

SERIES CIRCUIT INSTRUCTION SHEET

A series circuit also consists of multiple components that require electricity to work. Unlike the parallel circuit you just built though, these components are located on the same pathway instead of being limited to one component on each.

During our investigation we found that with a series circuit the current stayed the same with each additional component added to the single pathway, but the voltage was split between them. This meant that we needed more voltage to light two LEDs and had to use two coin cell batteries as the energy source in the circuit below (Our 3 mm red LED had a 1.8 - 2.2 voltage range so two of the LEDs required 3.6 - 4.4 volts). Since each coin cell battery is 3 volts two are necessary in the circuit below).

You will notice that this series circuit is also similar to the simple circuit you already built. Even though we're going to take you through the build instructions step by step your kids are now on their way to becoming experts and should be able to build this circuit quickly and easily.

Step 1 - Supplies:

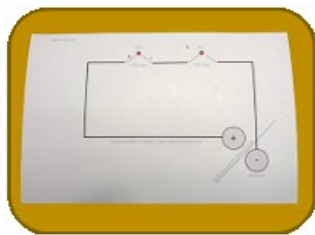


Image 1

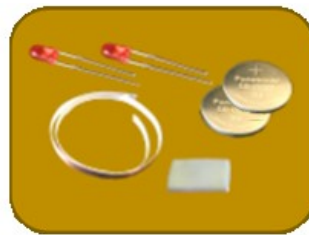


Image 2

1.1 Print out the series circuit template if you haven't already done so. You will also need 2 LEDs, 2 coin cell batteries, a 3/4" piece of foam tape, and 20" of copper foil tape with aconductive adhesive (**Image 1 & 2**).

Step 2 - Testing:

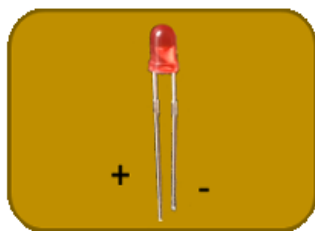


Image 3



Image 4

2.1 Test your batteries and LEDs. The longer leg of the LED is positive, and the shorter leg is negative (**Image 3**). You can also use the flat side of your LED to determine which leg is negative as it's the leg closest to that side. We had a hard time finding the flat side during our investigation though, so we always looked at the leg length when testing.

2.2 Polarity is important with LEDs so be sure to place the positive leg on the positive side of the battery and the negative leg on the negative side. If both the battery and LED are working you should see the LED light up (**Image 4**).

If the LED doesn't light up, try switching the direction of the LED legs. If it still doesn't work you either need a new battery or a new LED. It's a lot easier to replace a bad battery or LED now before you start the project so these tests are very useful.

Step 3 - Build:

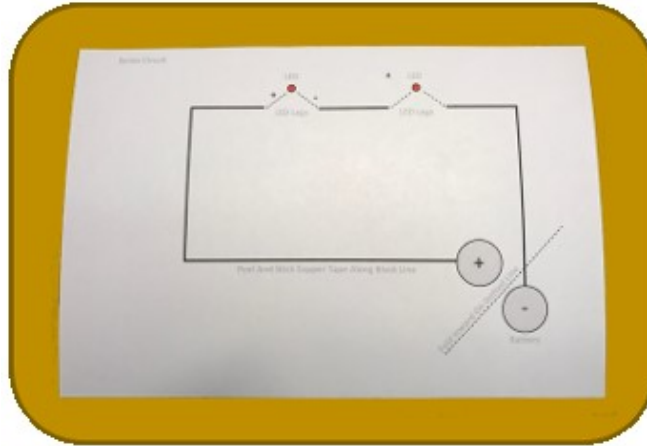


Image 5

Let's look at the series circuit template. The solid black line marks the path for the copper foil tape. The small red circles represent the placement of the LEDs with the attached dotted lines showing the position of the positive and negative LED legs. The gray circles located in the bottom right corner represent the battery position and the dotted line between them is where the template is folded to complete the circuit (**Image 5**).

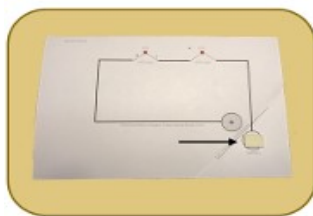


Image 6

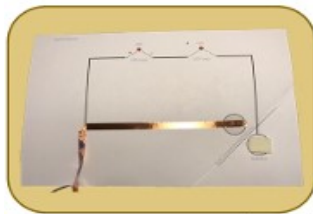


Image 7



3.1 Bend the bottom right corner of the template inward along the dotted line so the gray circles touch. Unfold the corner forming a crease on the dotted line.

3.2 Attach the 3/4" piece of foam tape to the gray circle marked negative ('-') in a horizontal direction. Be sure to place the foam tape horizontally or the copper tape in step 3.8 will cover too much of the adhesive surface needed for the battery to stay attached (**Image 6**).

3.3 Attach the copper tape to the solid black line, peeling the backing off as you go. Don't remove the backing all at once or the copper tape will twist and stick to itself. Start at the gray circle marked with the '+' sign and follow the black line counter clockwise until you reach the corner (**Image 7**).



Image 8

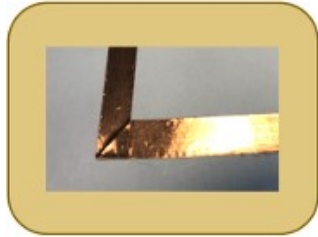


Image 9

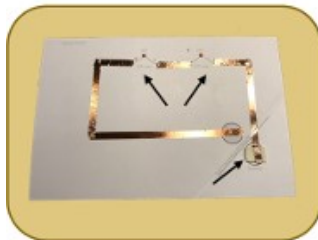


Image 10



Image 11



Image 12



3.4 Corners can be tricky but we're using copper tape that's conductive on both sides, so it should be okay if things get a little twisted.

3.5 When you reach a corner the trick is to bend the copper tape in the opposite direction from where you want to go first, creating a diagonal fold (**Image 8**).

3.6 Hold this folded section in place with your finger as you bend the copper tape back over to continue going in the right direction. You should see a nice corner formed but don't worry if it's messy. It gets easier with practice (**Image 9**).

3.7 Finish placing the copper tape along the solid black line. When you reach one of the gaps in the black line along the circuit use your fingers to cut the tape and then continue placing the tape along the black line on the other side of the gap (**Image 10**).

3.8 When you reach the end of the black line run the copper tape up and over the piece of foam tape (**Image 10**).

3.9 It's time to connect the LEDs. Bend the LED legs wide enough to connect to the copper tape on both sides of the gap, line the legs up with the dotted lines and the LED to the red circle. Do this for both gaps in the circuit (**Image 11**).

Note: Remember that polarity matters. The positive legs need to connect to the side marked positive and the negative legs need to connect to the side marked negative.

3.10 Tear off small pieces of copper tape and use them to cover the LED legs and stick them to the existing copper tape (**Image 12**).



Image 13

3.11 Attach the first coin battery to the piece of foam tape from step 3.2. Be sure to have the positive side of the battery facing up (**Image 13**).

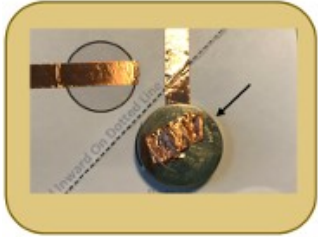


Image 14

3.12 Fold a 1 1/2" piece of the copper tape around on itself, sticky side out, and place it on the battery from step 3.11 (**Image 14**).



Image 15

3.13 Attach the second coin battery on top of the first one, using the loop of conductive tape to hold them together. Be sure to keep the positive side of the second battery facing upward as well so it connects to the positive side of the circuit when the corner is folded (**Image 15**).



Image 16

3.14 You have just finished building your series circuit (**Image 16**). It's time to fold the template along the crease created at the start in step 3.1 so the batteries can complete the circuit (**Image 17**).

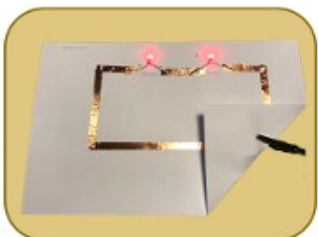


Image 17

Note: If your LEDs don't light up you should check out our trouble shooting tips at the beginning of this post, next to the investigation tab.