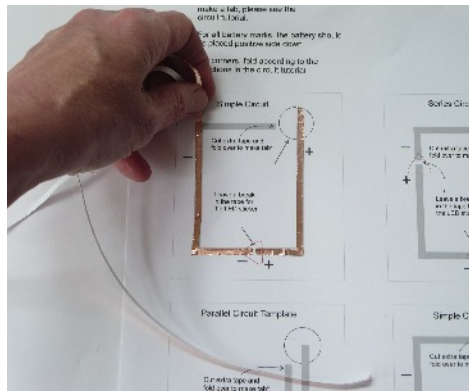
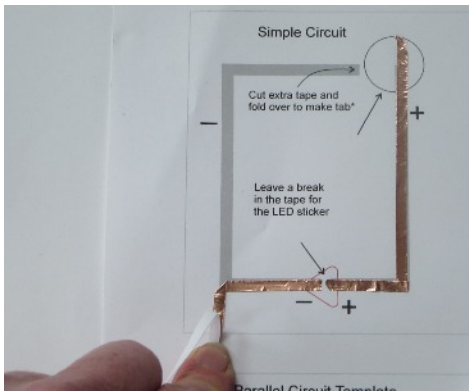
- The gray lines mark the path for the copper tape.
- Start to peel the backing off one end of the copper tape.
- Stick it to the diagram along the right side, starting at the battery mark and continuing to the lower end of the gray rectangle.



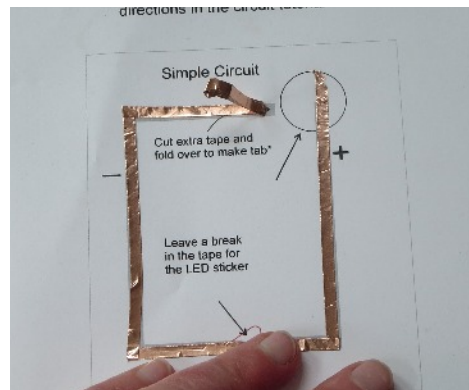
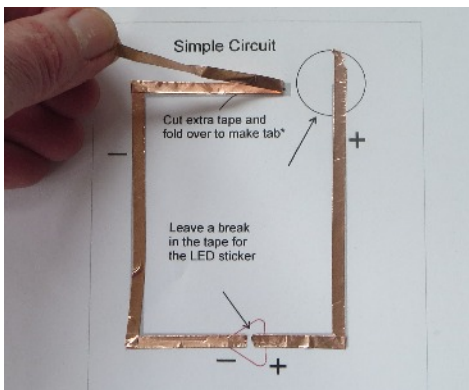
- Make a corner by folding the tape to the right
- Fold the tape back to the left and continue to attach it to the diagram until the break in the gray line, underneath the mark for the LED.
- Tear or cut the tap and adhere it.



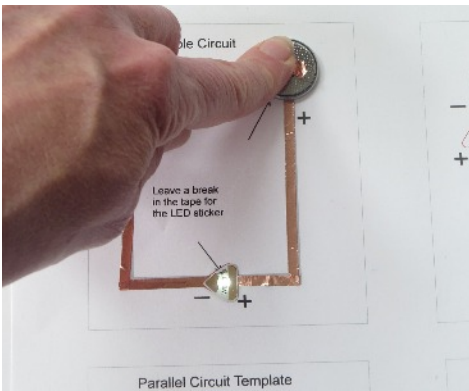
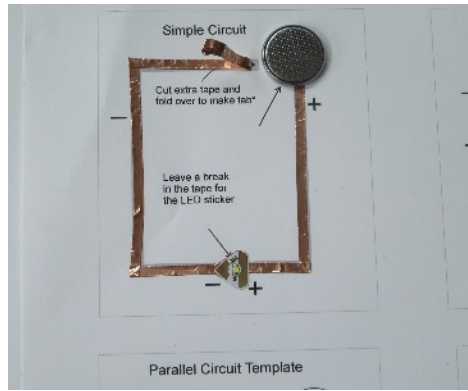
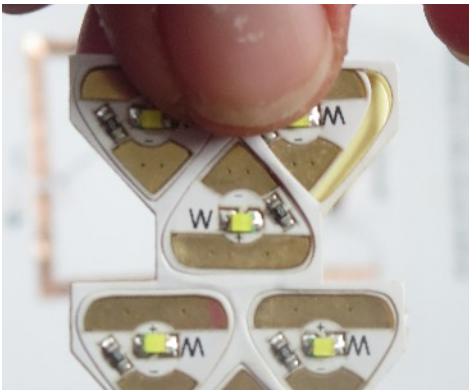
- Start to attach a new piece of tape, making sure there is a gap between the first piece and the one you are now placing.
- At the left edge of the rectangle, make another corner by folding the tape down then up.



- Fold again to make the final corner.
- When you reach the end of the gray line, rip or cut the copper tape about three inches past the end of the line.
- Fold the loose portion of tape in half and stick it to itself to make a tab.

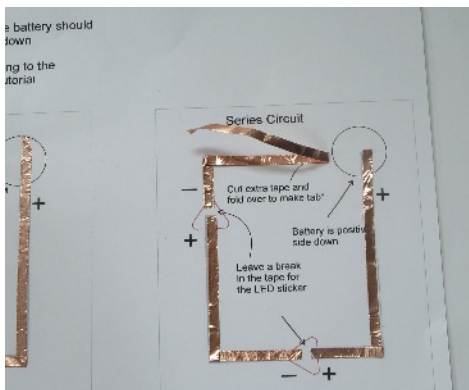
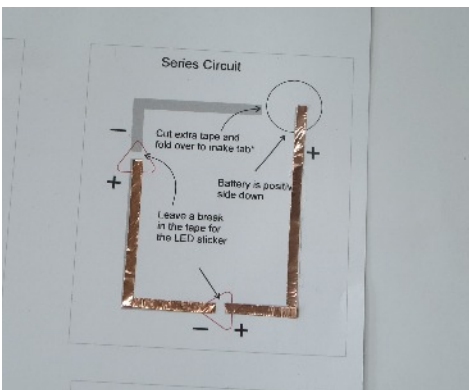
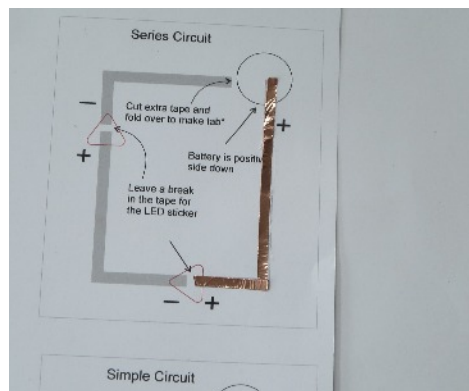
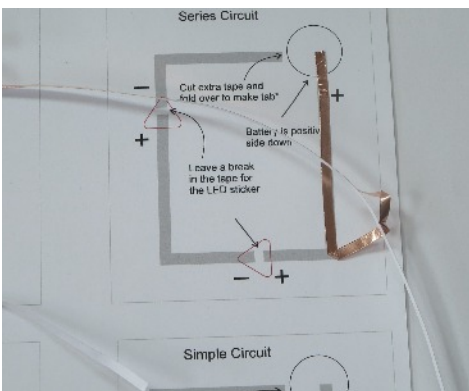


- Take one of the Chibitronic lights off the sheet of lights. Note that base of the light triangle is positive and the vertex is negative. The bottom surface of the light has a conductive adhesive surface.
- Place the light over the red outline of a triangle, pressing firmly to make sure the connection with the copper tape is solid.
- Place the battery, positive side down, over the battery circle.
- Place the copper tab over the battery to close the circuit.
- Does the light go on? If not, check the troubleshooting guide at the end of this document.



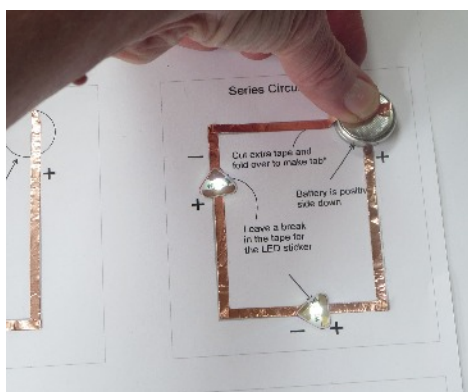
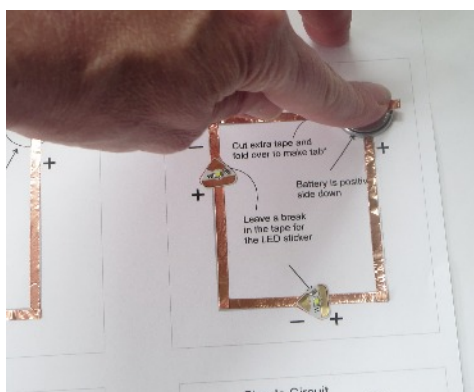
## Building the Series Circuit

The series circuit is built about the same as the simple circuit. Just make sure to leave space for the second chibitronic sticker:



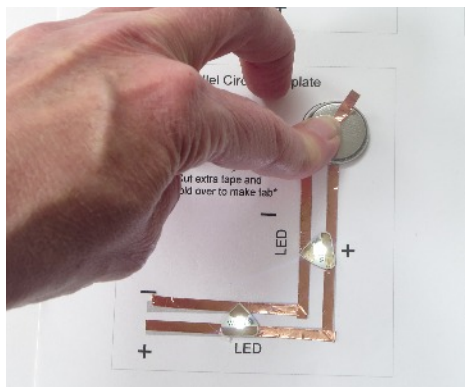
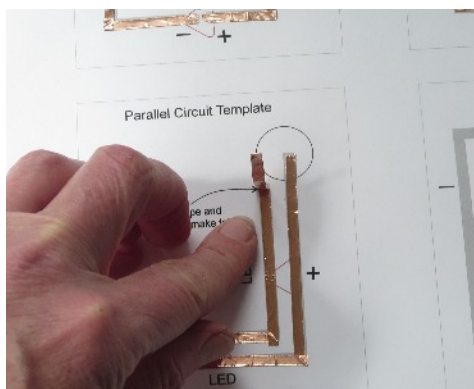
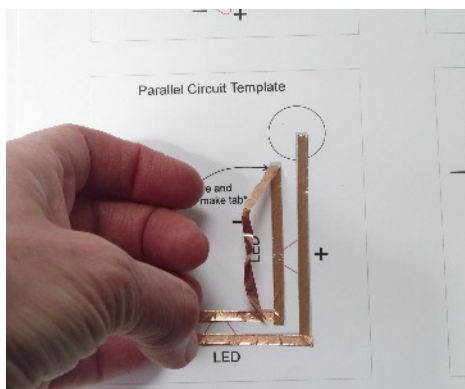
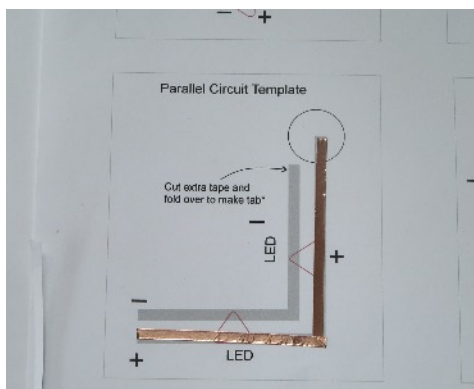


- Place the stickers, pressing firmly to make sure the contacts are good.
- Place the battery, positive side down, on the battery circle.
- Press the copper tab over the battery. Make sure the battery is connecting with both pieces of copper tape.
- Do both lights come on? If not, try adding another battery on top of the first one, making sure it is positive side down.
- Place the copper tab over the top battery.
- Do the lights come on? If not, please see the troubleshooting guide at the end of this document.

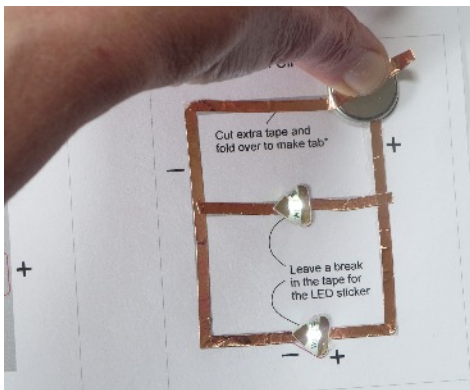
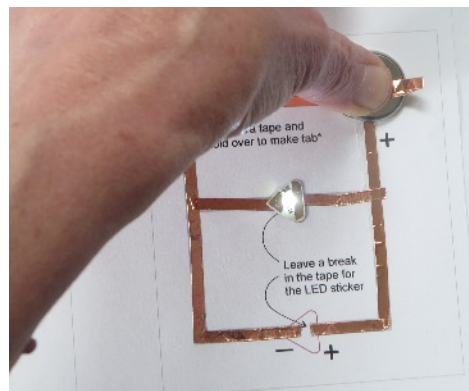
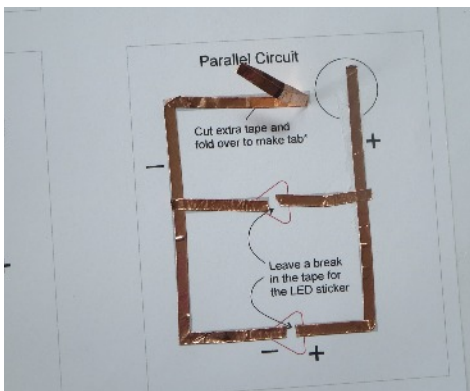
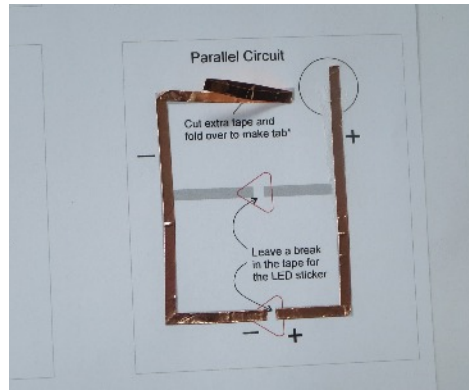
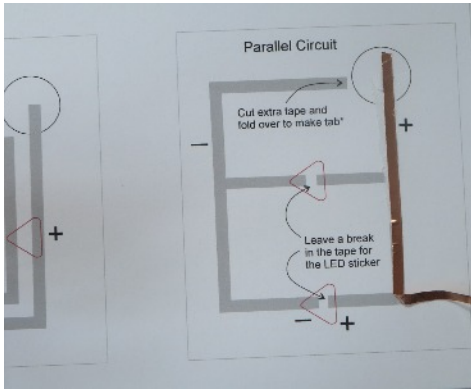


### Building the Parallel Circuits

- Build the parallel circuits using the same techniques that are described for the simple circuit.
- The first parallel circuit is built as follows:



- The second parallel circuit is as follows:



### ***Trouble Shooting - Lights not lighting? Try the following:***

- Make sure the positive side of the LED is facing right.
- Make sure the positive side of the battery is on the card and the negative side is up.
- Make sure the battery is connected correctly with the copper tape and that the negative tape is not touching the positive tape anywhere.
- Make sure the conductive edges of the lights are overlapping copper tape.
- Firmly press around the edges of the lights to make sure they are contacting the copper tape.
- Check the switch to make sure there are no breaks in the copper tape and that the horizontal and vertical pieces of tape actually touch when the switch is closed.
- Try a different battery.