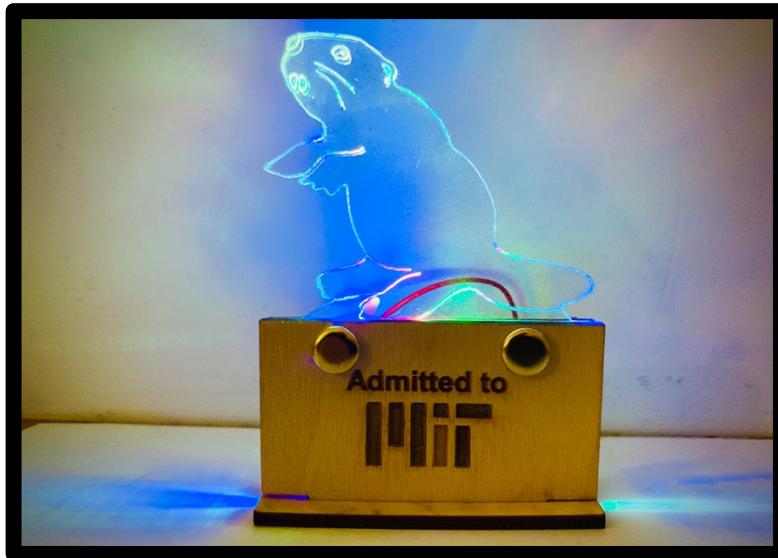


## Aurora BEAVERalis Assembly Guide

This edge-lit acrylic nightlight project began with a trip to Alaska (Read about it in the [MIT Technology Review](#)) and soon was adopted by many of our students and staff in many engineering outreach trips around the world, particularly K-12 programs. It's a simple, fun project that embodies MIT's motto of *Mens et Manus*, where you get to learn a bit of electronics and fabrication through a hands-on activity.

Find new friends and build together! Go to [admitted.mit.edu/experience](http://admitted.mit.edu/experience) to connect with other admitted students and find CP\* events for building and experimenting with your Aurora BEAVERalis. Show us your experimentations with your Aurora BEAVERalis at a CP\* event or send photos to us at [edgerton-cpstar@mit.edu](mailto:edgerton-cpstar@mit.edu). Happy building and we look forward to seeing your Aurora BEAVERalis!



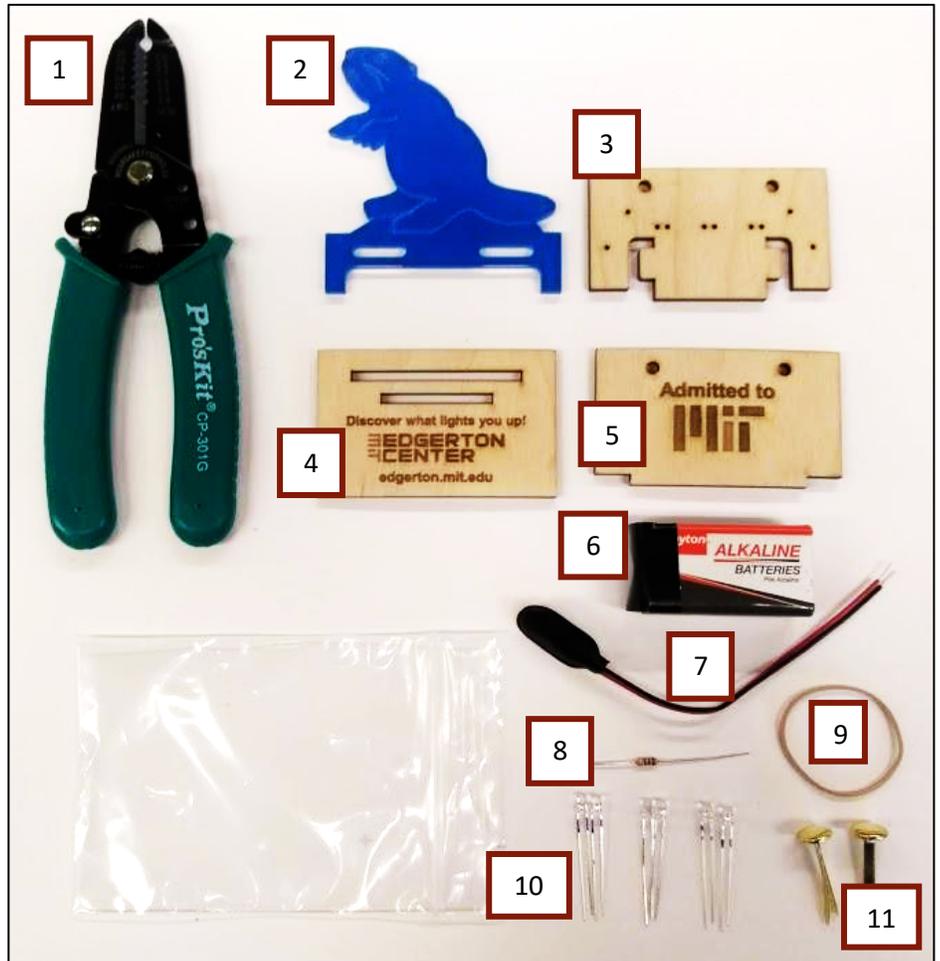
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## Kit Contents

1. Wire Strippers
2. Beaver
3. Electronics Board
4. Base
5. Front Panel
6. 9V Battery
7. Battery Snap
8. 100Ω Resistor
9. Rubber Band
10. LEDs (2 green, 2 red, 2 blue)
11. Brass Fasteners (x2)

(Items #7-11 are in the small bag)

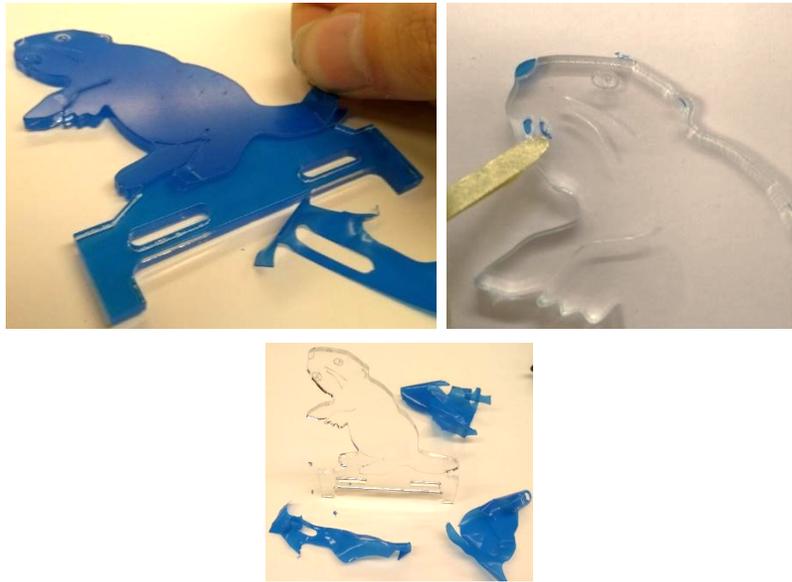


## Preparing for Assembly

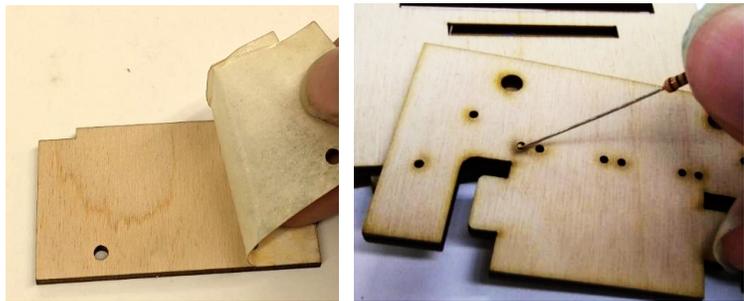
1. Peel the blue plastic backing from your beaver. Scratch at an edge until you can peel it.

Yes, it is on both sides...

You may need to use a brass fastener or another tool to remove the smaller pieces.



2. Check your three wooden pieces (the Electronics Board, Base, and Front Panel) to see if they need to have tape peeled or holes cleared.



3. Remove the electrical tape from the battery.



4. Identify and sort your LEDs. The red LEDs are not marked. The blue and green LEDs have been marked near the top of the metal legs. They are only marked on one side of the legs so flip them around to confirm.

For your Aurora BEAVERalis, you will need one blue, one green, and one red LED.

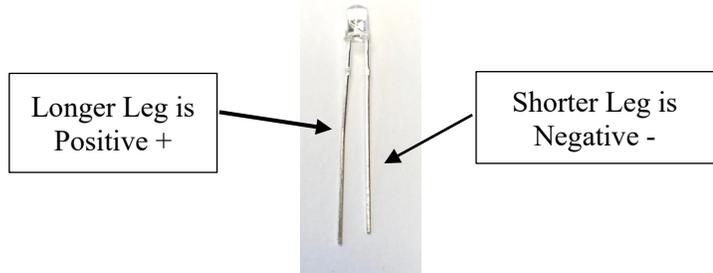


## Before you begin assembling.... Here are some good-to-knows!

**LEDs** are **L**ight **E**mitting **D**iodes. They produce light and come in different colors. You can think of them as light bulbs but they work a bit differently electronically.

Each LED has a positive and a negative side and it only allows current to flow in one direction. Like a battery, you have to put it in the right direction.

How do you determine if an LED side is positive or negative?



Learn more about identifying LED polarity:

<http://owlcircuits.com/resources/how-to-determine-led-polarity/>

**Wire strippers** are a tool that can cut and take off the outer insulation from the wire.

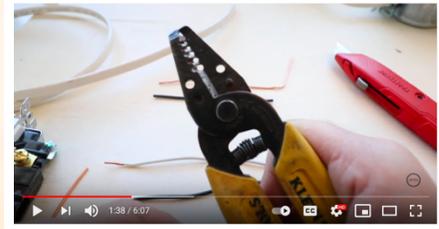
To strip a wire, orient the strippers so the wire is perpendicular to the plane of the hole, squeeze the grip, and then easily slide the insulation off the end of the wire.

You will use the hole for 26 AWG to strip part of the red and black wires of the battery clip.

Rotate the “lock” piece counter clockwise to open.



[Video tutorial](#) on how to strip wire.



**Resistors** are needed to limit the amount of current that the battery would send through the LEDs or any electrical components. Without protection of a current limiting resistor, they will quietly just cease ever being able to glow. To find the right resistor amount, we have to look at our LED specifications and do a calculation.

In Aurora BEAVERalis, 100 Ohm or  $\Omega$  resistors are used.

Other notes:

- You can find out a resistor’s value base on the color bands on it
- There is no positive or negative end so you can put it in either direction.

**Want to figure out why we put in a 100  $\Omega$  resistor?**

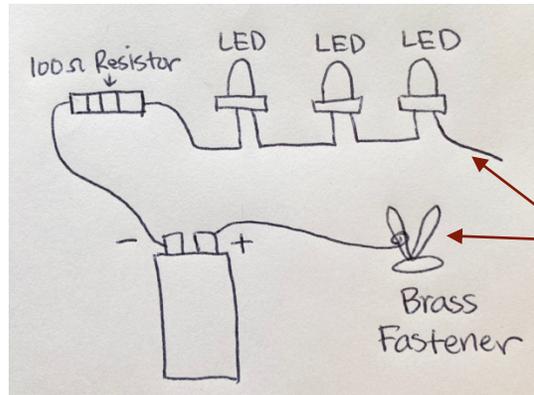
Here are the specifications for the LEDs that we have:

	Green LED	Red LED	Blue LED
<b>Forward Voltage</b>	3-3.4 V	1.9-2.1 V	3 -3.4 V
<b>Current</b>	20 mA	20 mA	20 mA

Use [this website](#) to find the formula that will give you what resistance is needed.

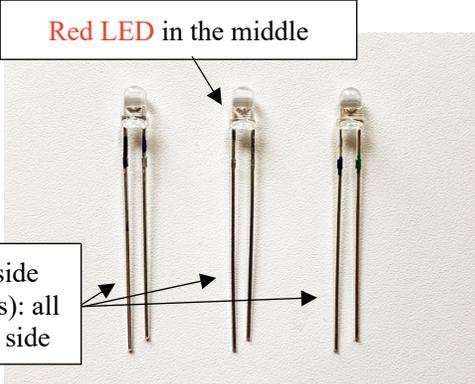
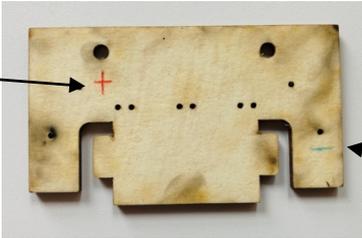
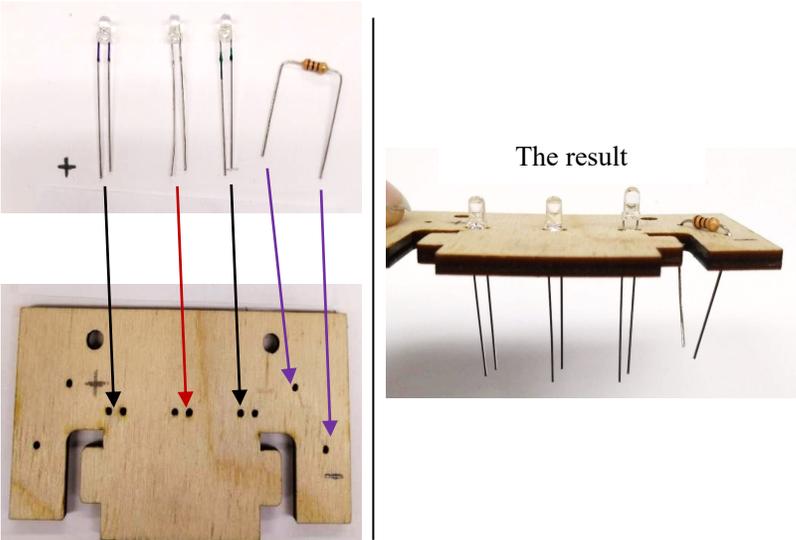
Note: what you calculate is the minimum resistance needed, so we upped it a little to allow for longer operation and almost maximum brightness

**A working circuit** requires a completed path for electrons to flow. Shown is the circuit you will be creating in the Aurora BEAVERalis. To turn on the lights, you will rotate the brass fastener to touch the end of the LED that is not connected. The brass fastener is our low-tech switch.

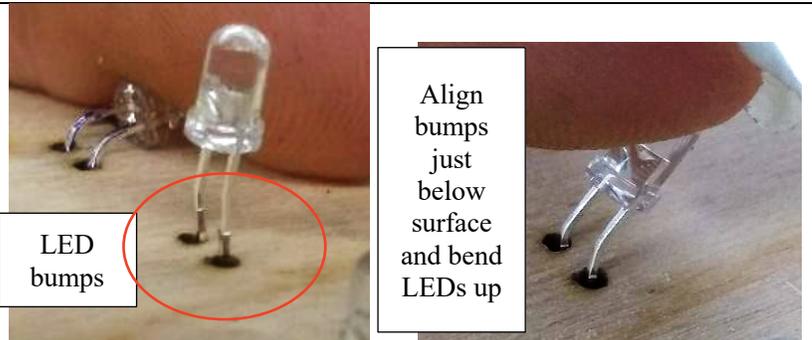


Rotate to connect the Brass Fastener to the LED leg to complete and turn on the circuit

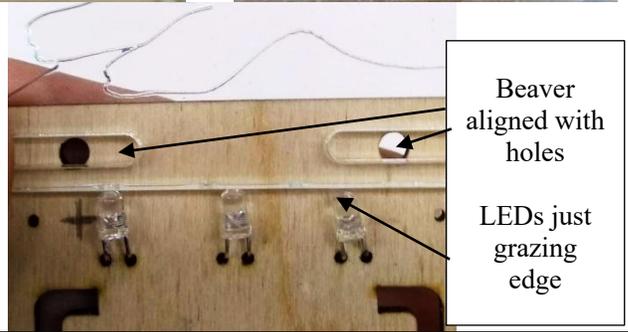
# Assembly Process

<p>1. Gather one LED of each color. Line up your LEDs in a chain with the red LED in the middle. All three LEDs must allow current to flow in the same direction. If any LED is backwards it will block current from flowing and the LEDs will not light. <b>Make sure each LEDs' positive leg is on the left side.</b></p>	 <p>Red LED in the middle</p> <p>Positive side (longer legs): all on the left side</p> <p>Why put the red LED in the middle? It will make the best color spread in our opinion, but feel free to experiment!</p>
<p>2. Get your resistor. Bend the legs on your resistor as shown.</p>	
<p>3. Get your Electronics Board and a pencil or pen.</p> <p>On your Electronics Board, mark the positive a negative as shown</p>	 <p>Positive</p> <p>Negative</p>
<p>4. Insert the LEDs and resistor as shown. The resistor can be put in either orientation, there is no positive or negative end.</p>	 <p>The result</p>

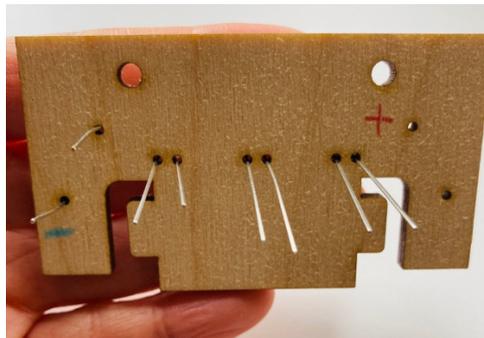
5. Look for the bump on each leg of the LED. For each LED, lift until the bump is just below the surface then press to bend the LED towards the top edge of the board (towards the 2 large holes). If you hold up your beaver as shown, the LEDs should just graze the edge.



The result

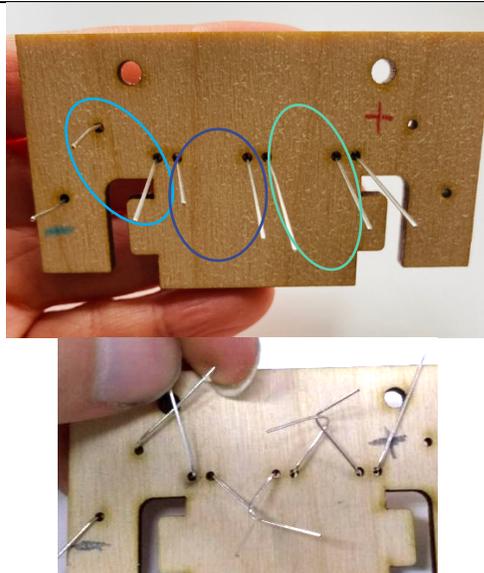


6. Mark your + and - marks to the other side of the Electronics Board where the legs of the LEDs and resistor are sticking out. The - should be by the resistor.



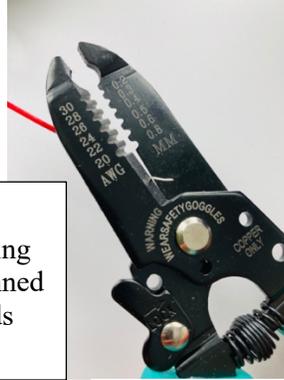
7. Now, you will be twisting 3 pairs of neighboring components legs together to connect them.

Bend neighboring legs around each other then add a few loose twists with your fingers. Make sure the twisted pairs are not touching each other.

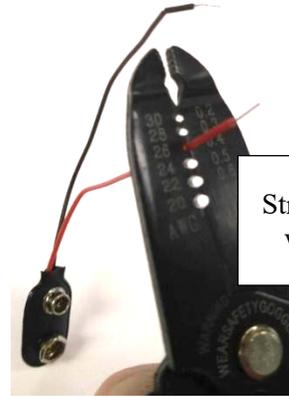


8. Get your wire stripper and battery snap.

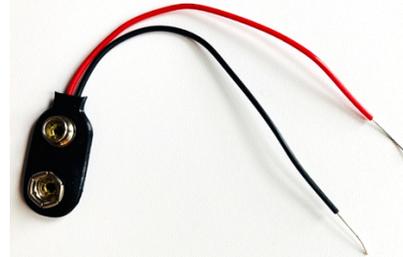
First, cut off the tinned ends of both wires. Then using the wire strippers on the 26 AWG setting, remove ~2 cm of insulation from both battery snap wires.



Cutting off tinned ends

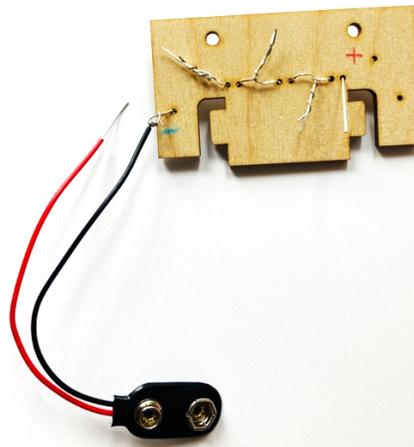


Stripping wires



The result

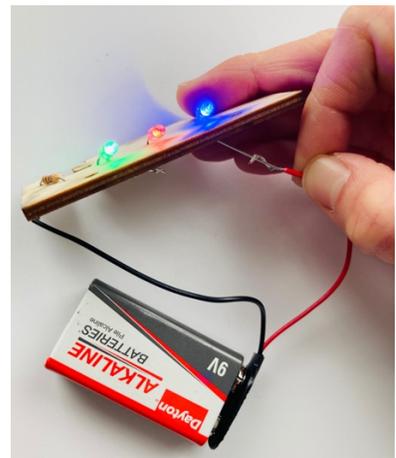
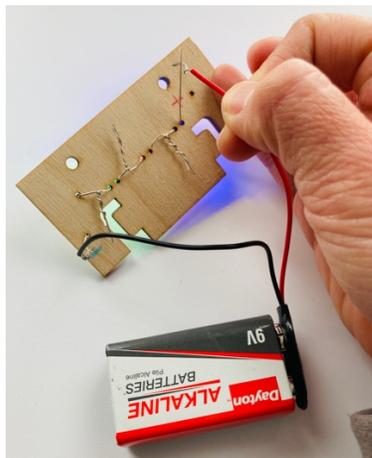
9. Twist the black, negative wire around the resistor leg that was not twisted (at the - mark).



10. Testing your circuit.

Get your battery and attach it to your battery clip. Touch the red wire from your battery clip to the one unpaired LED leg by the + mark. Your LEDs should light up at this point. If not, it's time to troubleshoot!

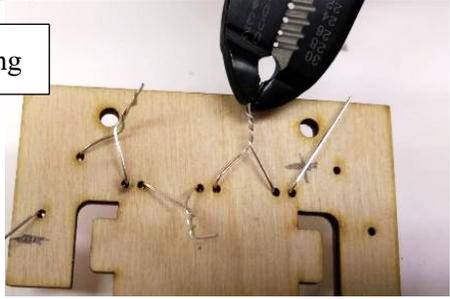
When you know your circuit works, disconnect the 9V battery.



11. Hold the LEDs in place and use your fingers and the plier ends of the wire strippers to twist the legs tighter. Do not over tighten.

When finished, make sure your twisted pairs touch do not touch other twisted pairs. You can cut the twisted legs shorter so they do not interfere with each other.

Twisting

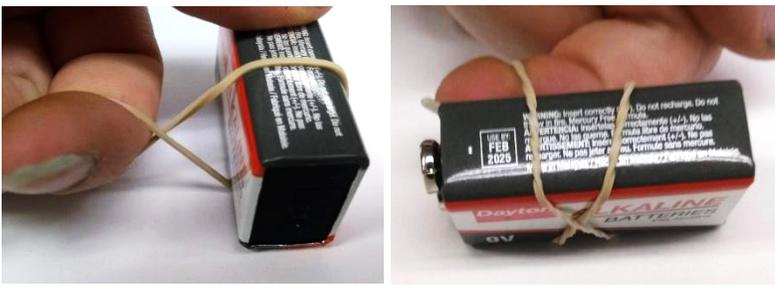


Cutting



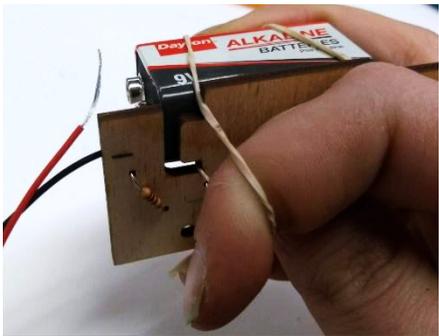
10. Get your 9V battery and rubber band.

Double tie the rubber band around the 9V battery.

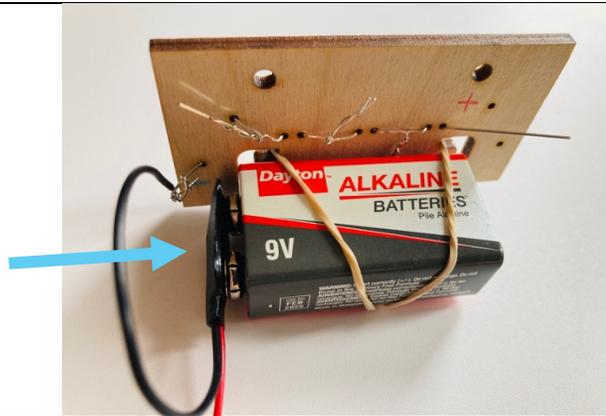


11. Attach the 9V battery to the side of the Electronics Board where the legs are twisted. Pull the rubber bands around the two tabs on the Electronics Board as shown.

It will be easiest to attach the battery clip if the + side of the battery (side with the circular terminal) is against the Electronics Board.



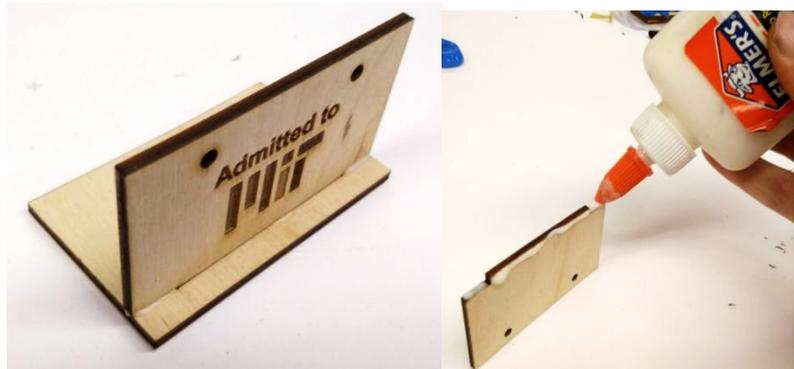
12. Attach the battery clip to the 9V battery terminals.



13. Gather your Front Panel and Base.

Insert the Front Panel into the Base. The fit will be tight.

You may want to use a little glue. To make it look nice, keep the glue away from the front face.

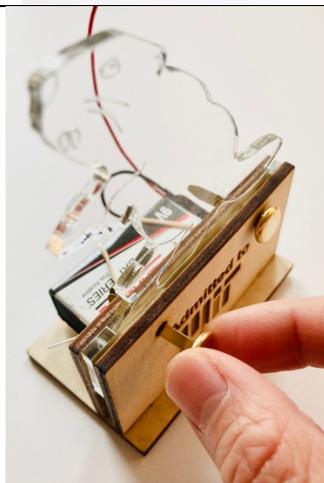


14. Insert the Electronics Board into the Base.

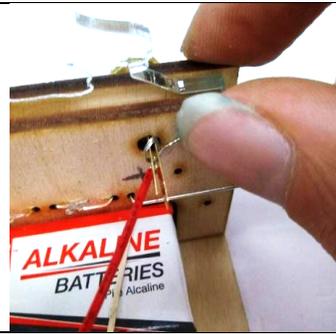


15. Get your beaver piece and brass fasteners.

Place your beaver in between the Front Board and the Electronics Board, onto the LEDs. Push a brass fastener through each of the two holes.



16. Before expanding the fasteners on the back, wrap the red, positive battery snap wire around the fastener near the + sign.

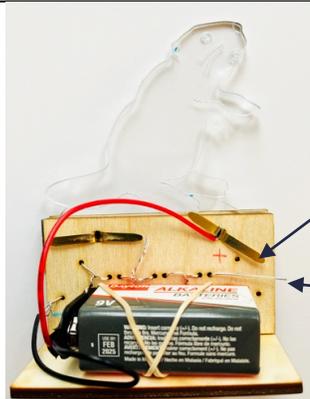


## You have completed your Aurora BEAVERalis!

17. Turn on your Aurora BEAVERalis by rotating the brass fastener that is closest to the + and connect it with the only LED leg not twisted!

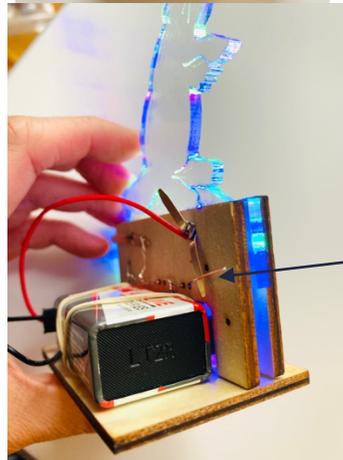
Experiment and play with your Aurora BEAVERalis kit! Some starting ideas:

- Play with shadows and color - Remove a fastener, rotate the Aurora BEAVERalis open, and shine it at a white wall or paper. Change distance, slide the beaver around, cover up an LED or two, spray water over the beaver.
- Hack this kit or use the extra LEDs to light up something else for fun
- Think up other activities or projects that would encourage us to explore with fresh eyes and curiosity
- Take photos of your Aurora BEAVERalis that showcases you! Where are you from? What is your story? What is your passion? What is your future?



This brass fastener

This LED



Rotating the brass fastener below the LED leg works well to keep your Aurora lit!



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<https://edgerton.mit.edu/>