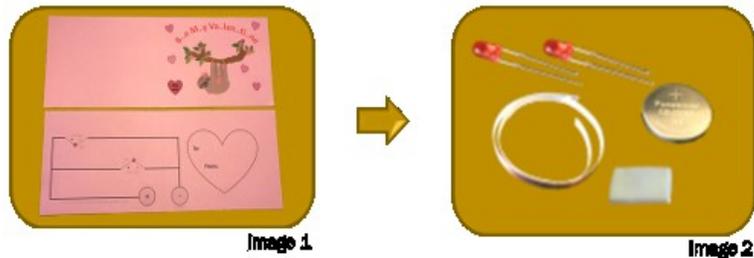


VALENTINE'S DAY CARDS INSTRUCTION SHEET

As we walk you through building one of our Valentine's Day cards, the directions are going to sound familiar. We decided not to skip over any steps even though you're a pro at them by now just in case you prefer your kids go through the process independently.

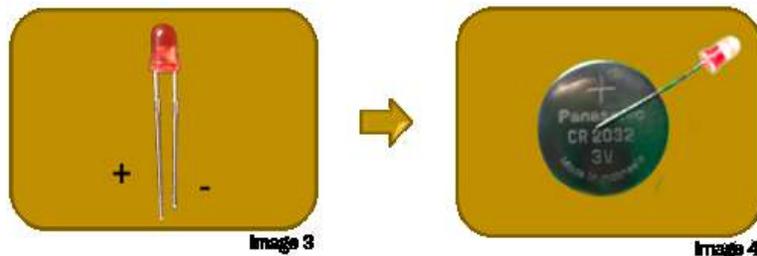
During our investigation we designed several templates you can use so feel free to download as many as you'd like. Another option is to help your kids design cards of their own.

Step 1 - Supplies:



1.1 Print out your favorite Valentine's Day card template if you haven't already done so. You will also need 2 LEDs, a coin cell battery, a 3/4" piece of foam tape, and around 25" of copper foil tape with conductive adhesive (**Image 1 & 2**).

Step 2 - Testing:



2.1 Test your battery 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:

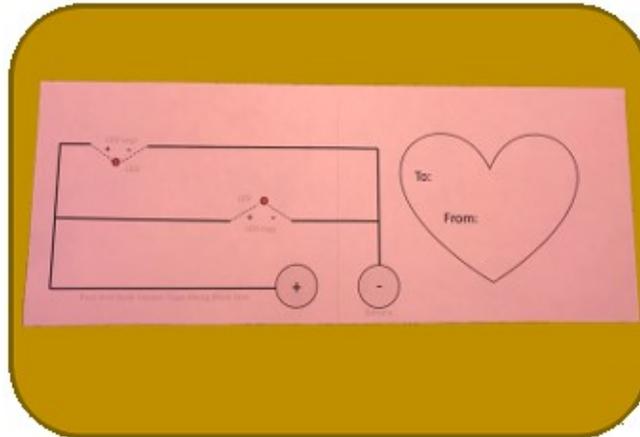


Image 5

Let's look at the back of your Valentine's Day card. It should look familiar as it's using a parallel circuit design. The solid black lines mark the paths 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 vertical dotted line between them is where the card is folded to complete the circuit (**Image 5**).

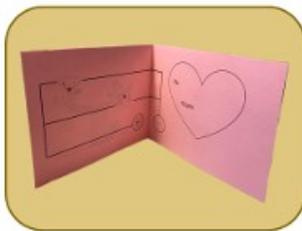


Image 6

3.1 Fold your card in half along the dotted line so the circuit image is on the inside (**Image 6**).



Image 7

3.2 Carefully poke two holes through the front of the card where the LEDs are located. The holes need to line up with the small red circles that are part of the circuit on the inside of the card, so it may be easier to poke from the inside out (**Image 7**).

Note: You may want to push the extra card material back through the hole towards the inside to clean it up a little when you're done.



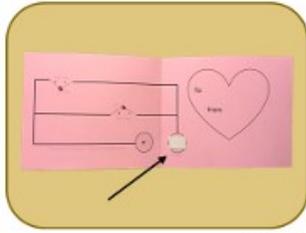


Image 8

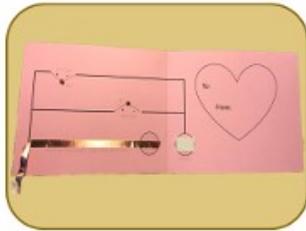


Image 9

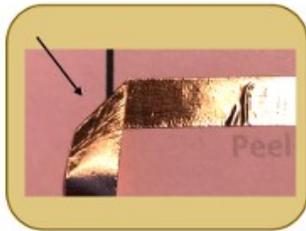


Image 10

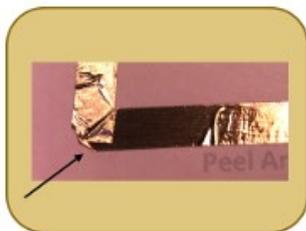


Image 11

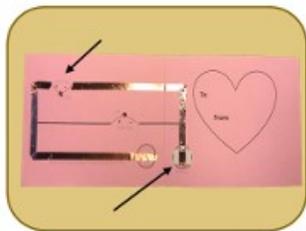


Image 12



3.3 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 3.9 will cover too much of the adhesive surface needed for the battery to stay attached (**Image 8**).

3.4 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 9**).

3.5 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.

3.6 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 10**).

3.7 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 11**).

3.8 Finish placing the copper tape along the outer solid black line. Ignore the black line that cuts across the circuit near the center for now. When you reach the gap in the black line along the top of 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 12**).

3.9 When you reach the end of this black line run the copper tape up and over the piece of foam tape (**Image 12**).

3.10 It's time to connect the first LED so we can test the circuit before adding the second pathway. It will be easier to find a problem in the circuit now before we add more components.

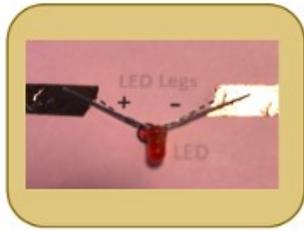


Image 13

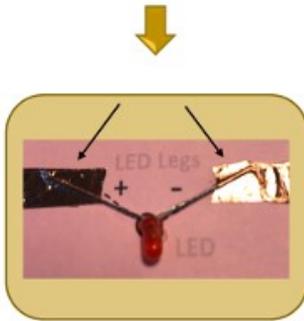


Image 14

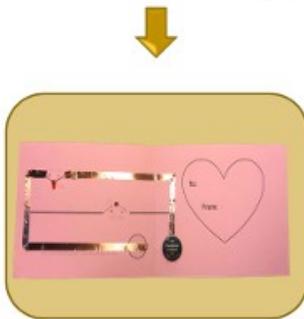


Image 15



Image 16

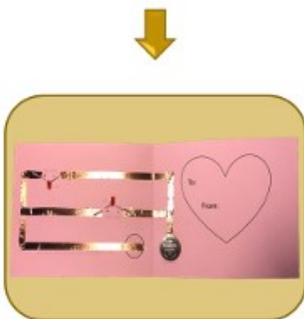


Image 17

3.11 Bend the LED legs wide enough to connect to the copper tape on both sides of the gap along the top line of the circuit, line the legs up with the dotted lines and the LED to the red circle (**Image 13**).

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

3.11 Tear off two small pieces of copper tape and use them to cover the LED legs and stick them to the existing copper tape (**Image 14**).

3.12 Attach the coin battery to the piece of foam tape from step 3.2. Be sure to have the positive side of the battery facing up so it connects to the positive side of the circuit when the corner is folded (**Image 15**).

3.13 You have just finished building the first pathway in your parallel circuit. It's time to fold the template along the crease created at the start in step 3.1 so the battery can complete the circuit. Once you see the LED light up you will be ready to build the second pathway in the circuit (**Image 16**).

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

3.14 Attach the copper tape to the solid black line that cuts across the center of the parallel circuit. Start on the left side of the line and be sure to overlap the vertical piece of copper tape already in place so a connection is formed. This line is the second pathway to the circuit which turns the simple circuit into a parallel circuit (**Image 17**).

3.15 When you reach the gap in the second pathway of 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.

3.16 This second pathway is completed when the copper tape reaches the vertical piece of copper tape on the right side of the circuit. Again, be sure to overlap the two pieces of copper tape so a connection is formed (**Image 17**).

3.17 It's time to connect the second LED. 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 (**Image 17**).



Image 18



Image 19

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

3.18 Tear off two small pieces of copper tape and use them to cover the LED legs and stick them to the existing copper tape (**Image 17**).

3.19 You have just finished creating your Valentine's Day card. It's time to fold the card along the crease created at the start in step 3.1 so the battery can complete the circuit. You should now see both LEDs light up (**Image 18**).

3.20 You can also poke the LED bulbs through the holes from step 3.2 if you prefer a brighter look to the cards (**Image 19**).

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

Thank you for checking out our Valentine's Day cards. We hope you join us again as we continue to delve into the world of paper circuits.