adafruit learning system

Cardboard Box for Circuit Playground Express

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Overview

Cardboard Project for Students

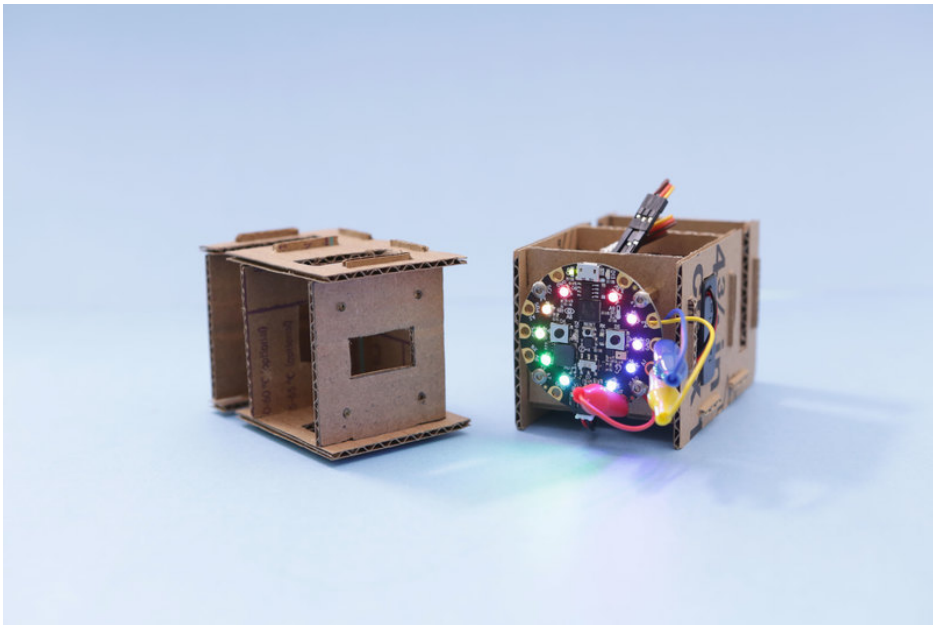
In this guide we'll show you how you can make a project box that will house an Adafruit Circuit Playground Express, micro servo and 3xAAA battery pack. We'll use a paper template to create cardboard panels that snap fit together. Print the design on paper, stick it on cardboard and cut away!

Students will learn an assortment of skills by accomplishing this project. Cater this project to your curriculum and let your students customize the details to make it theirs!

Using cardboard as a material to make stuff allows for experimentation and rapid prototyping. It's easily to work with, dirt cheap and normally gets thrown out. So this stuff is great for teaching young students and kids how to build projects.

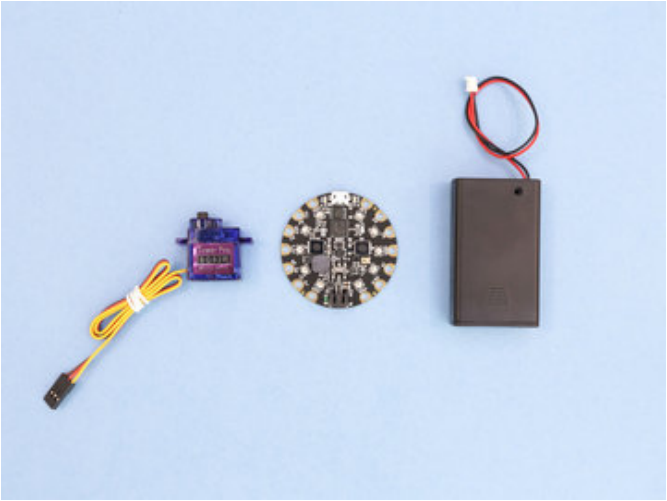
Companies like Nintendo and Google have shown how precisely cut pieces of cardboard can form intricate project enclosures that are sturdy enough to house components snugly and look neatly packaged.

Designing and creating your own templates is a fun exercise in engineering. Using low-cost materials and methods allows for wide spread adoption for open sourced projects because it's easy to make.



Fun PaperCraft!

Get creative and turn this project into a playful creation with colorful paper cutouts. Papercraft is an art form that uses paper as a medium to create three dimensional objects. Here we made Blink The Python Snake move with the help of a micro-servo and Circuit Playground Express.



Electronic Parts

We'll be using the Adafruit Circuit Playground to control a micro servo and power our project using a 3x AAA battery pack. This is all we need to create simple movements. But thats not all! Circuit Playground Express has tons of sensors (like accelerometer, light, sound and temperature sensors) to experiment with, not to mention the radiant glow of 10x NeoPixels!

Tools & Supplies

Assortment of materials and hand tools to work with.

- Cardboard – 8.5x11 (2.6mm)
- Office paper – 8.5x11
- Cutting Mat
- Ruler / T-Square
- Scissors
- X-Acto Knife
- 3x AAA Batteries

Prerequisite Guides

There's resources in these guides that go beyond what's covered in this tutorial. MakeCode guide is all about setting up your CPX board. The main CPX guide walks you through all of the pinouts, sensors and everything you need to know.

- MakeCode for Circuit Playground Express (https://adafru.it/wWd)
- Introducing Circuit Playground Express (https://adafru.it/adafruit-cpx)

Your browser does not support the video tag. Circuit Playground Express

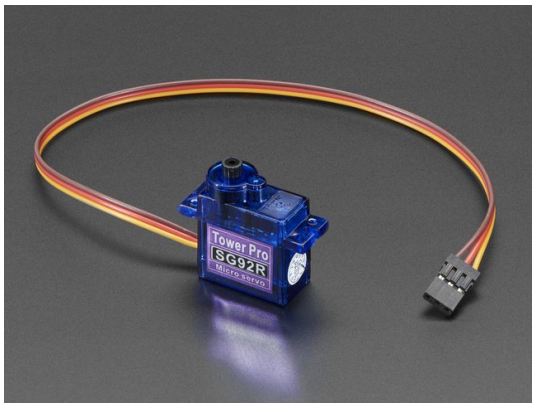
$24.95
IN STOCK

Add To Cart

Small Alligator Clip to Male Jumper Wire Bundle - 12 Pieces

$7.95
IN STOCK

Add To Cart



Micro servo

$5.95
IN STOCK

Add To Cart

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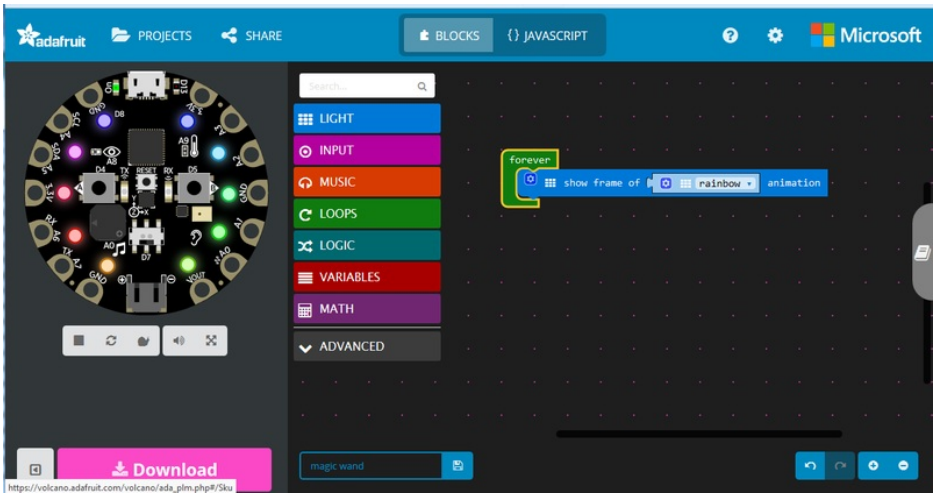
3 x AAA Battery Holder with On/Off Switch and 2-Pin JST

$1.95
IN STOCK

Add To Cart

MakeCode



One of the beautiful things about Circuit Playground Express is that you can make **three ways**:

1. MakeCode (https://adafru.it/wmd)
2. CircuitPython (https://adafru.it/BeW)
3. Arduino IDE (or direct ARM GCC programming)

If this is your very first time programming or coding, we suggest starting with MakeCode (https://adafru.it/wmd) - it is the super fast to get started not just with Circuit Playground Express, but coding in general! (Once you've got the hang of MakeCode (https://adafru.it/wmd) you can then take a look at CircuitPython or Arduino.)

MakeCode does not require any software installation, it works on any computer with a web-browser. You can use it with Mac, Windows, Linux, Chromebooks.

MakeCode uses drag-and-drop blocks just like Scratch, there is no syntax or semicolons. The blocks snap together to create larger and more complex projects

MakeCode lets you get started in 5 minutes or less, there are built in guides and projects, but its also just fun to play around.

MakeCode has surprisingly advanced runtime, despite looking very simple it can do very complex tasks that normally would require advanced programming. You can get creative very very quickly.

Read on to learn how to use MakeCode (https://adafru.it/wmd) and build your first project!

Software

Button Inputs

This demonstrates how to control servo movements with button inputs. Three main inputs are laid out for producing three different events. These input blocks are color coded in purple. These do something when button **A**, **B** or **A** and **B** are pressed. You can also change the type of input by choosing **long click**, **up** or **down**.

Servo Pins

Under the **advanced** option, the pin menu has several blocks for controlling servos. The **servo write pin** block allows you to choose a pin and degree value. Pick any analog pin (**A1** in this project) and enter a value from **0-180** for determining how far the servo should rotate/move.

Display NeoPixel LEDs

Under the **light** menu, you can choose the **show ring** block to display LEDs. Here you can pick how many pixels to display and which color to be.

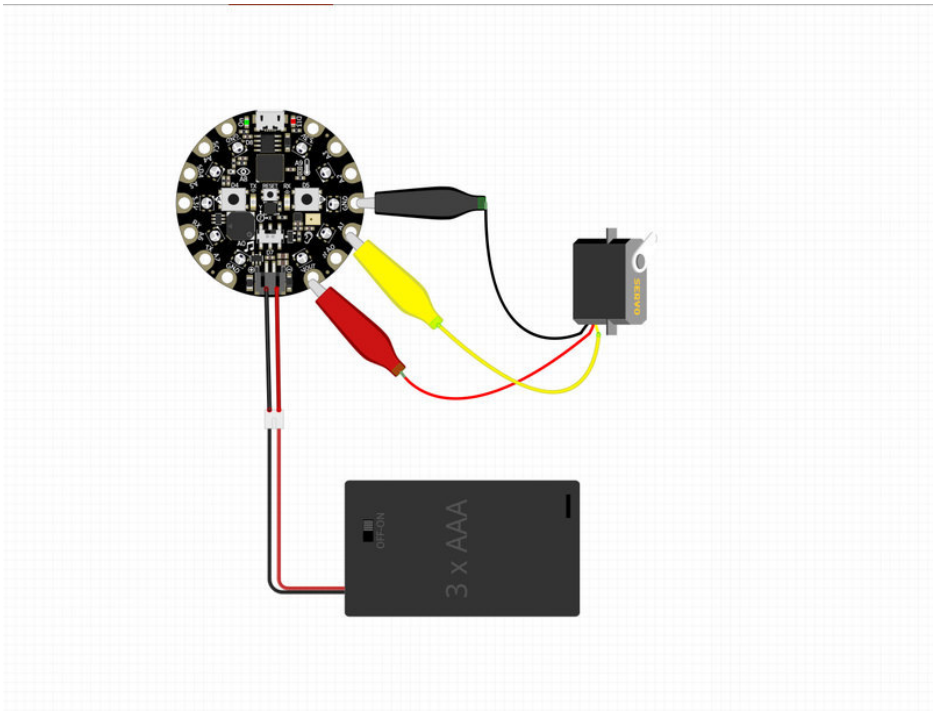
Experiment

Feel free to add more blocks to this project to make more interaction. For example, you can add sound effects to play when pressing buttons. Trigger servo movements using sound or light. Activate lights and sound by using shake detection. There's so many things you can do with different combinations of blocks!

Circuit Diagram

Circuit Diagram

This provides a visual reference for wiring of the components. They aren't true to scale, just meant to be used as reference. The vibration switch wasn't available in Fritzing so instead we have a tilt switch – These are basically the same pin layout.



Wired Connections

The micro servo has three connections. Most common servos has ground and signal on the left or right and voltage in the middle.

- **Yellow** wire from servo to Pin **A1** on Circuit Playground Express
- **Brown/Black** wire from servo to **GND** on Circuit Playground Express
- **Red** wire from servo to **VOUT** on Circuit Playground Express

Cardboard Template

Download Files

Our *Template Sheet* is a **PDF** designed to fit standard **8.5 x 11** inch paper. For direct cutting, we provide a *Flat Pack* **SVG** files of just the parts. The *Fusion 360 archive* file is available to download in **STL**, **STEP**, **OBJ**, and other formats. The F360 archive contains original sketches and editable user parameters for creating custom sizes.

https://adafru.it/Ble

https://adafru.it/Ble

https://adafru.it/Blf

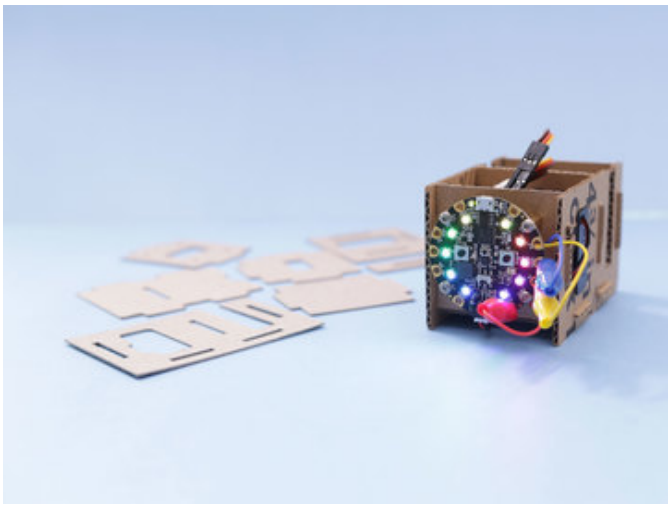
https://adafru.it/Blf

https://adafru.it/BfO

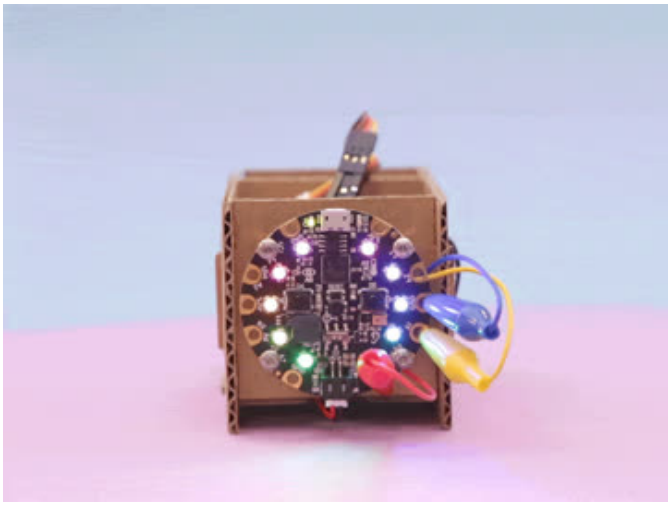
https://adafru.it/BfO

Enclosure Template

The enclosure is made out of 5 pieces that snap fit together via tabs and slots. Two main side walls feature slots that allow tabbed pieces to snugly fit together. Each part is designed to secure a component or become a structural piece of the enclosure. The template for this design was made in Autodesk Fusion 360 with user driven parameters so it can be customized to fit specific projects.

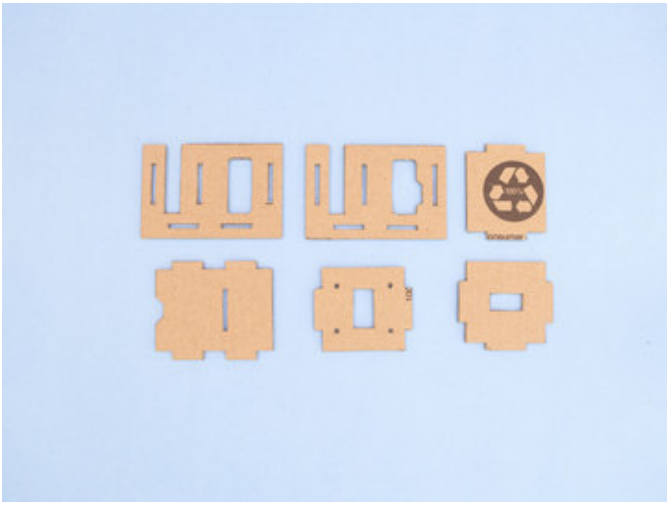


The enclosure is similar to cases that are designed to be made on a laser cutter. This design doesn't require screws or glue because of the tight tolerances in slots. Cardboard has a bit of flex so it can compress and fit through tight openings. The tabs extend beyond the slots to accommodate for slop during the cutting process.



Paper Template

We designed the enclosure to be made out of cardboard. This is the type of cardboard most commonly used by UPS shipping boxes. It's around 2.6mm thick. If you're using a material that is thinner or thicker, it might not fit perfectly when assembling. The tabs and slots are designed for ~2.6mm clearances.



Cutting Parts

The template can be printed with an office/home inkjet printer. This can then be transferred to cardboard by cutting each part out and tracing it with a marker or sticking it to the surface. Either way, you can cut it out by hand or use a vinyl cutter like a Cricut or Silhouette.

For Inkjet Printers

If you're using an inkjet printer to print the template, you can use common office paper. Use scissors to cut around the outline of each part. Then, use a knife pen to carefully remove the inner cutouts like the slots and mounting holes. Place each part over a piece of cardboard and trace the outlines using a sharpie, marker, pen or pencil. Once the parts have been transferred to cardboard, cut them out using a retractable blade or x-acto knife.

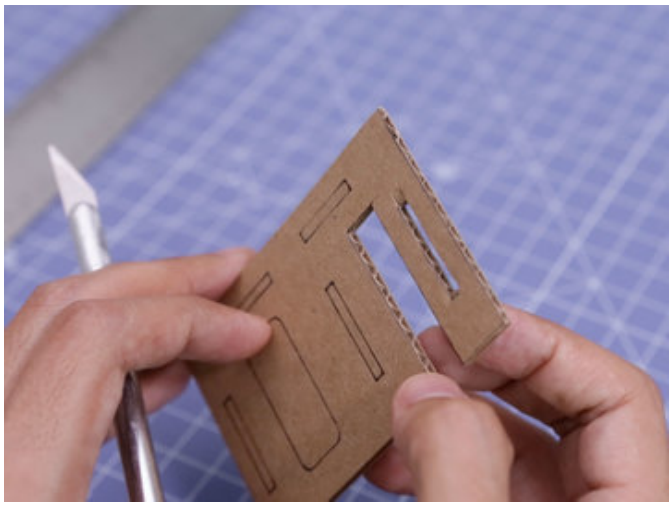
For Cutter Bots

A laser or vinyl cutter can help speed up the process so if you have access to one definitely take the opportunity to learn how to operate it. The SVG and DXF files contain the vector shapes for precise cutting machines. Each machine has a different software for processing these files so we won't cover them in detail here.

Explode Wireframe

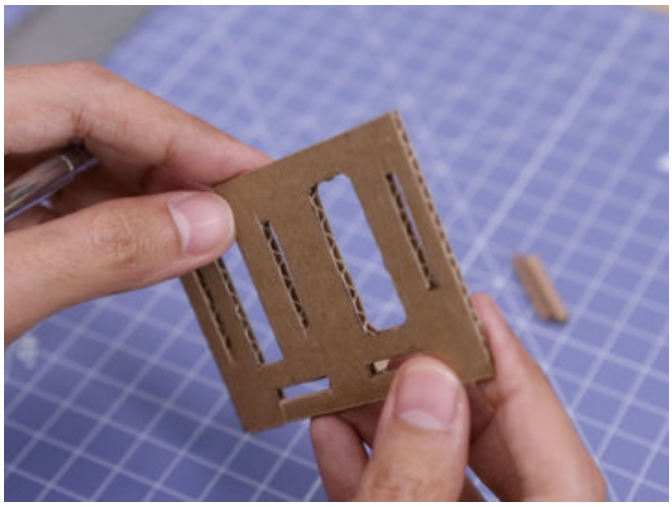
This animated GIF showcases the assembly of the case. Here's how the pieces fit together. Start with the left wall and insert the tabs from the three non-slotted parts. Then, insert the longer part to the bottom. Fit the remaining tabs into the slots of the right wall to hold everything together.

Assembly



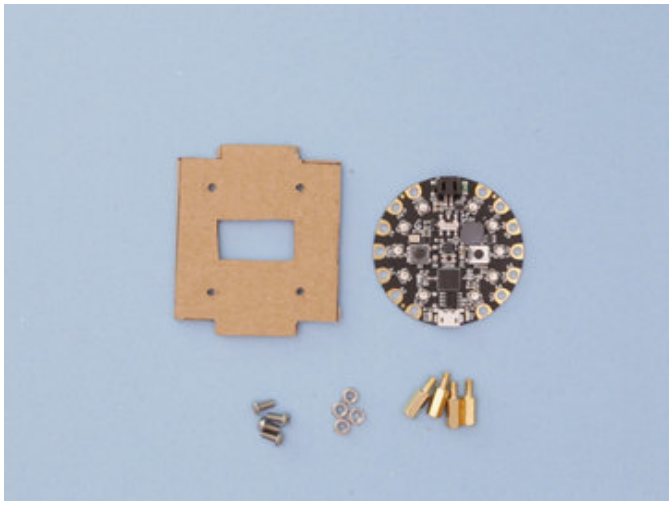
Along The Grain

When cutting the left and right pieces, it's important to orient the paper template so the corrugations are going along the length of the sides. This way the cardboard is a bit stronger and less likely to bend when cutting and handling.



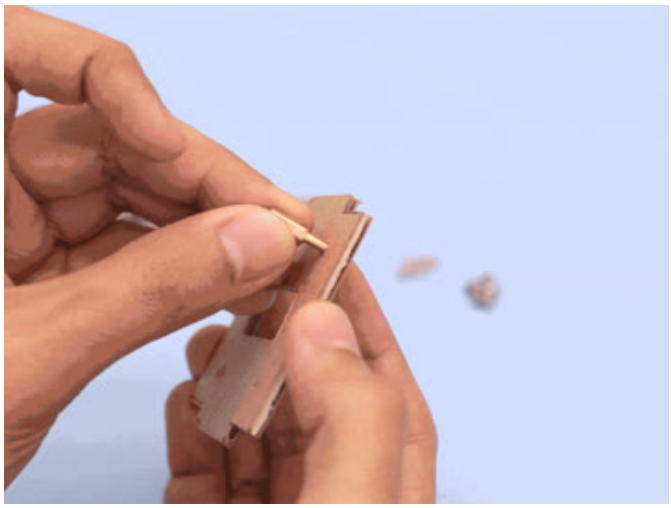
Making Cutouts

The slots and cutouts for the tabs and components can be a little tricky. I found it easier to freehand cut than using a ruler. Slowly insert the tip of the blade and cut in a reciprocating manner. Doing this several times will cut through the internal corrugations. Flip the part over and follow the cut by slightly scoring the outline.



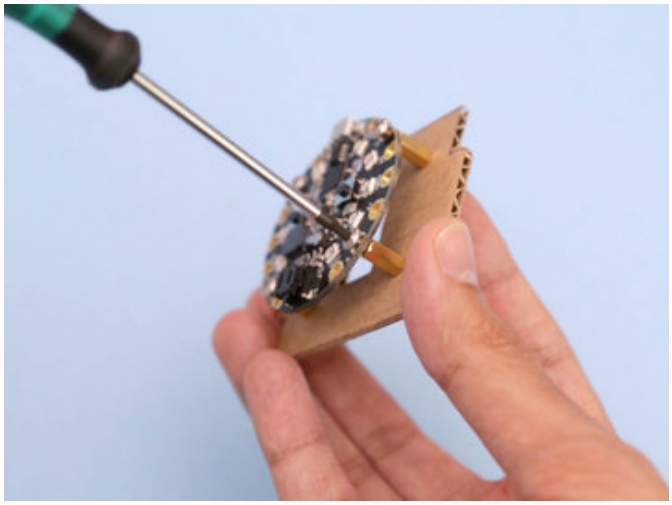
Mount Holes

The Circuit Playground Express board can be secured to this cardboard piece using M3 sized standoffs, screws and hex nuts. To make the holes I used a Dremel rotary tool with a 1/8in drill bit. You could also use a hand awl (commonly used for making holes in fabric when sewing or stitching).



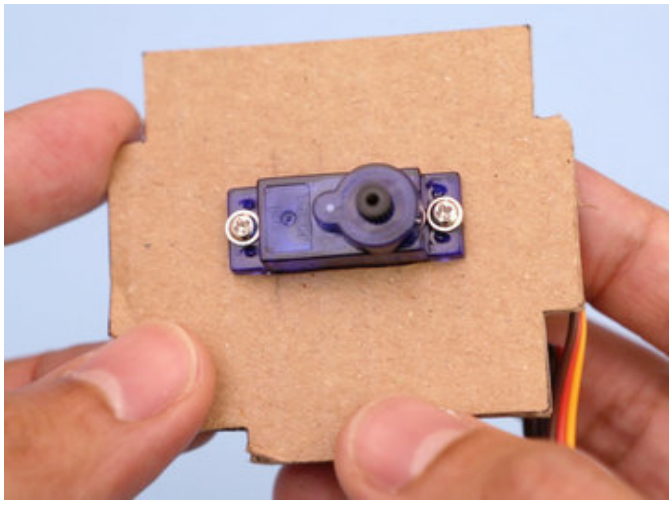
Install Standoffs

These M3 female/male brass standoffs are 10mm in height. I got a variety pack (https://adafru.it/Blg) from amazon. These have a threaded hole on one side and a male threaded end on the other. Insert the male end into the cardboard and fasten a hex nut to secure it in place. Repeat this process for all four mounting holes.



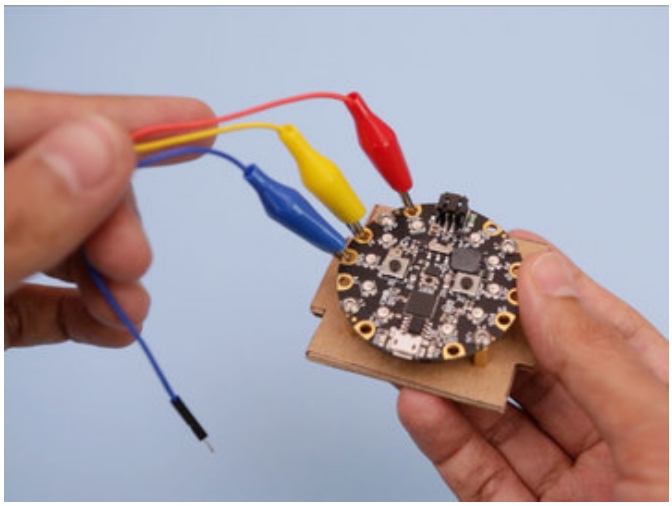
Secure CPX

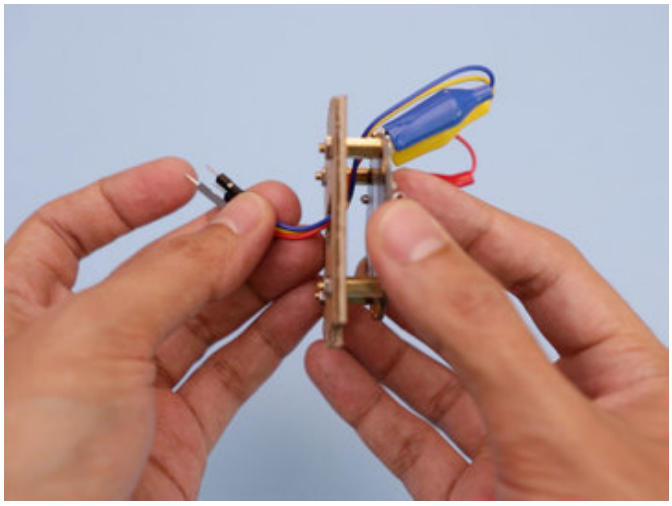
Place the CPX over the four standoffs and orient the PCB so the mounting holes line up. Depending on your project, you'll want to orient the board so it's easy to access the JST and USB ports for connectivity. In my case I had the ports facing "right-side up". Insert and fasten 4x M3 machine screws through the top of the CPX going into the brass standoffs.



Install Micro Servo

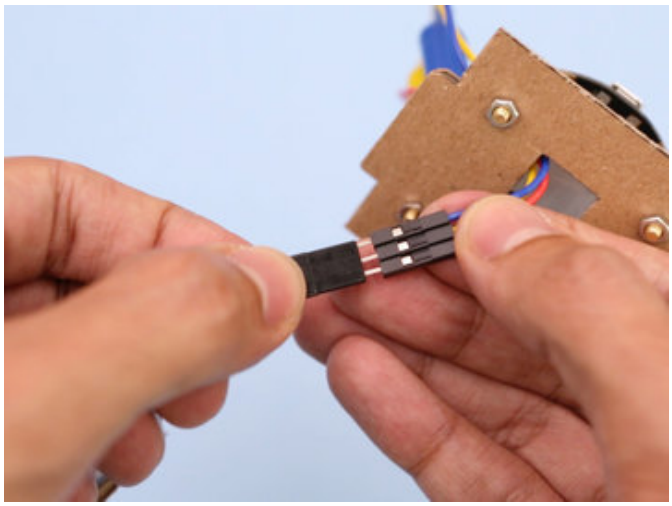
Start by inserting the cable from the micro servo into the cutout. Then, carefully press the body of the servo through. It should have a tight fitting. Using the two mounting screws that came with the micro servo, insert and fasten them to secure the servo.





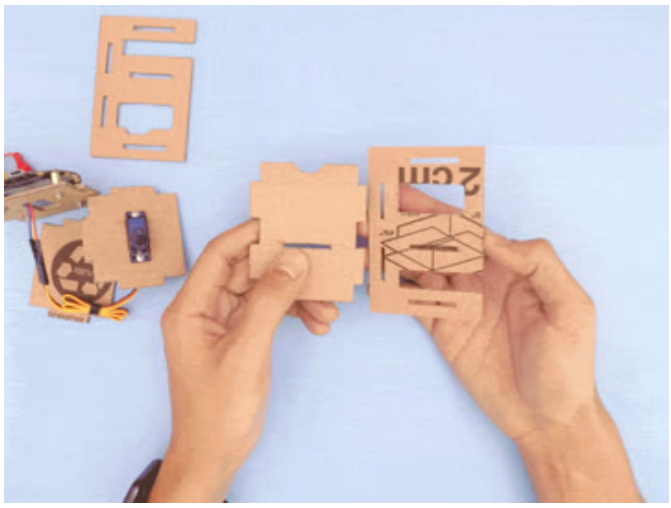
Alligator Clips

Before we assemble the rest of the case, we'll need to hook up the wires. Connect three mini alligator clips to **VOUT**, **A1** and **GND** labeled pads on the Circuit Playground Express board. Grab the male jumper connectors and thread them through the bottom cutout in the center of the CPX. This will make it easier to connect the micro servo to the mini alligator clips.



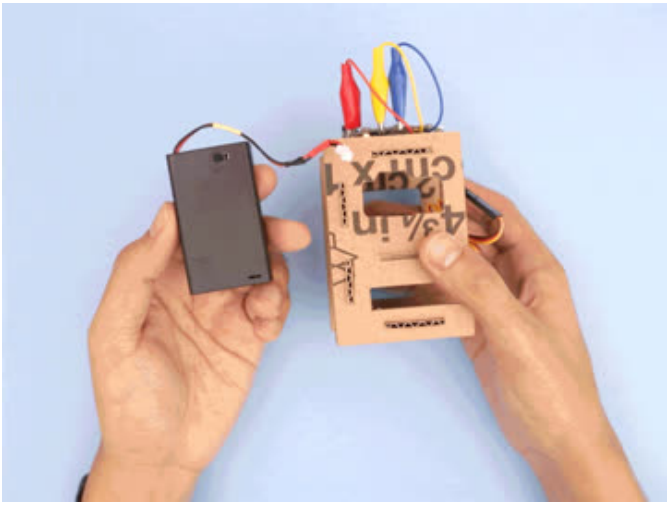
Connect Micro Servo

Grab the male jumper cables from the alligator clips and connect them to the female jumper cables on the micro servo. Make sure the connections are correct. Yellow (siginal) to **A1**, Blue (ground) to **GND**, and red(voltage) to **VOUT.** Double check these connections are correct.



Box Assembly

Start with one of the **side** pieces and the **bottom** piece. Insert the tabs into the slots and hold them together in place. While holding assembly in one hand, place the **servo** piece over in the center. Orient the piece so the tabs can insert into both the slots of the **bottom** and **side** pieces. Grab the **cpx** piece and insert the the tabs into the slot. Now the opposite side piece can be installed by fitting the tabs into the slots. Keep the orientation consistent with the opposite piece. Finally insert the last piece into the left and right sides.



Install Battery

Start by inserting the JST connector from the battery pack through the notch near the bottom piece. Thread the cable through the piece and connect it to the JST port on the Circuit Playground Express. Press the battery through the side piece and push it through the opening in the opposite piece. To keep the wiring inside, fold the wire into a bundle and secure with a twisty tie.

Next Steps

Servo Movements

Micro servos come with a few different servo horns that can be used to attach to stuff. In our demo, we constructed a paper crafted version of Blinka. Using a piece of cardboard, you can secure the servo horn using included screws. The piece of cardboard can be glued to the lower back of Blinka.

Interaction

You can use different sensor input to trigger the servo movements. For example, you can use the microphone to detect when someone's clapping. Or use the accelerometer to detect when it's shaking or tilted. The light sensor can detect different levels of light to make variable movements in degrees. There's also sound effects, 10 NeoPixel LEDS and much more!

Modify & Remix

This is just a starting point we can take this so much further when we add mechanisms. There's so many things to do but this gives you a basis to get going. Use this template as a starting point so when you setup your next project you have an idea of where to start.