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  ╷
4 │ @import "gist";
  │         ^^^^^^
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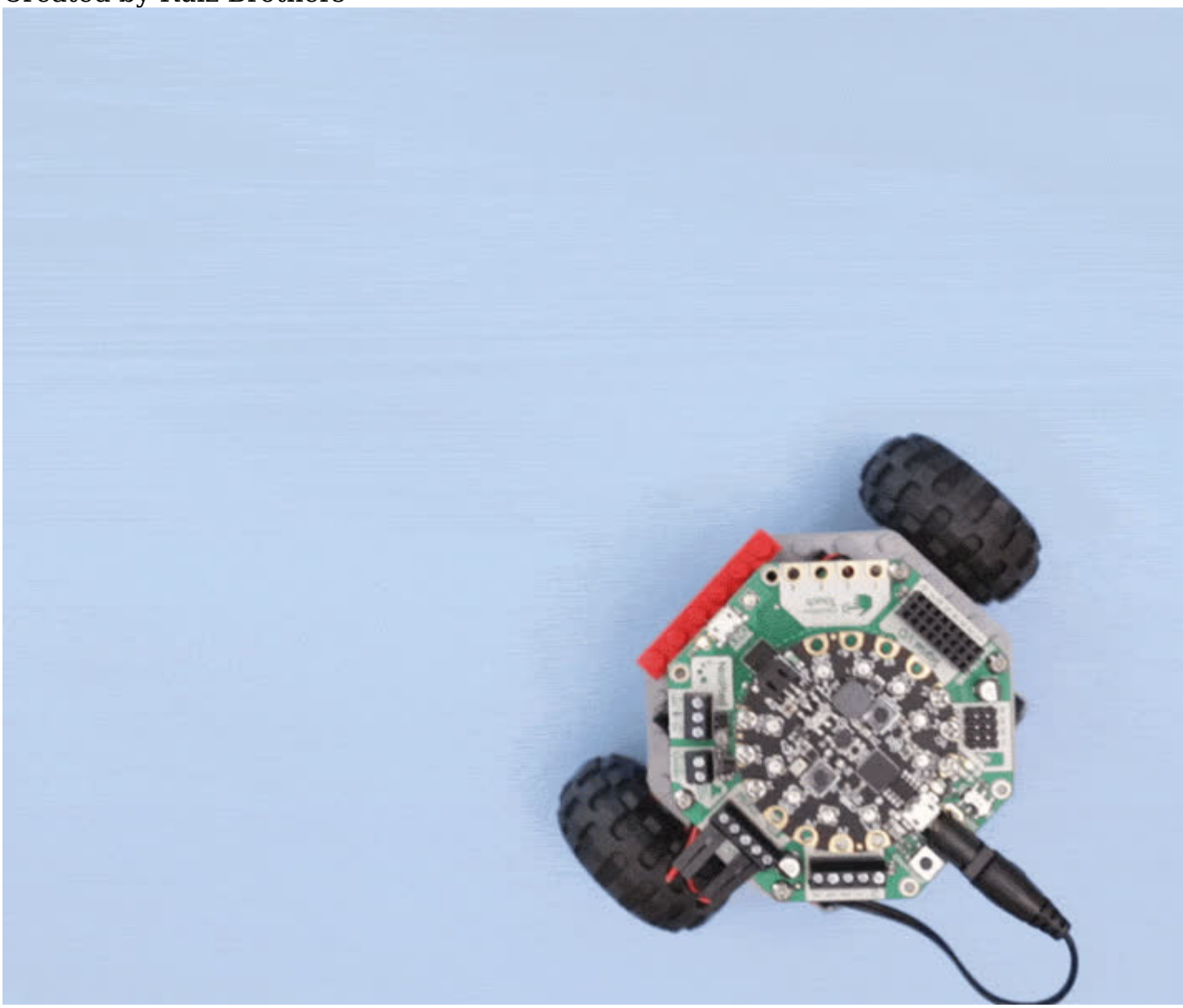
LEGO Compatible Crickit Rover

Created by Ruiz Brothers



https://learn.adafruit.com/lego-compatible-crickit-rover
Last updated on 2024-03-27 04:44:23 PM EDT

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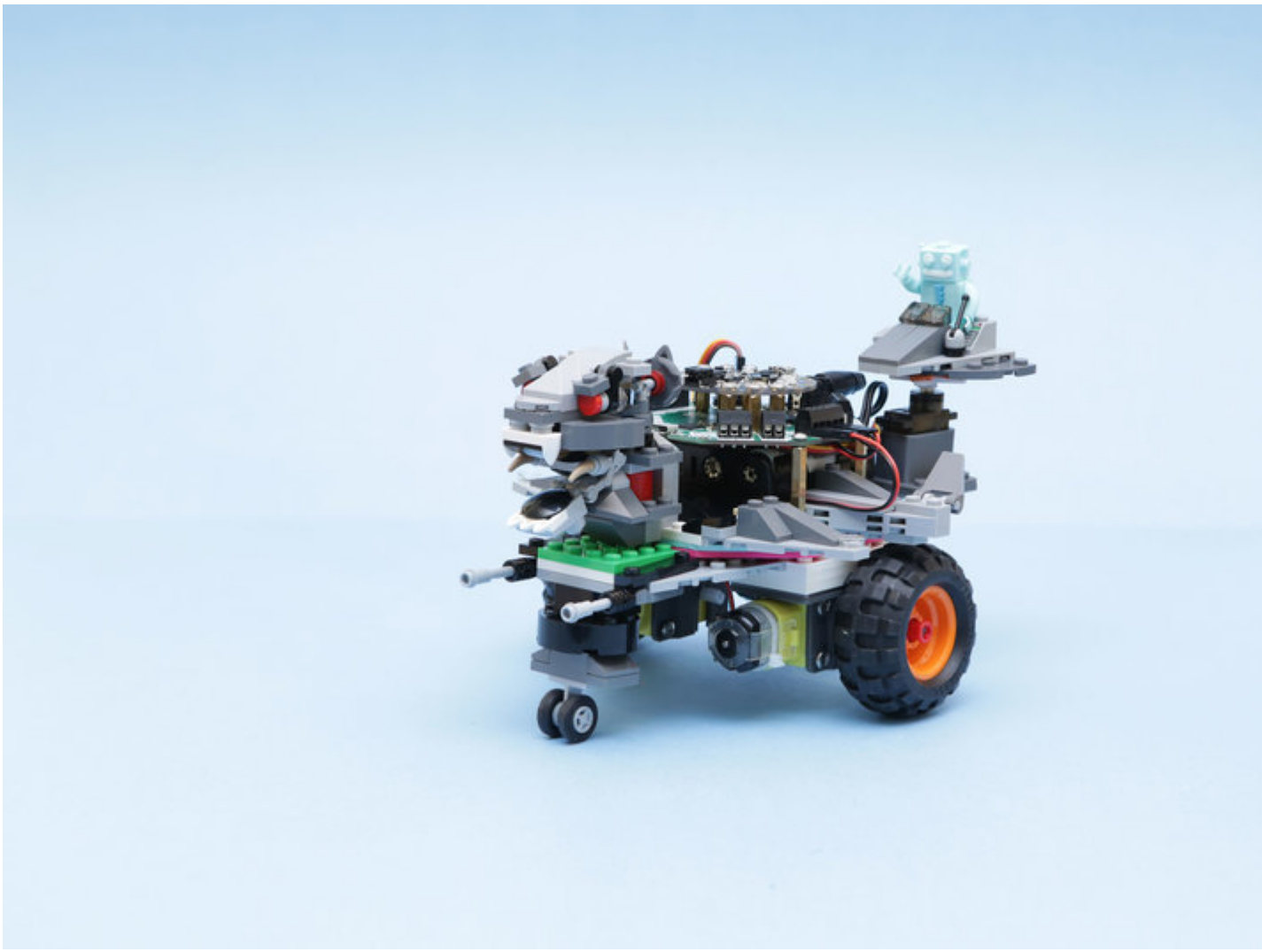
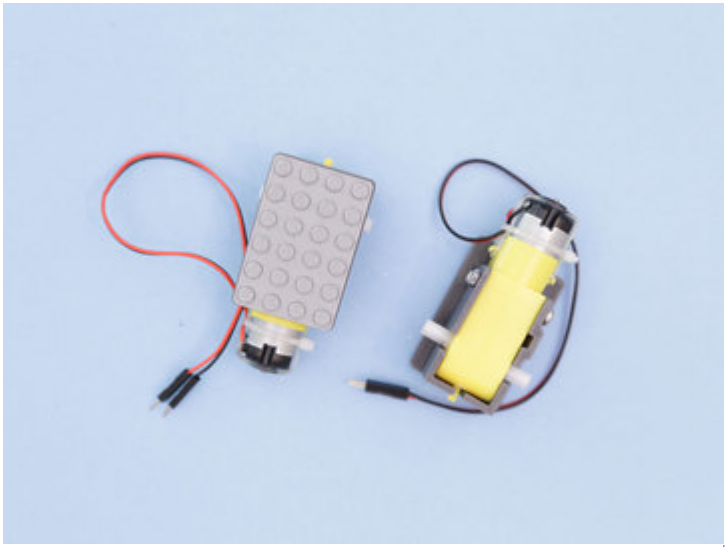
Overview

Prototyping Robotics

Build a CRICKIT (https://adafru.it/BD7) powered rover robot using LEGO pieces and 3D printed mounts! Learn how to use the Circuit Playground Express (https://adafru.it/adafruit-cpx) and the LEGO brick system to build a two wheeled robot. Use Microsoft MakeCode (https://adafru.it/wpC) to program movements with interactive lights and sounds. LEGO is the breadboard equivalent to mechanical design. It's modularity makes it perfect for prototyping robotics. With just two motors, an Adafruit CRICKIT (https://adafru.it/BD7) and Circuit Playground Express (https://adafru.it/adafruit-cpx) board, you can quickly make a moving robot. It's expandable and completely customizable with 3D printing!



- 

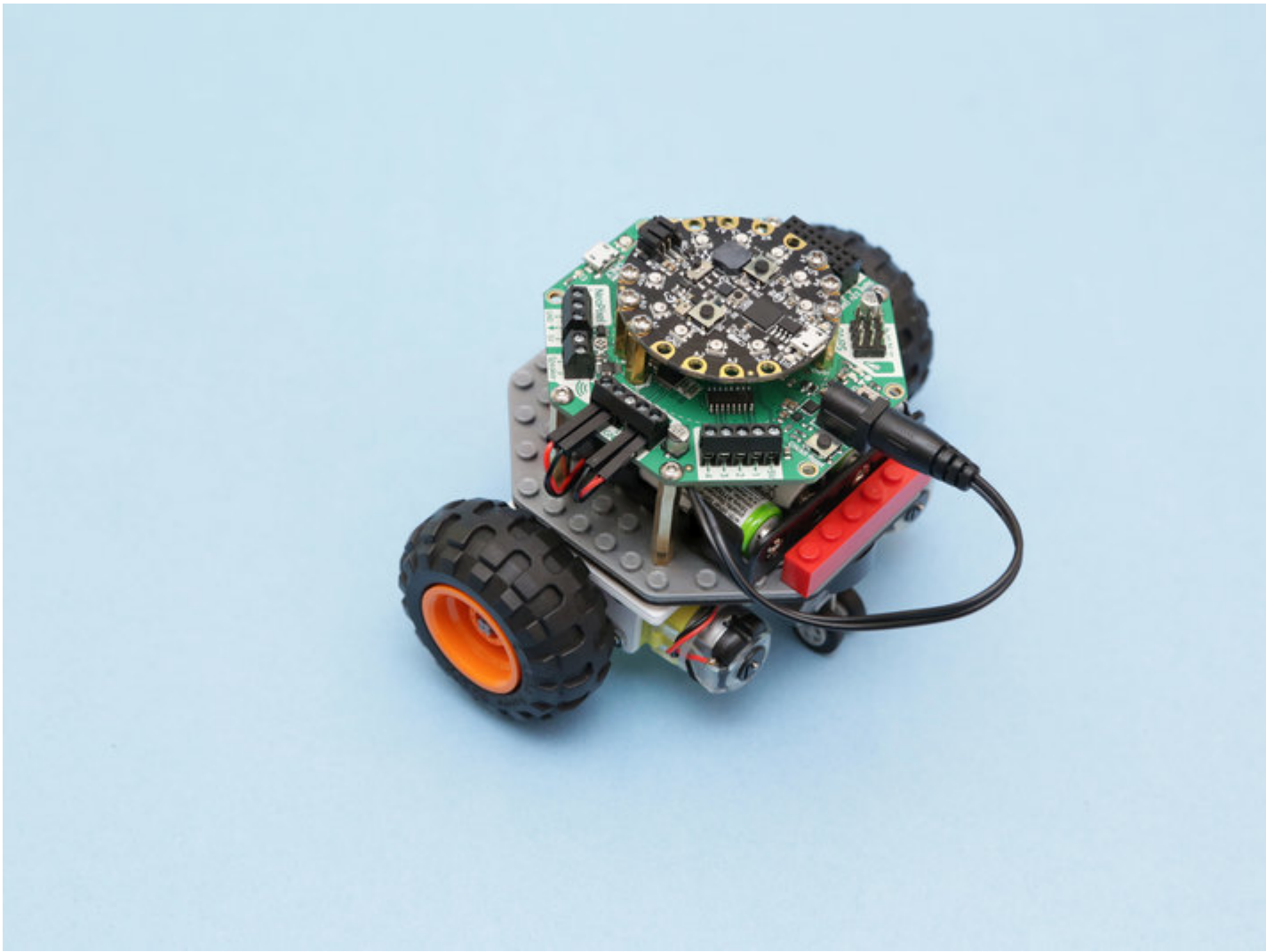
Building LEGO robotics without LEGO Mindstorms NXT

Standard "off-the-shelf" components such as motors and servos are fairly inexpensive and widely available. The LEGO Mindstorms (https://adafru.it/BOJ) components and accessories are pretty expensive and commonly included in a larger kit that will set you back about $350 USD. With 3D

printing and low cost DIY electronics, you can make custom mounts and parts to adapt those off-the-shelf components into LEGO compatible modules.

What's a CRICKIT?

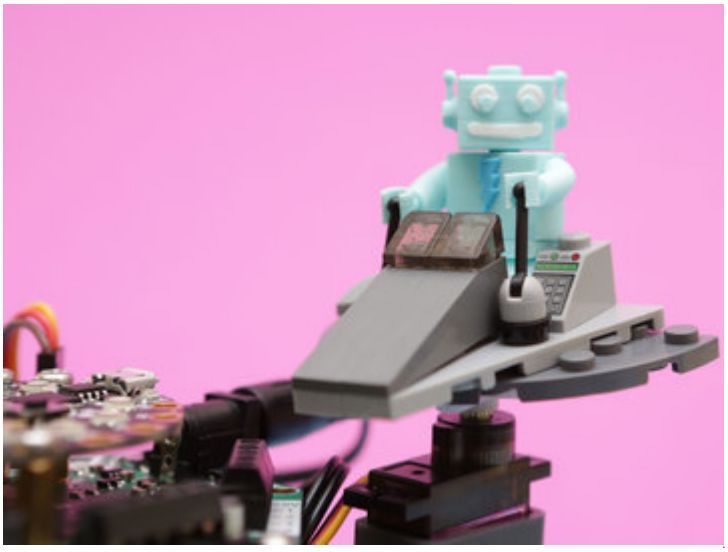
With the Adafruit CRICKIT (https://adafru.it/BD7) robotics platform, you can control and program a bunch of cool stuff from motors to servos and even RGB LEDs and sound effects. No soldering required, you just plug stuff in and use the screw block terminals to keep everything together. This makes prototyping projects super easy and more importantly, fast and fun! Program CRICKIT over a USB cable using Microsoft MakeCode (https://adafru.it/wmd), a drag and drop coding language that runs in the Google Chrome web browser.



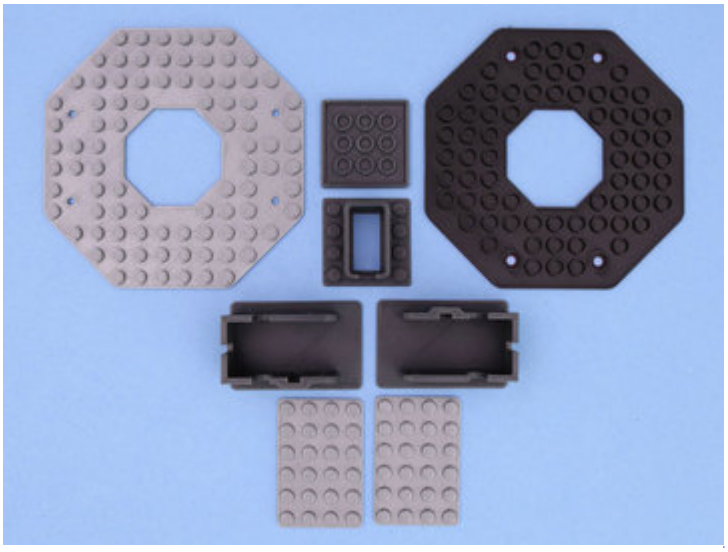
Base Plate Design for CRICKIT

The base plate serves as the rovers chaises and provides structural support. It features compatible elements like the stubs and tubes you'd find on a typical LEGO brick. It's octagonal shape follows the outline of Crickit PCB and matches up nicely. Using the LEGO system allows for easy to assemble prototyping and a plethora of parts, components and pieces available from LEGO.

Programming Robots

- 

The movements of the rover are programmed using Microsoft MakeCode (https://adafru.it/wmd), a drag-and-drop block based coding language. The CRICKIT extension in MakeCode allows quick and easy programming of motors, servos, lights and sounds. You can create sequential animations or more interactive movements using the on-board sensors. Use the example demo code to get started and modify it to make it your own!

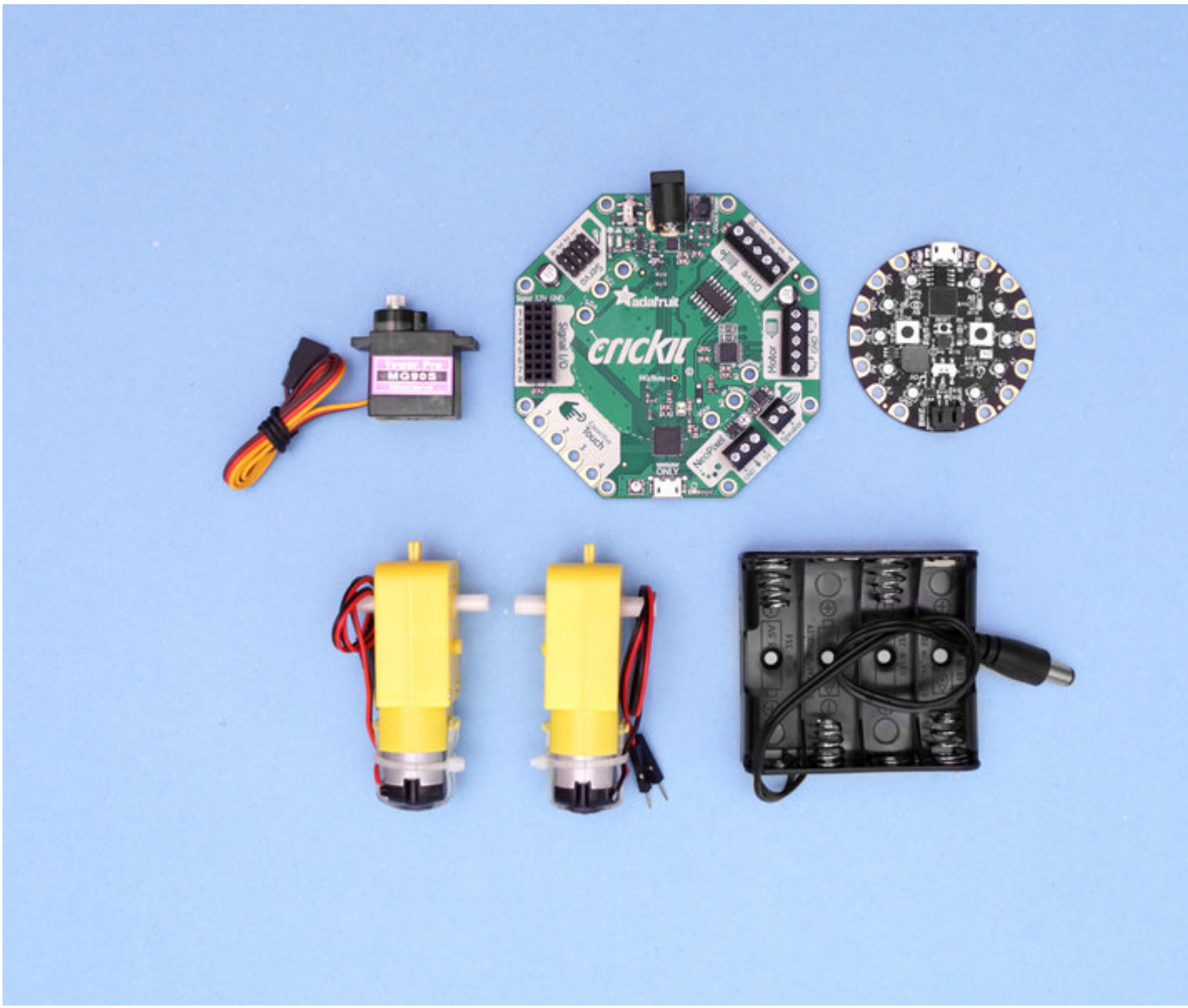
- 

3D Printed Parts

Mounts and connecting parts are 3D printed in PLA filament on FDM type 3D printers. These parts are optimized to print without any support materials. They feature tight tolerances that allow parts to snap fit together. Mounting holes are also used to secure subassemblies together.

Electronics

Here's a list of components used to build this project. The Adafruit Crickit requires an Adafruit Circuit Playground Express, these are sold separately. The CRICKIT includes with M3 hardware screws and standoffs for bolting onto the Adafruit Circuit Playground Express.



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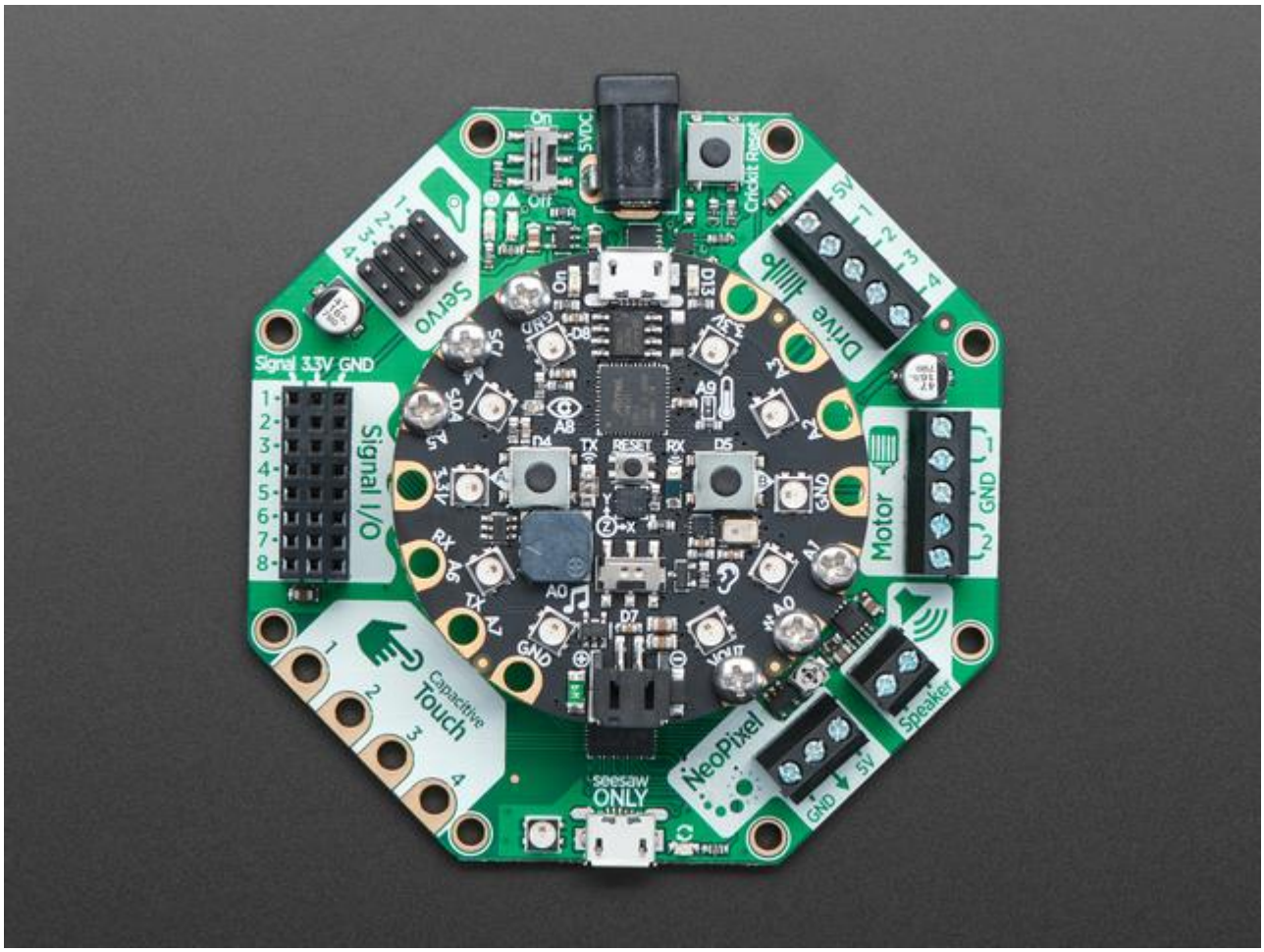
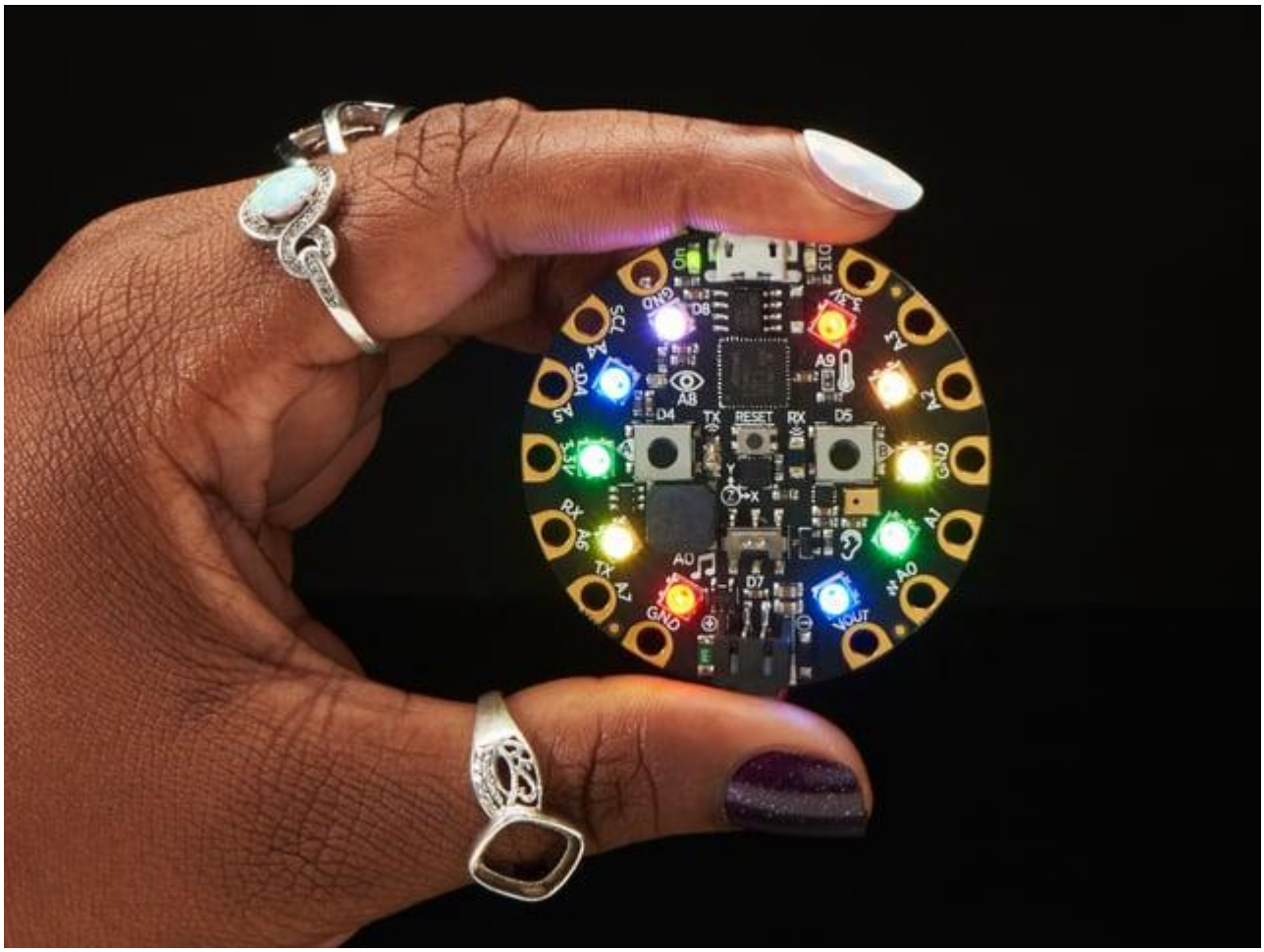


[Circuit Playgro Express](#)

Circuit Playgro Express next ste a perfec introduc electron program We've ta original Playgro Classic [https:// www.ad product



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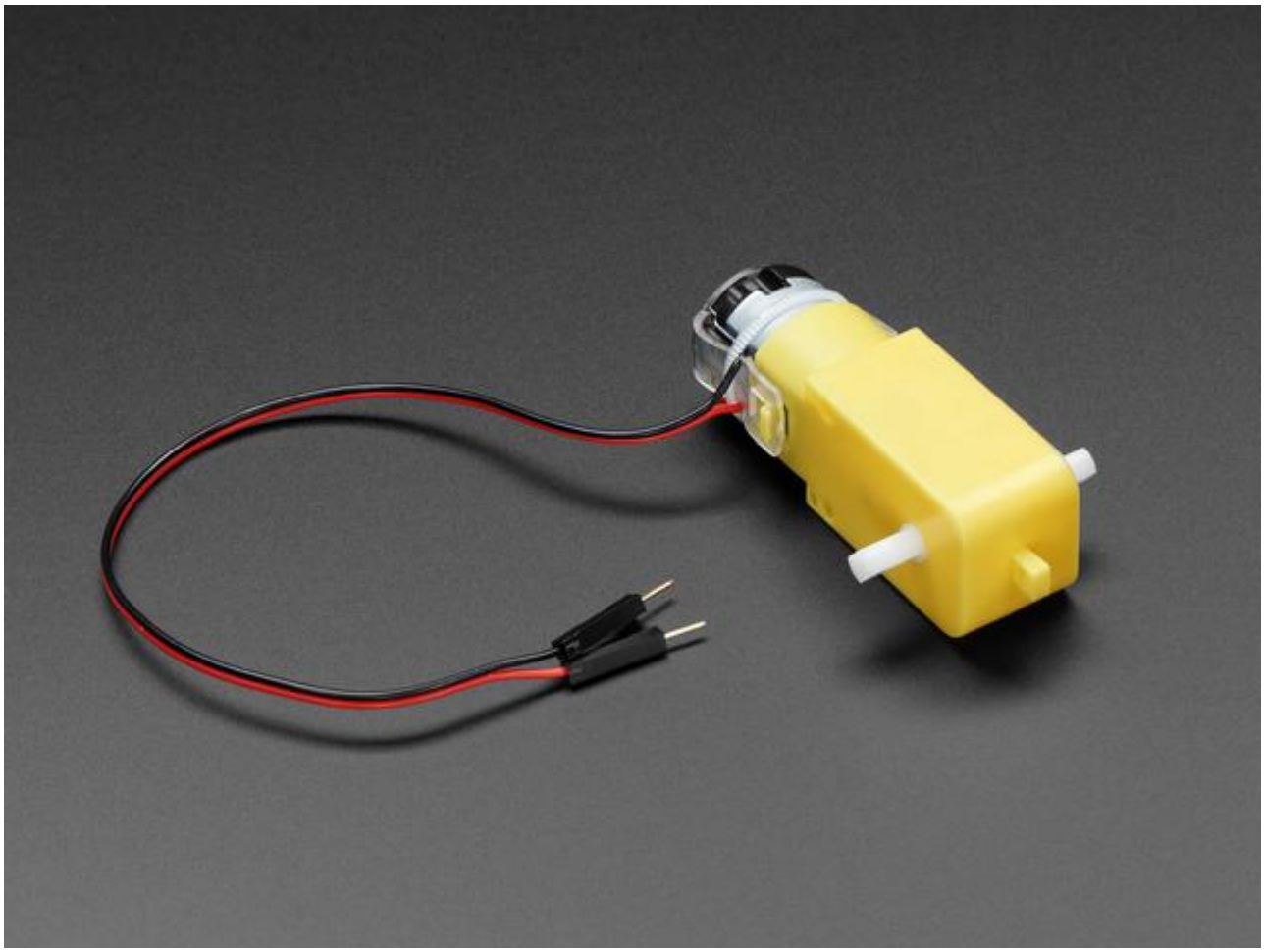

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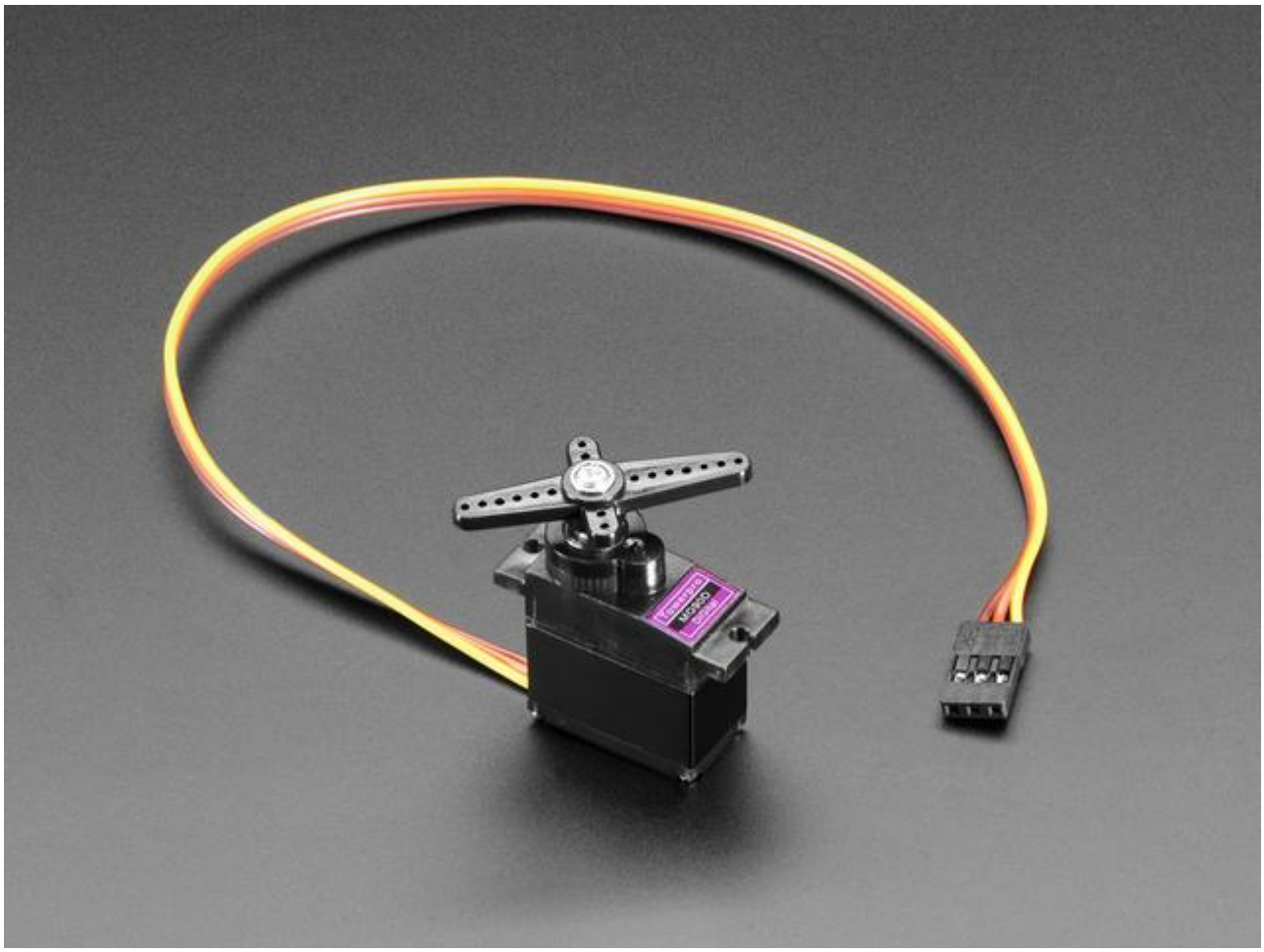


- 

Hardware

You'll need some extra hardware like machine screws, nuts and hex standoffs to assemble this project. They're linked below, but feel free to source them from your favorite supplier.

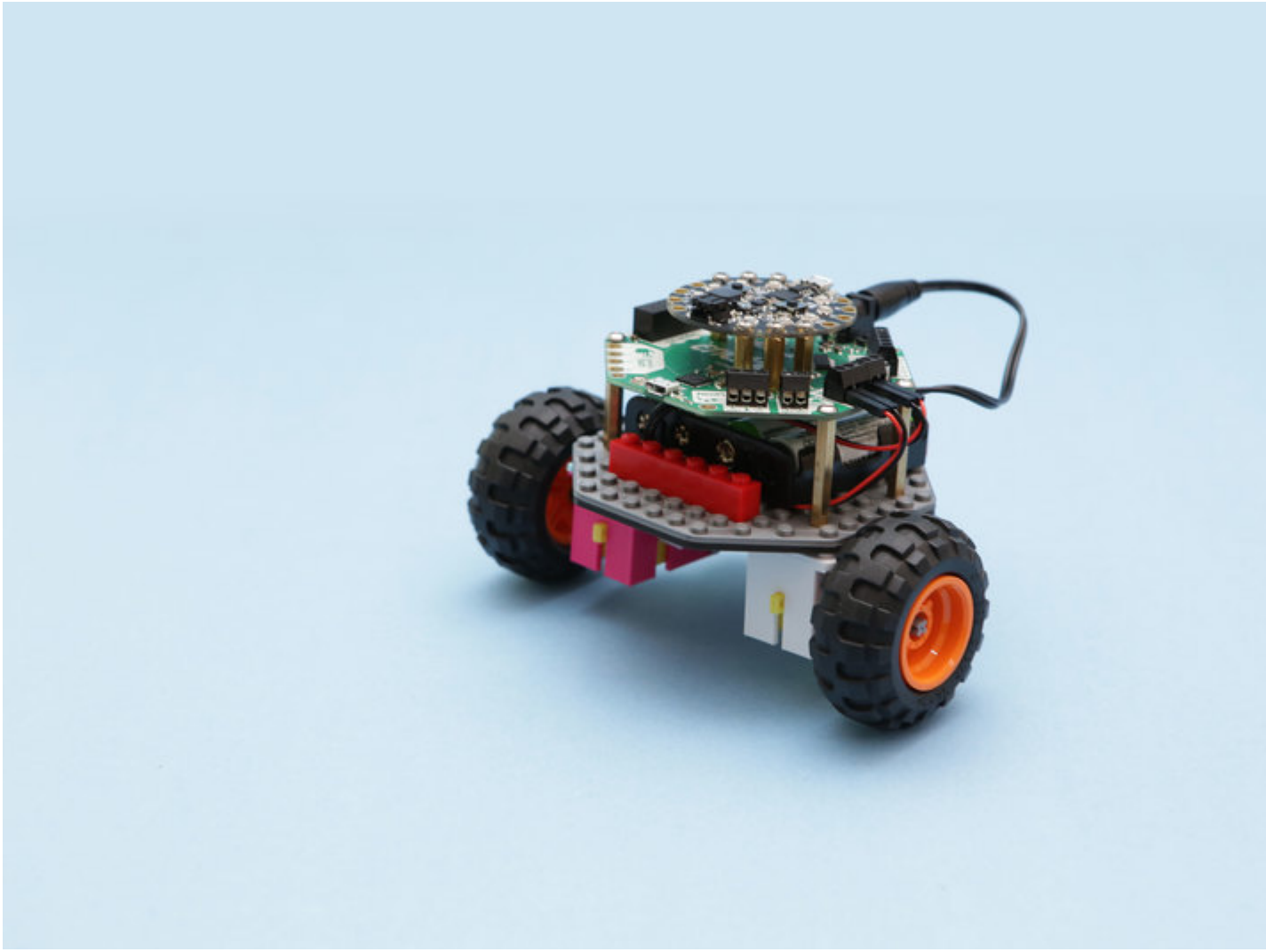
6 x M3 x 12mm standoffs
Brass Hex Metric Standoffs
https://www.adafruit.com/product/3816
12 x m3 x 6mm machine screws
M3 Phillips Button Head Metric Machine Screws
https://www.albanycountyfasteners.com/Phillips-Pan-Head-Machine-Screw-M3-x-5-p/1066-1008.htm
4 x M3 x 30mm Standoffs
M3 Brass Hex Metric Standoffs

https://www.amazon.com/gp/product/B015A3LROO
1 x M3 Standoffs Assortment Kit
M3 Brass Hex Metric Standoffs
http://a.co/4R7WbPj
4 x M3 x 0.5 x 1.55mm Hex Nuts
Metric Sized Hex Jam Nuts
https://www.albanycountyfasteners.com/Metric-Hex-Jam-Nuts-A2-Stainless-Steel-p/5580000.htm
4 x M3 x 8mm machine screws
M3 Phillips Pan Head Metric Machine Screws
https://www.albanycountyfasteners.com/Phillips-Pan-Head-Machine-Screw-M3-x-5-p/1066-1008.htm
4 x m3 x 12mm machine screws
M3 Phillips Flat Head Metric Machine Screws
https://www.albanycountyfasteners.com/3-MM-x-5-Phillips-Flat-Head-Machine-Screw-p/1011-1006.htm

Power

We'll need just a 4xAA battery packs to power our CRICKIT rover. **We recommend NiMH rechargeables.** For one, they have less waste, but they also perform better than alkalines in high-current draw robotics. So if you can, please use NiMH!

1 x 4 x AA Battery Holder
Battery Pack with 2.1mm Plug
https://www.adafruit.com/product/3784
1 x AA Rechargeable Batteries
1.3V AA NiMH batteries
http://a.co/gSp3lEj



Prerequisite Guides

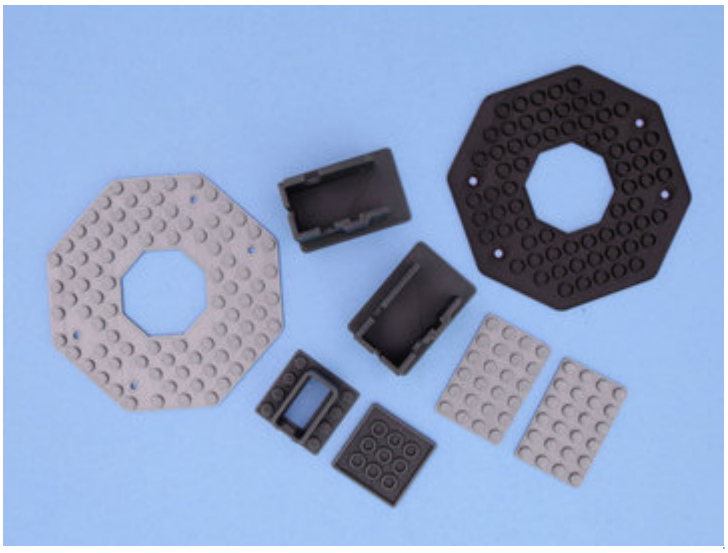
There's resources in these guides that go beyond what's covered in this tutorial. MakeCode guide is all about setting up your Circuit Playground Express board. TheCircuit Playground Express introduction guide walks you through all of the pinouts, sensors and everything you need to know.

- MakeCode for Circuit Playground Express (https://adafru.it/wWd)
- Introducing Circuit Playground Express (https://adafru.it/adafruit-cpx)
- Introducing CRICKIT (https://adafru.it/BD7)

3D Printing

Mounts & Plates

The various mounting parts and plates are

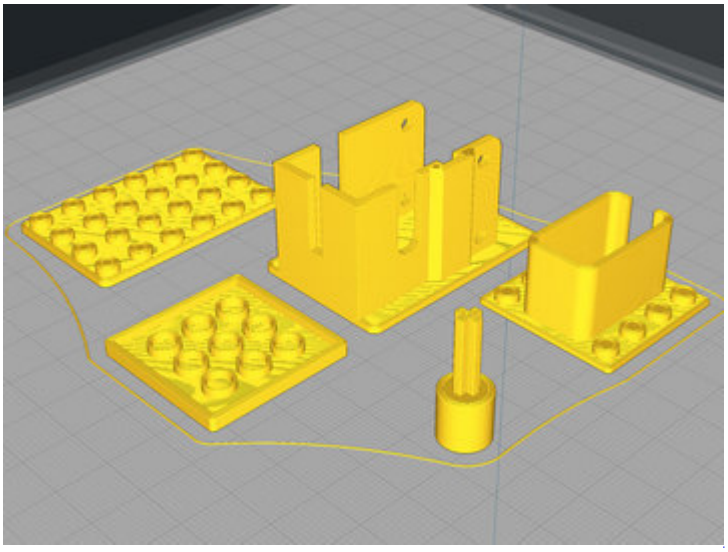
- 

designed to 3D print with FDM style machines using PLA filament. These parts require very precise tolerances and should be printed with a well calibrated machine. Fittings may vary depending on slice settings.

3D Printed Parts List

Models are oriented to print as is and do not require any support material. The lego studs and tubes needs to be tested before printing the full plates. I suggest test printing the **lego-motor-studs** part first and see how the fittings feel. Bricks ought to have a tight fit but still be able to remove.

- lego-base-plate-tubes.stl
- lego-base-plate-studs.stl
- lego-motor-studs.stl
- lego-motor-box.stl
- lego-motor-axle.stl
- lego-servo-tubes.stl
- lego-servo-box.stl

- 

CURA Slicing

Use the slice settings as reference. Settings may need to be adjust for tolerances. Print parts independently for best results. Test fit parts before full assembly. Parts tested with PLA filament using Ultimaker 3.

- 0.25mm nozzle for fine quality

- 0.10mm layer height for LEGO studs/tubes
- 0.38mm line width / 2 wall line count
- 60mm/s printing speeds

What If I Don't Have A 3D Printer?

Not to worry! You can use a 3D printing service such as 3DHubs (https://adafru.it/jNb) or MakeXYZ (https://adafru.it/veh) to have a local 3D printer operator 3D print and ship you parts to you. This is a great way to get your parts 3D printed by local makers. You could also try checking out your local Library or search for a Maker Space.

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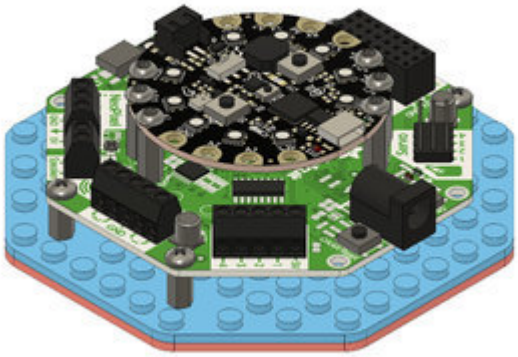
Download STLs

You'll need an STL file to 3D print the mount for the circuit playground express. Click the button below to download the STL from your choice of repo site.

Download STLs from Thingiverse

https://adafru.it/BW7
[Download STLs from Pinshape]
https://adafru.it/BWu
[Download STLs from Youmagine]
https://adafru.it/BWv

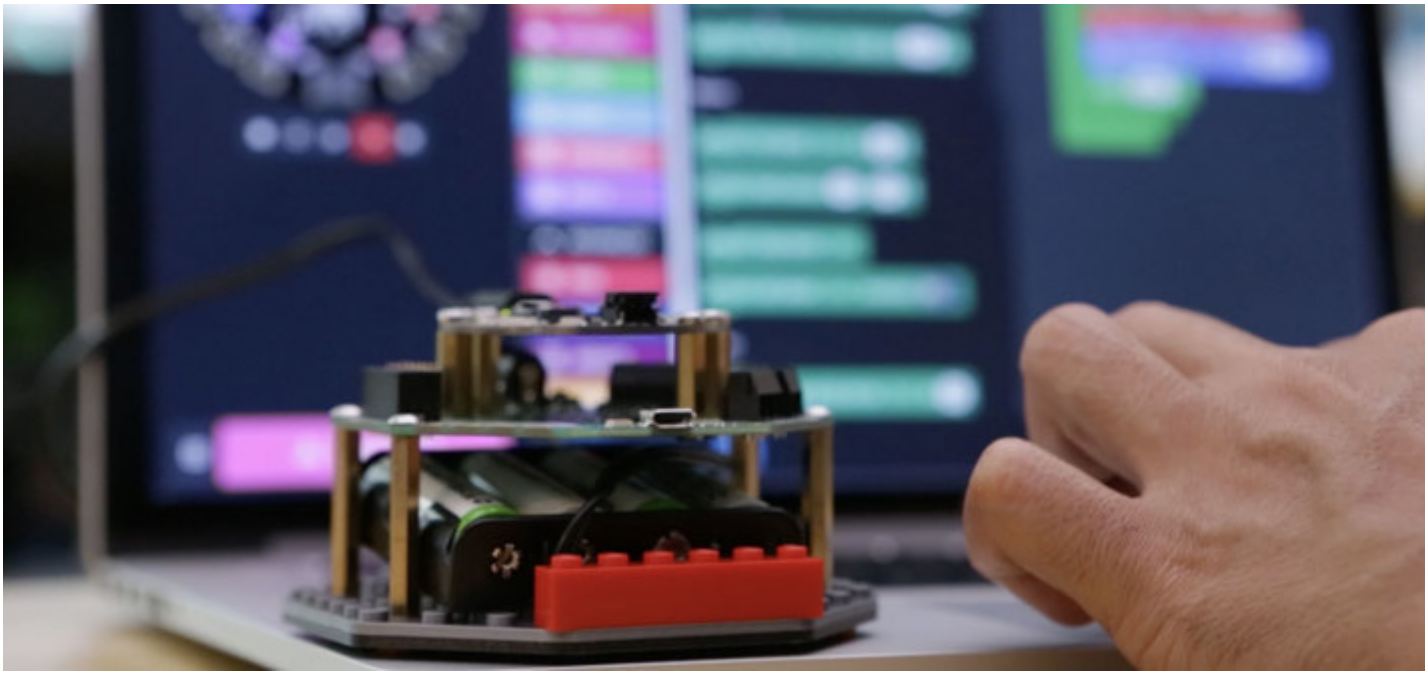
- 

Design Source Files

The enclosure assembly was designed in Fusion 360. This can be downloaded in different formats like STEP, SAT and more. Electronic components like the board, displays, connectors and more can be downloaded from our [Fusion 360 CAD parts github repo] (https://adafru.it/AW8).

[LEGO Motor Mount Fusion 360 Project]
https://adafru.it/19Mb
[LEGO Plate Fusion 360 Project]
https://adafru.it/19Mc
[Adafruit CAD Parts Github]
https://adafru.it/AW8

Software

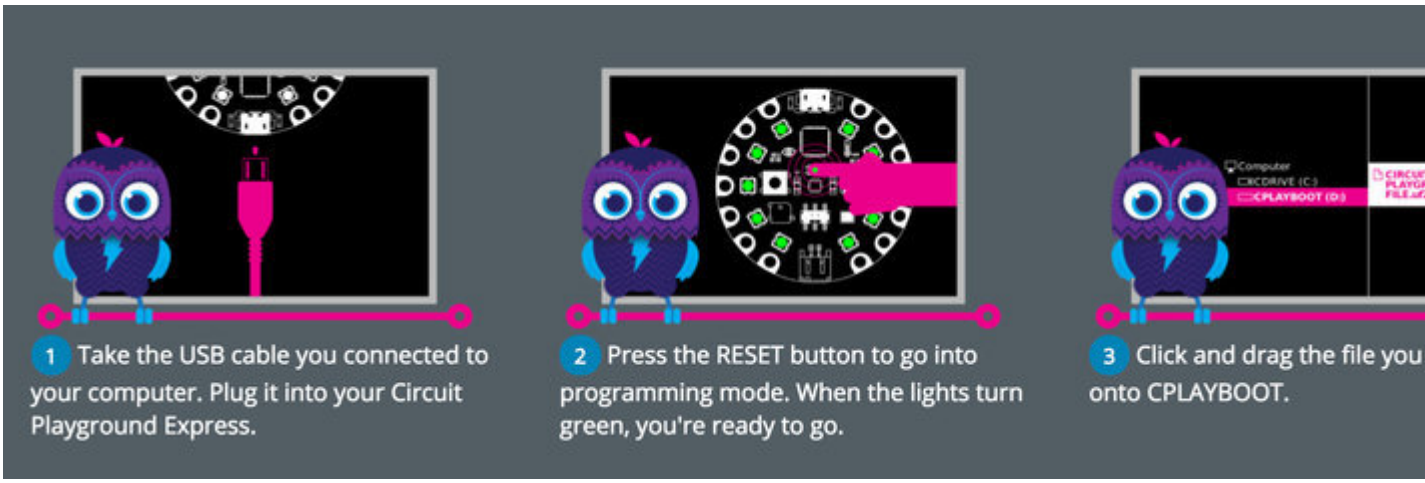


MakeCode for CRICKIT // Circuit Playground Express

MakeCode is this programming editor that runs in the Google Chrome web browser. It’s has an intuitive interface that’s both block based and text editor.

It works with Adafruit's CRICKIT and Circuit Playground Express so you can make interactive projects with the on-board sensors and components. You can drag & drop blocks to make interactive programs using lights and sounds without having to solder or learning a new syntax.

You can upload code directly to the Circuit Playground Express with WebUSB, [see this guide page](https://adafru.it/CLO) (https://adafru.it/CLO) for that option.



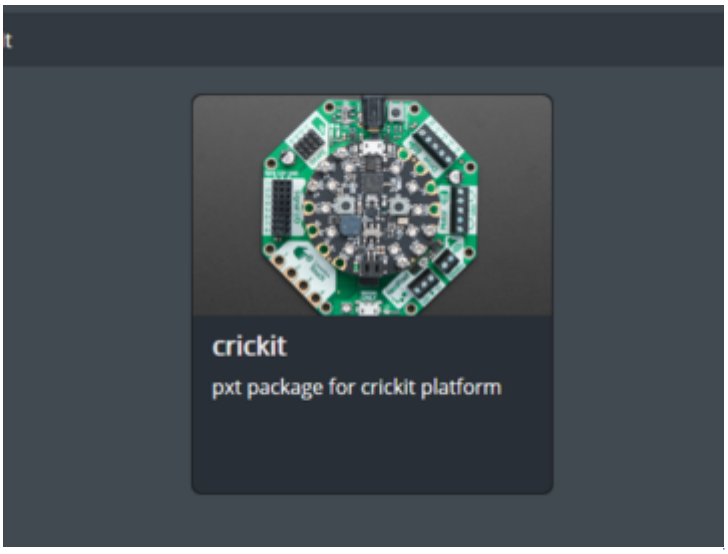
Setup Circuit Playground Express for MakeCode

To get started, we'll need to head over to the Adafruit MakeCode (https://adafru.it/Bct) website and follow the steps below.

1. Plug in your Circuit Playground Express with a **USB Cable**
2. Press the **RESET** button. Green light means you're ready to MakeCode
3. Download the **UF2** file and drop it onto **CPLAYBOOT**.

Launch Adafruit MakeCode Website
https://adafru.it/Bct

Install CRICKIT Extension for MakeCode

- 

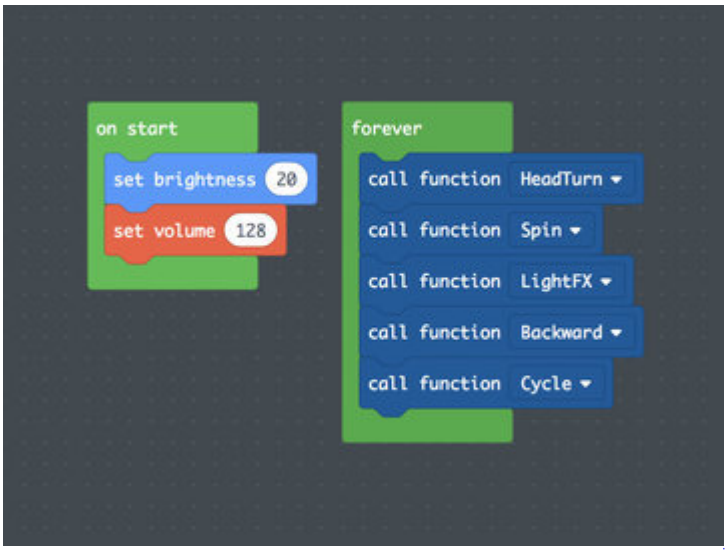
On the MakeCode site, click on **New Project**. In the list of blocks, select **ADVANCED** and then **EXTENSIONS**. Click on the Crickit block that shows up and install Crickit support! You will now have a new **CRICKIT** bin of blocks you can use! Continue on to learn how to use these blocks. Read the full guide here for more info (https://adafru.it/BKC).

LEGO Crickit Rover MakeCode Project
https://adafru.it/BW9

Upload and Test Code

Once you have your CPX setup with the MakeCode UF2, try testing it out by uploading the code to the board. Click the link below to open up the program in makecode. Click on the pink edit icon near the top of the title to open the code. This will create a project in MakeCode and allow you to edit, modify and upload the code to the board.

On Start & Forever

- 

Let's focus on the **on start** and **forever** code blocks. Anything in the **forever** block will continuously run, looping forever. Stuff placed in the **on start** code block will run first, in the beginning of boot up. This is generally used for initial setups such as NeoPixel brightness or speaker volume. In this project, we have several **function** blocks that are labeled and represent a single motion. Each of these functions contain several code blocks that tell the motors how to move.

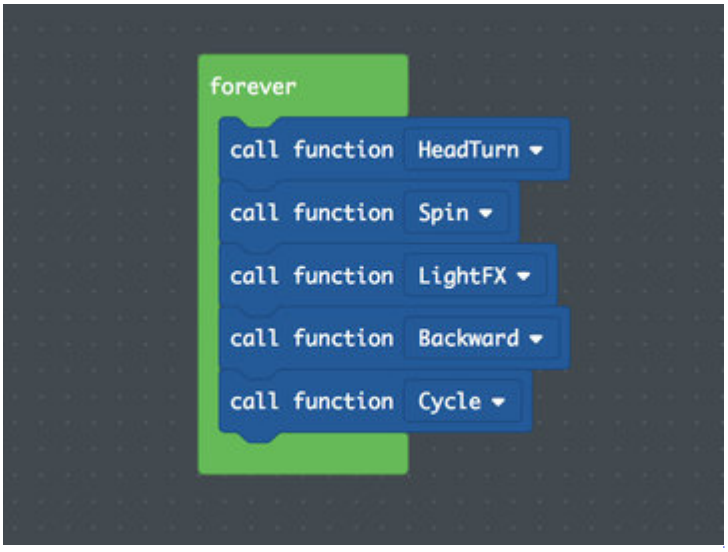
Crickit Code Blocks

- 

Each code block is grouped into a section that pertains to the type of component. Here we have blocks for controlling servos, motors, NeoPixels and more. For this project, we'll only focus on motors and servos. We'll use the code blocks in the **LIGHT** category to control the NeoPixels on-board the Circuit Playground Express. Read through the various blocks and hover over on them to see a tool tip with

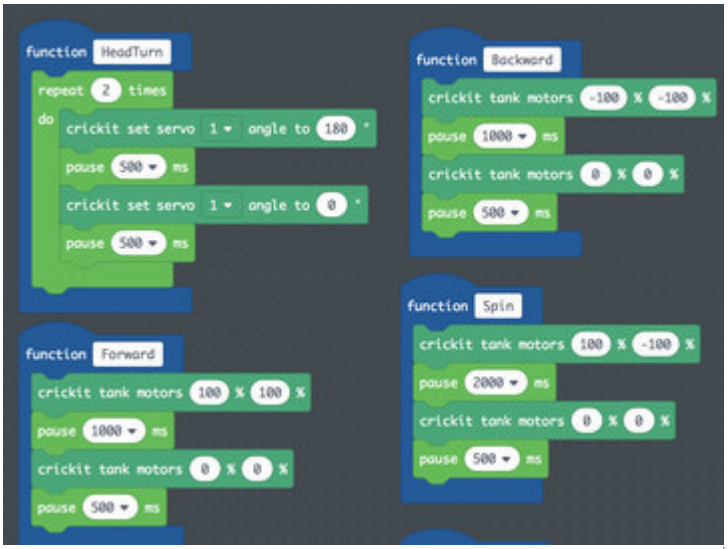
description of what they do.

Using Functions

- 

Each function contains several code blocks that tell the motors what to do. You can create custom functions by clicking on the **Make** buttons in the **functions** category. To create forward motion using two motors, we can use the c**rickit tank motors** code block. Using several functions allows for quick rearrangement of movements. This can aid in the creation of sequential rover movements.

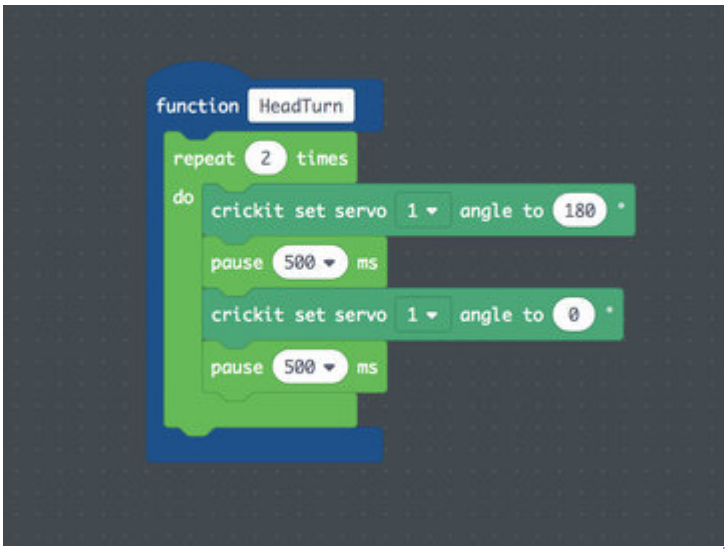
Tank Motors Code Block

- 

This single block can control both motors by assigning a numerical value from **-100** to **100**. The value **0** is a full stop. A positive value of **100** is full speed. **50** for half speed. A negative value will make the motor turn in reverse. To create rotational movements, set one motor to **-100** and the other to **100**. This will also result in spinning movement. Use a **pause** block in between motor

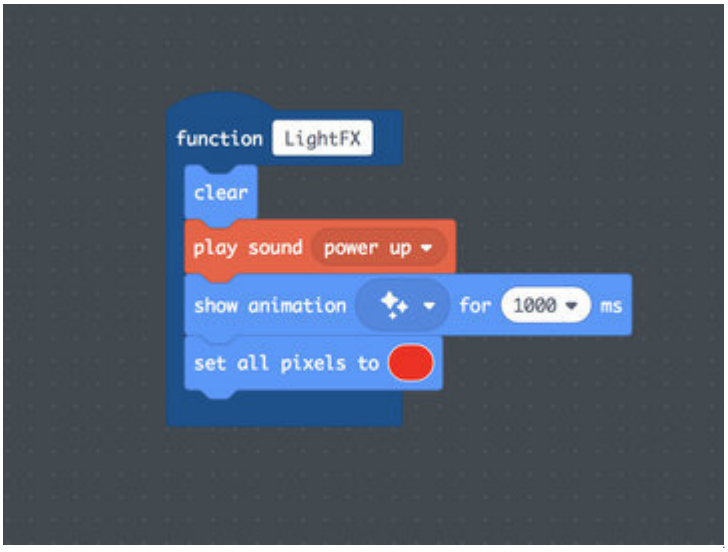
blocks to create duration between movements. **500ms** - **1000ms** should be a good starting point.

Servo Control & Repeat

- 

Program servos using the **crickit set servo** code block. Choose a servo number and assign a value to the angle. 0-180 will give you the available range of rotation from the servo. Use a **pause** block to create duration between the movements. A **repeat** block, found in the **loops** block category, can be used to create repetitive movements.

Lights & Sounds

- 

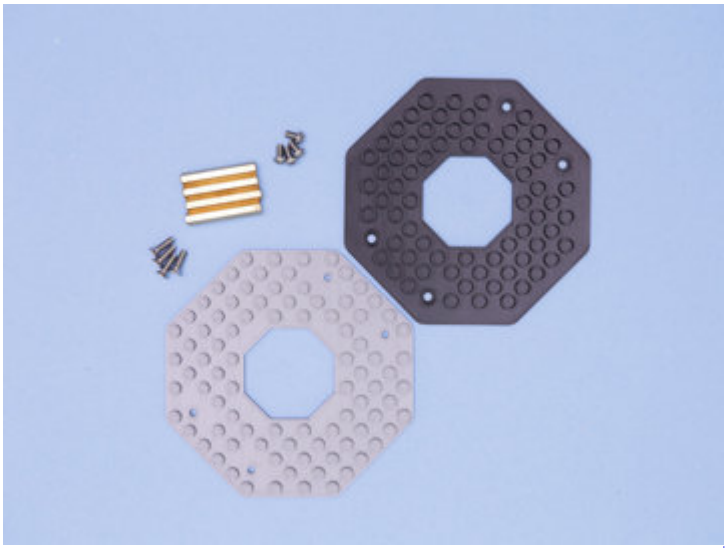
Display dazzling NeoPixels using the **show animation** code block in the **LIGHT** category. Use the **set brightness** block to change the intensity. Create colored patterns using the **show ring** block. Create a custom function and place it in between motor movements.

Music notes can be generated with the on-board speaker. Choose notes from a piano

keyboard and write a custom jingle. Playback canned effects from the **play sound** code block.

Base Plate Assembly

Base Plate

- 

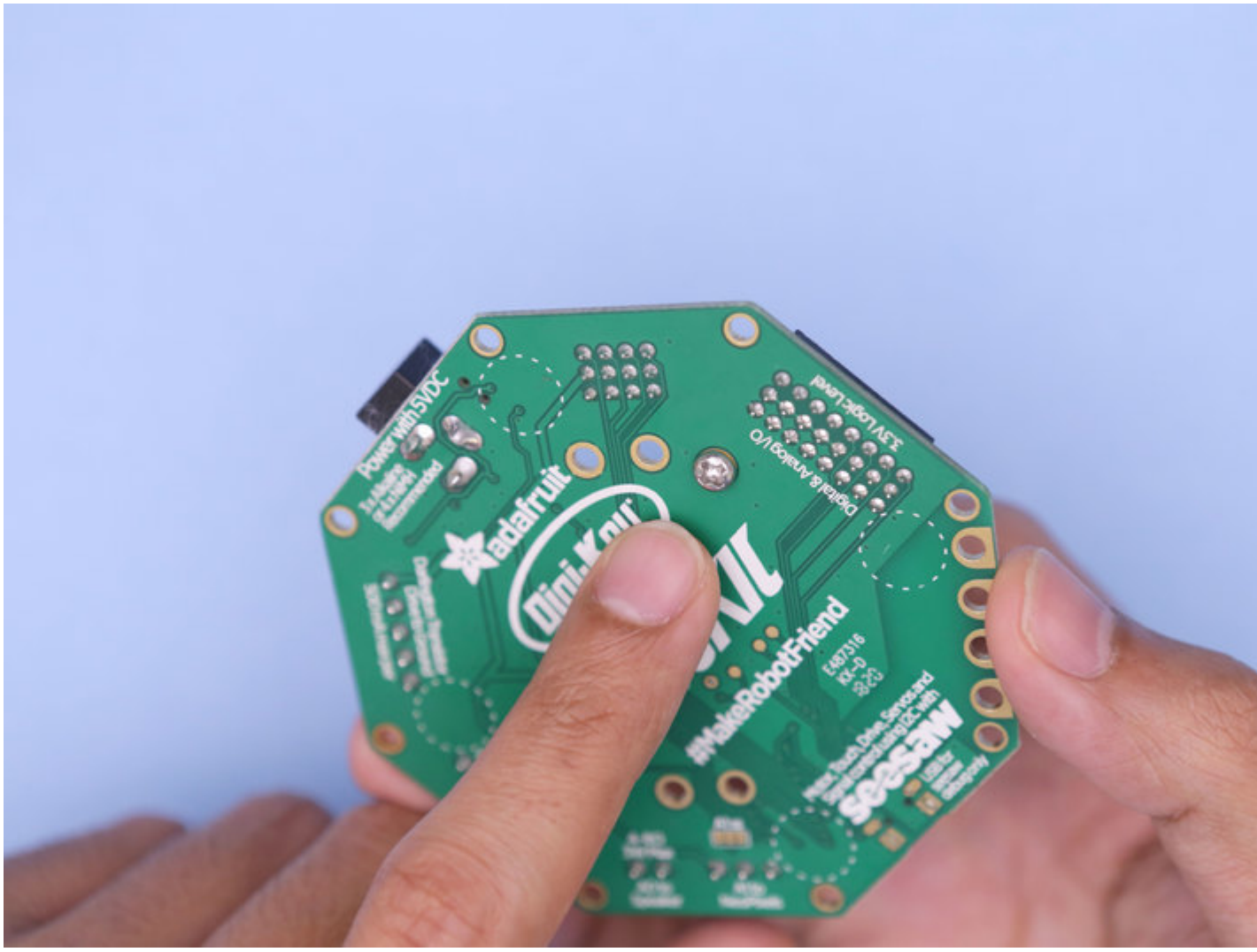
The base plate is split into two separate pieces that are joined together with screws. The plate with tubes connects to LEGO studs. Join the two pieces together at the flat sides. While holding them together, insert and fasten an M3 x 12mm (flat head) screw. The screws heads needs to be flush with the surface of the base plate. The mounting holes are chamfered and designed to recess the screws. Repeat this progress for the four mounting holes.

Install Standoffs to Plate

While holding the base plate, insert one of the long standoffs and twist to fasten onto one of the screws. Tighten the standoffs by hand for each of the four screws.

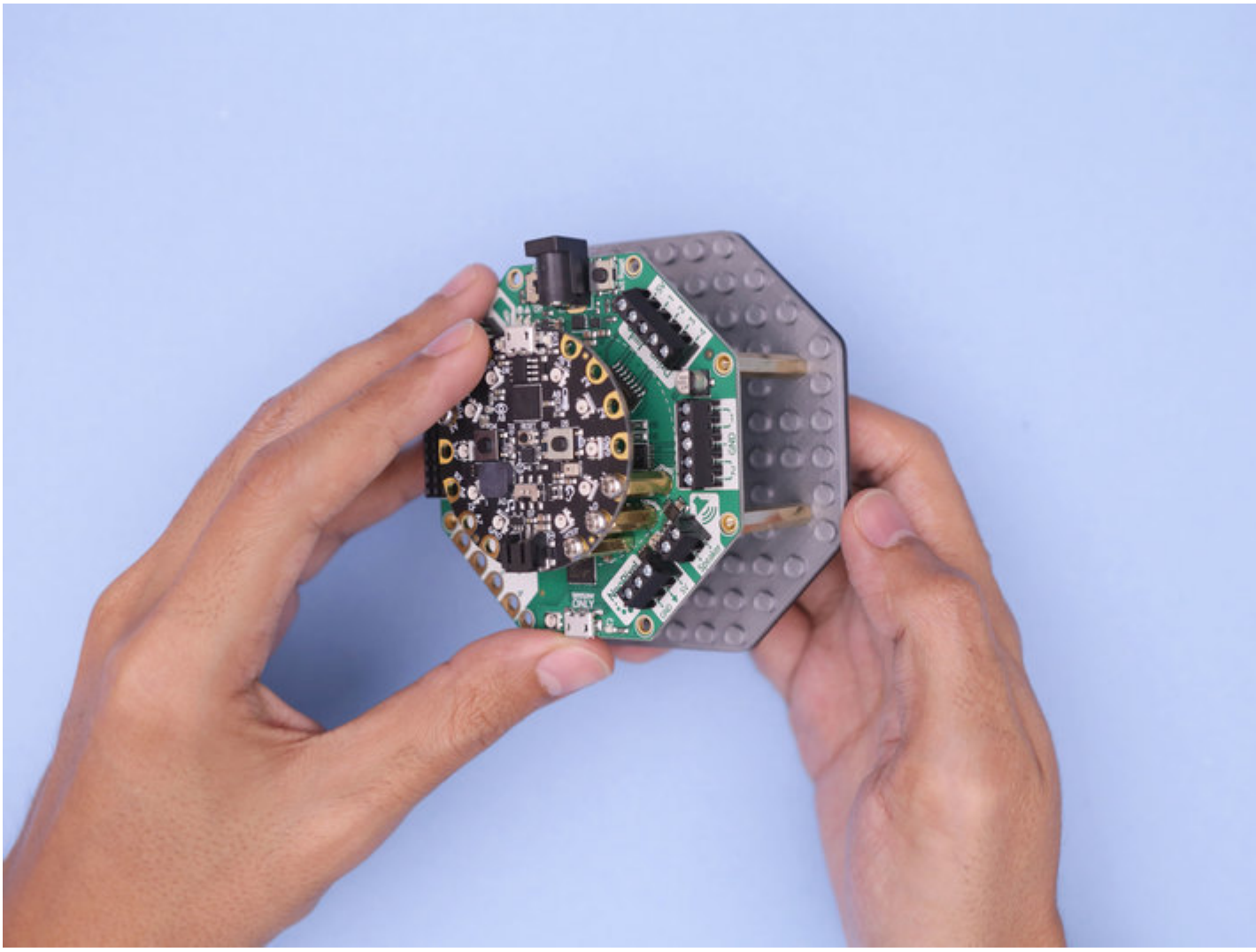
Install Circuit Playground Express to CRICKIT

If you haven't put these two together yet, now is the time to do so! Grab the pcbs, screws and standoffs that came with your crickit. Insert a screw through the bottom of the CIRCKIT board. While holding the screw with your finger, flip the board over and twist a standoff onto the threading of the screw. Twist until tightened. Repeat the process for all six mounting holes. When your done, place the CPX over the standoffs and line up the pins. Be sure they're in the correct spot with matching labels! Insert and fasten the machine screws on top to secure the CPX.



Install CRICKIT to Plate

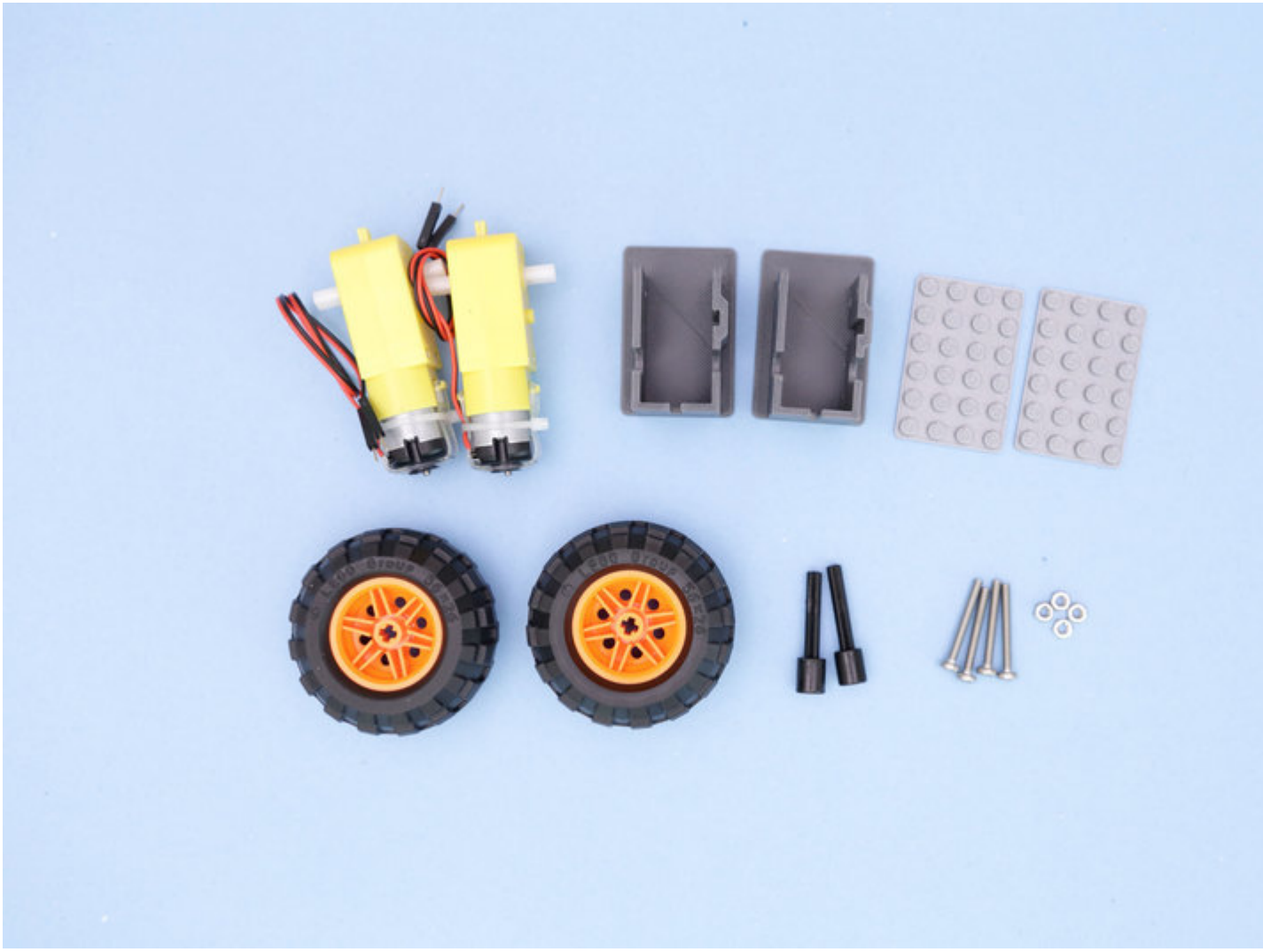
Place the Crickit PCB over the standoffs and line up the mounting holes. Either set of four holes can be secured to the standoffs. Pick your orientation and insert machine screws through the mounting holes. Fasten the screws until tight.



Assembled CRICKIT and Plate

Now the base plate is ready for adding LEGO bricks! To make our rover, we'll need to assemble some wheels using TT motors. We'll also need a wheel assembly and an axle connector.

Motor Assembly



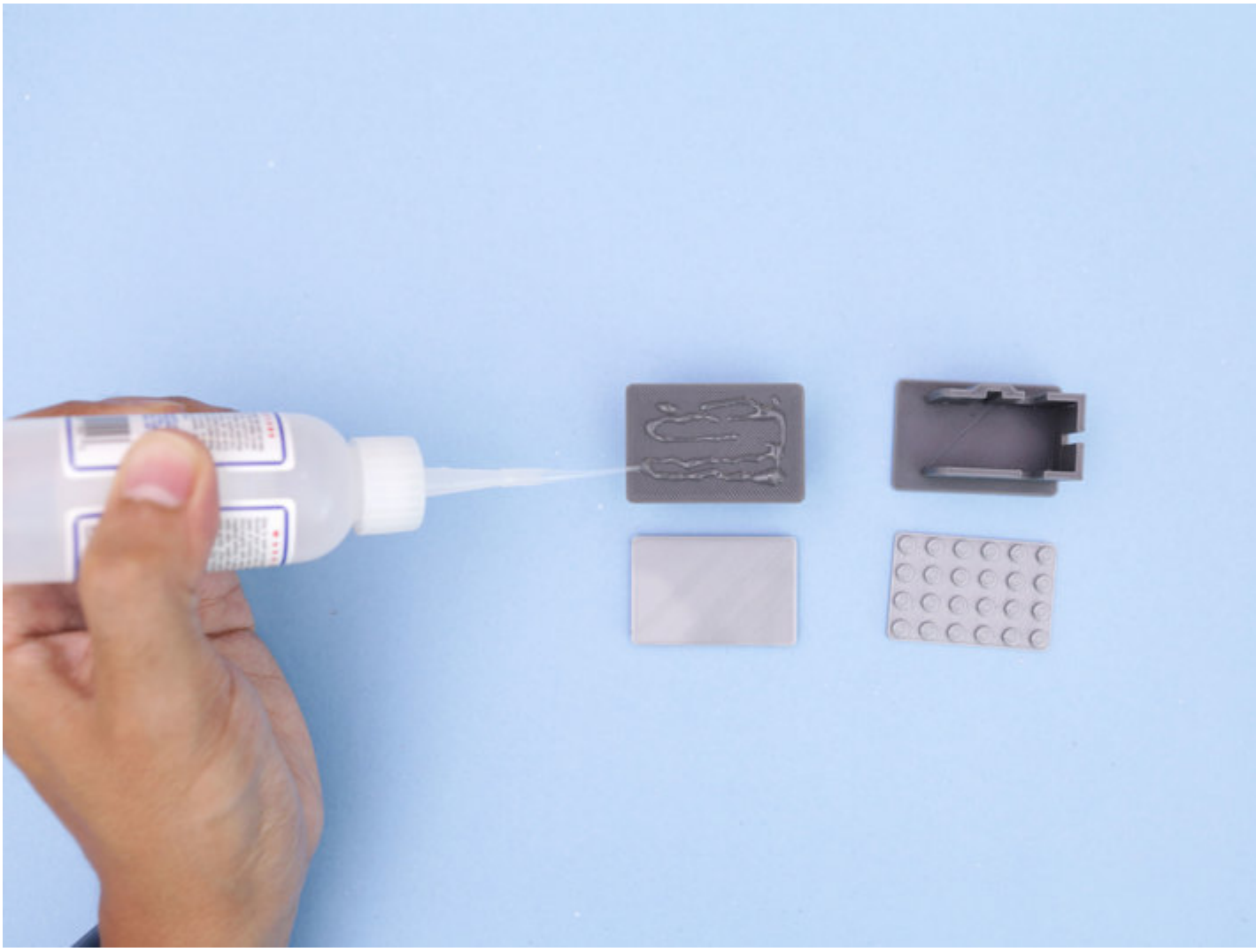
Motor Parts

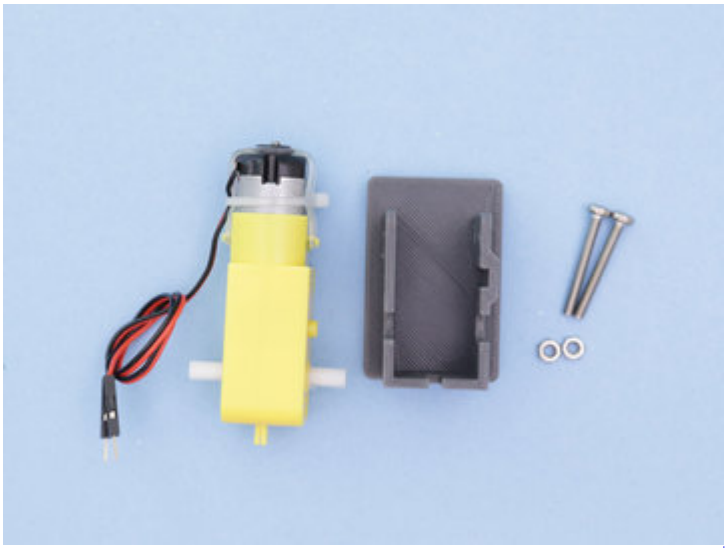
Here's a parts list of the individual parts needed to make the wheel assembly.

- LEGO wheels 56x26
- DC Gearbox TT Motor to LEGO and Compatible Cross Axle
- 3D Printed Motor Mount
- 3D printed Lego Adapter for Motor
- 4x M3 x 25mm Phillips Pan Head Metric Machine Screws
- 4x M3 x 1.55mm Metric Hex Nuts

Assembly Motor Mount

The motor mount is separated into two pieces. The first piece houses the geared DC motor while the other is a LEGO base plate adapter. These two will need to be glued together. A few lines of super glue will permanently bond the two pieces together. Be sure to make their as square as possible.



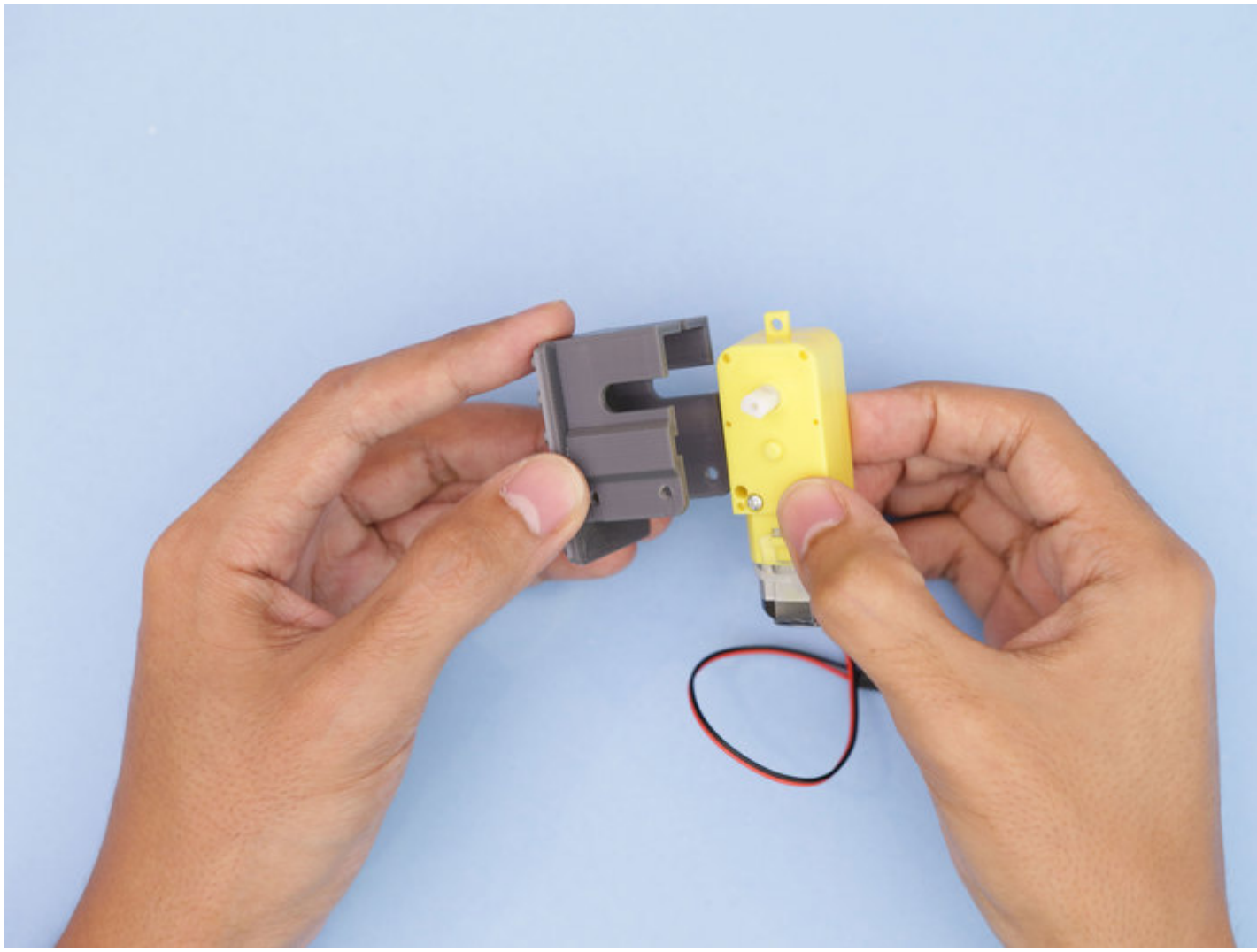
- 

Motor Hardware

Next we'll need to gather our screws and nuts for securing the motor to the mount. Each motor will need two M3 x 25mm long metric machine screws and M3 hex nuts.

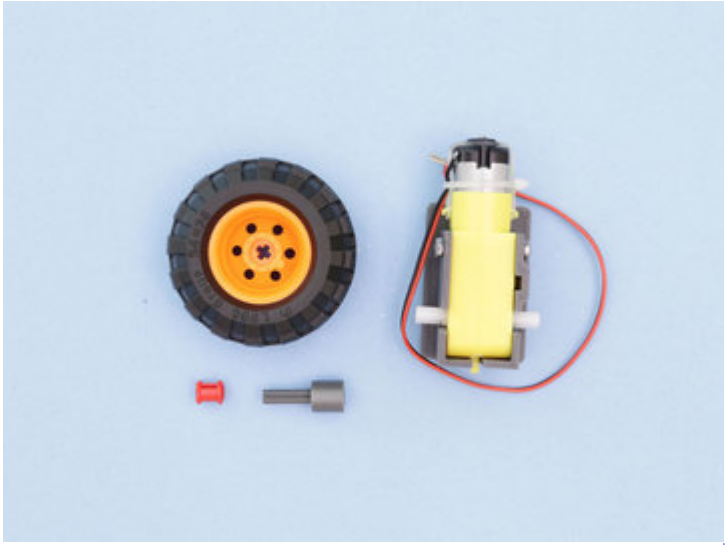
Install Motor Mount

Orient the motor and the motor mount so the features line up. The shaft and mounting tabs should line up with the cutouts in the mount. Insert the motor into the mount carefully. Press the two together until the motor is fully seated. Insert and fasten the screws through the motor body and motor mount. Use the hexnuts to secure the motor by tightening.



Wheel Subassembly

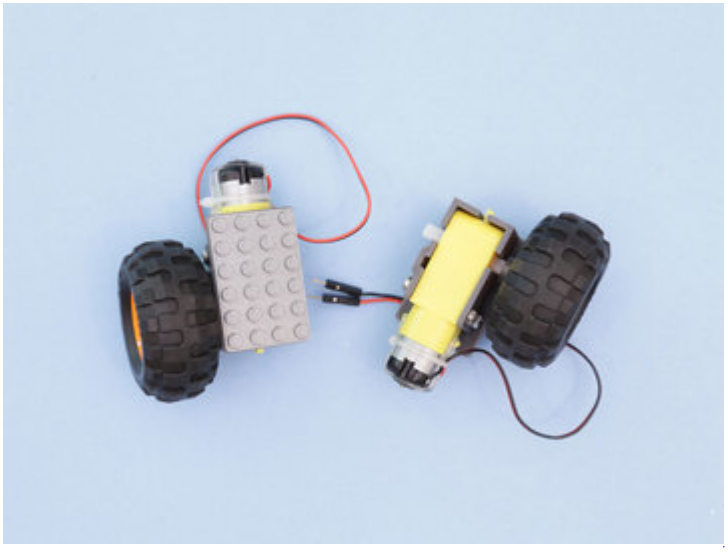
We'll use a few LEGO parts to create our wheel sub-assembly. Here I'm using a LEGO rim / tire thats 56x26mm. We also have a motor cross axle

- 

LEGO adapter and an extra axle connector.

Install Wheel to Motor

Insert the motor axle LEGO adapter through the center of the LEGO rim. Press to fully seat the wheel. Press fit an extra axle connector for secure placement. Line up the hub end of the motor axle adapter with the shaft of the motor. Then, press the motor axle adapter into the shaft of the motor until it's fully seated. Rotate the tire to test out the connectivity.

- 

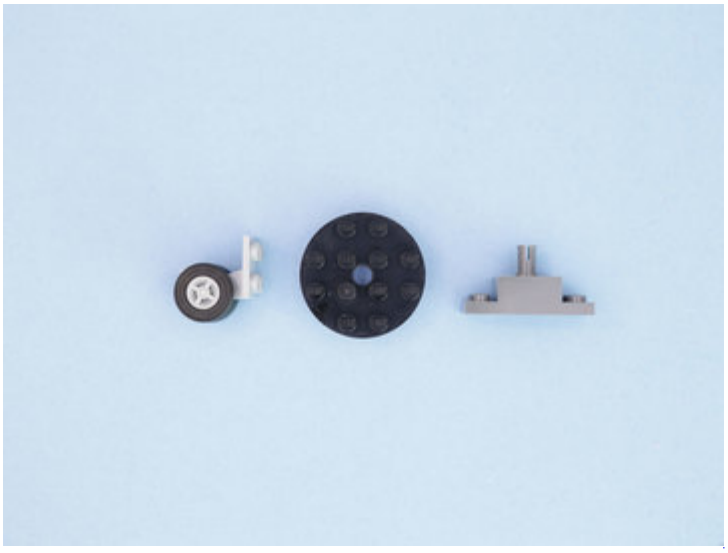
Motor Wheel Assemblies

Test out the fitting and ensure everything has been fully pressed and connected together. Note the orientation of the wheels. It doesn't matter which side they go, so you can flip them if needed. The motor mounts are not mirrored because the movement would be inverted when programming.

- 

Install Wheels

Now we can attach the motor mounts to the base plate. You can choose where you think well work best in your project. The orientation can be in either direction, so there's no wrong way to put it! However, you will have to counter balance it using a caster wheel. We'll go over that next.

- 

LEGO Cast Wheel

There's lots of different ways to build a caster wheel using lego pieces and this one isn't anything special. You'll need the following lego bits to create a swiveling wheel with double tires.

- Aeroplane Wheel Hub
- Circular brick with female connector in center
- 2x4 brick with male connector in center

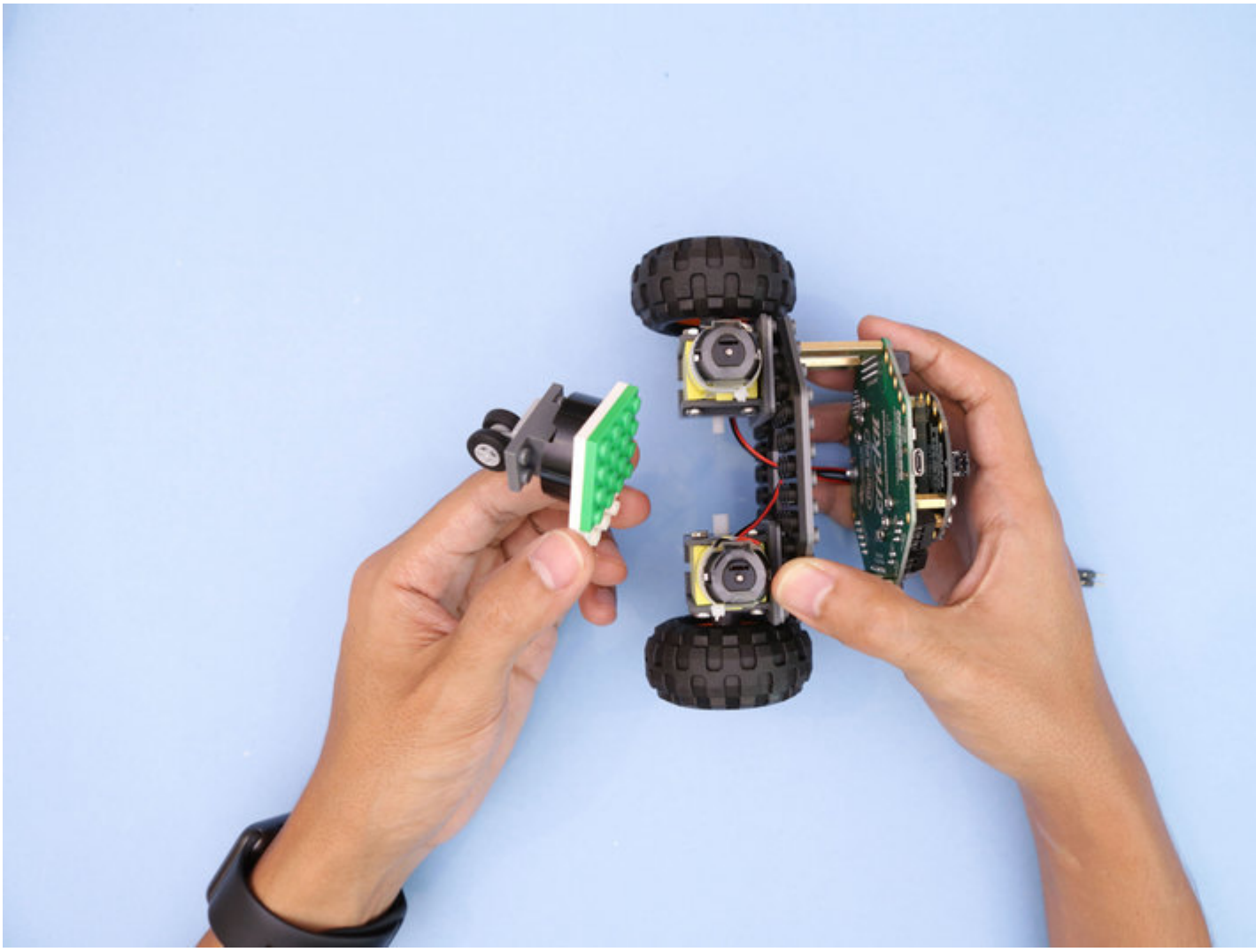
Caster Wheel Assembly

Snap the aeroplane wheel hub onto the bottom of the 2x4 brick with the male connector in the center. Fit the circular piece into the brick with the male connector. The

-  wheel hub should swivel and rotate freely.

Install Caster Wheel

Place the caster wheel assembly onto the bottom of the base plate. I put them near the front center of the plate to counter balance the motors. Experiment with different placements, depending on your bricks, you may need to wedge one or two more bricks to level out the rover.



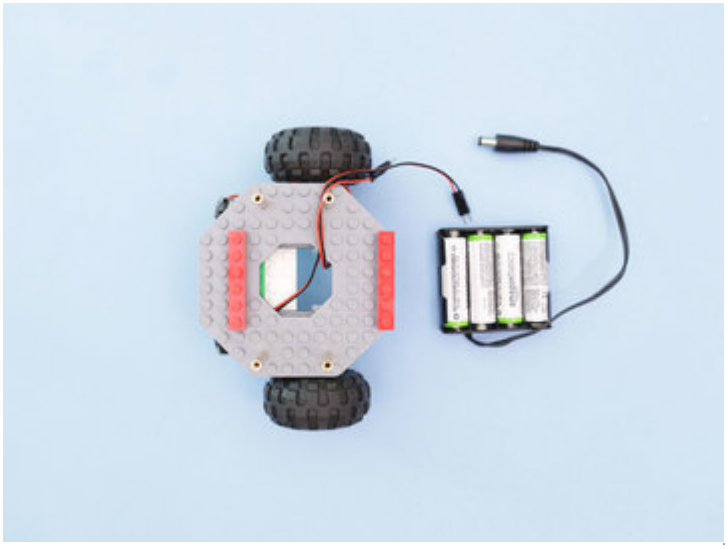
Prep for Battery

Next we'll need to sort out where the battery pack will go. In this project, we'll place in the between the CRICKIT and base plate. TO do that we'll need to temporarily remove the PCB from the stand offs. We'll fashion ourselves a holder for the battery pack out of LEGO bricks, naturally!

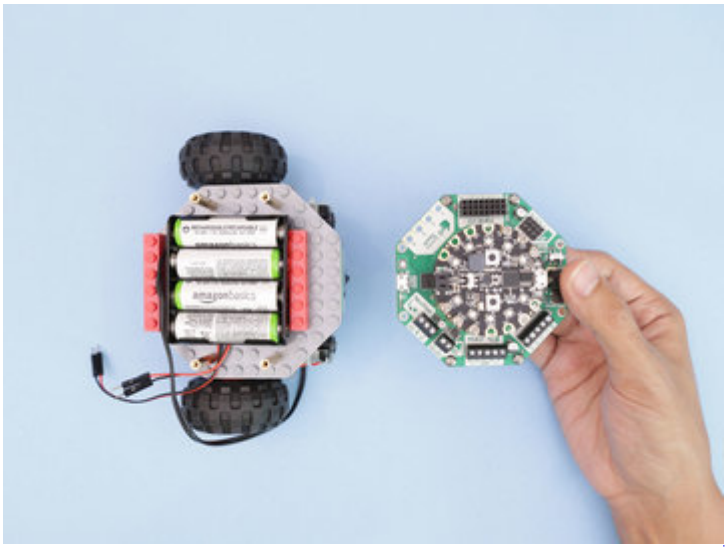
Install Battery

Battery Bricks

We need to fit the battery pack onto the rover somehow. I placed it in the center of the base plate. To keep it held in

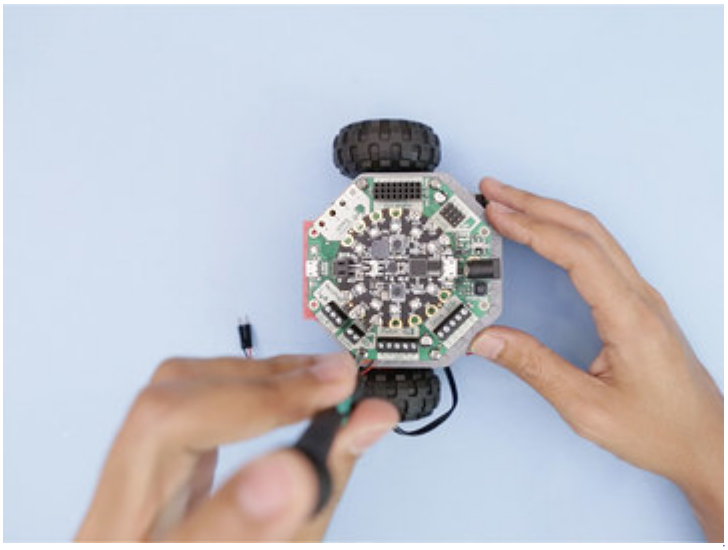
- 

  place, I used two 1x6 bricks to line the edges of the battery pack. This way it has less room to rock around. Use as many bricks as you'd like.

- 

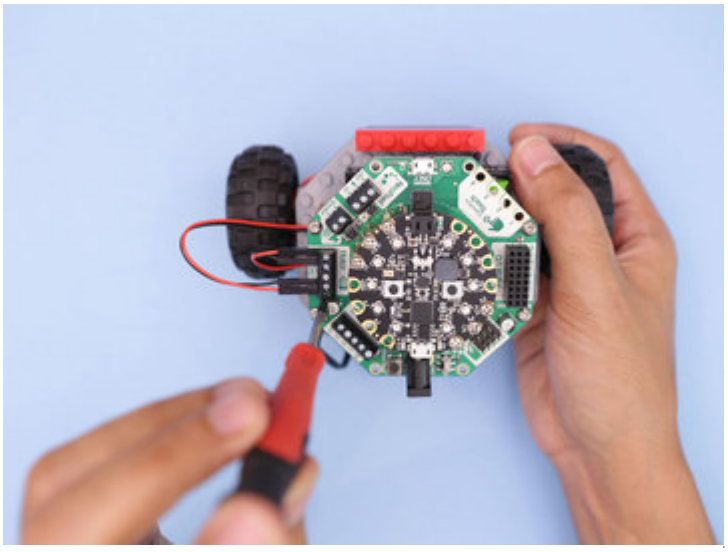
  ## Secure Battery

  If bricks aren't enough, try double sided foam tape or mounting tack. Next we need to secure the CRICKIT back onto the base plate. Before we do, it's a good idea to note wheel positions and best wire placement. We need the wires to reach, so plan out where the need to be.

- 

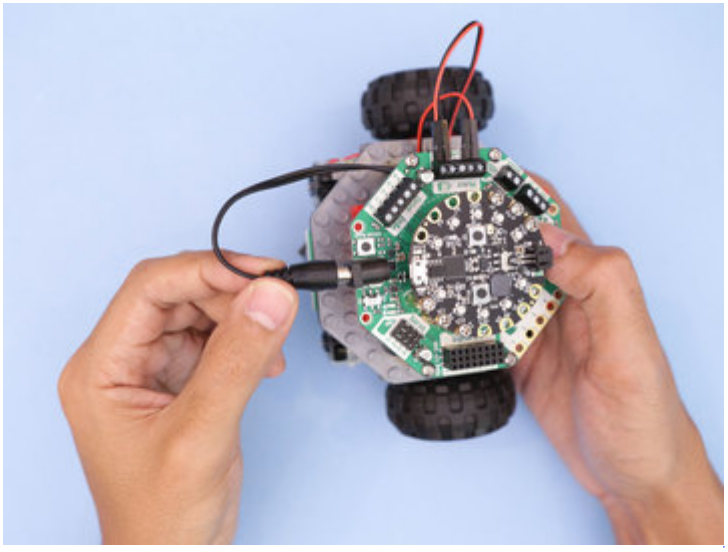
  ## Secure Crickit

  Place the Crick PCB over the battery pack. Line up the mounting holes with the standoffs and orient the PCB to your preference. While holding in place, insert and fasten M3 screws to secure the PCB to the standoffs.

- 

Connect Motor Wires

Insert the jumper wires from the motors into the screw terminal blocks. The CRICKIT has the motors labeled on the PCB. Reference the photo for correct polarity. If you find the wires lengthly, try wrapping them or routing them around the battery pack and or standoffs.

- 

DC Power Connect

Now it's time to plug in the battery into the DC barrel jack. Make sure the power switch on the CRICKIT is set to off! You don't want the rover falling off the table.

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Battery Installed

The battery pack should be fairly sturdy in between the base plate and CRICKIT PCB. There's extra room of more wires and perhaps other modules and components. The bottom of the Crickit PCB has sharp points that could potentially scratch or puncture, so be aware and cautious.

Servo Assembly

Glue Servo Mount Parts

The servo mount is separated into two pieces in order to 3D print without support material. These two parts need to be glued together. The bottom surface should be flat and even. Join them together with CA glue and allow time to fully cure and set.

Install Servo

The body of the micro servo can be inserted into the servo box with the wiring fitting through the slit on the side. The servo box should be able to attached on top of LEGO bricks. Experiment with different placements, gears and mechanisms! PLug in the cable from the servo to one of the available headers in the SERVO section of the CRICKIT board.