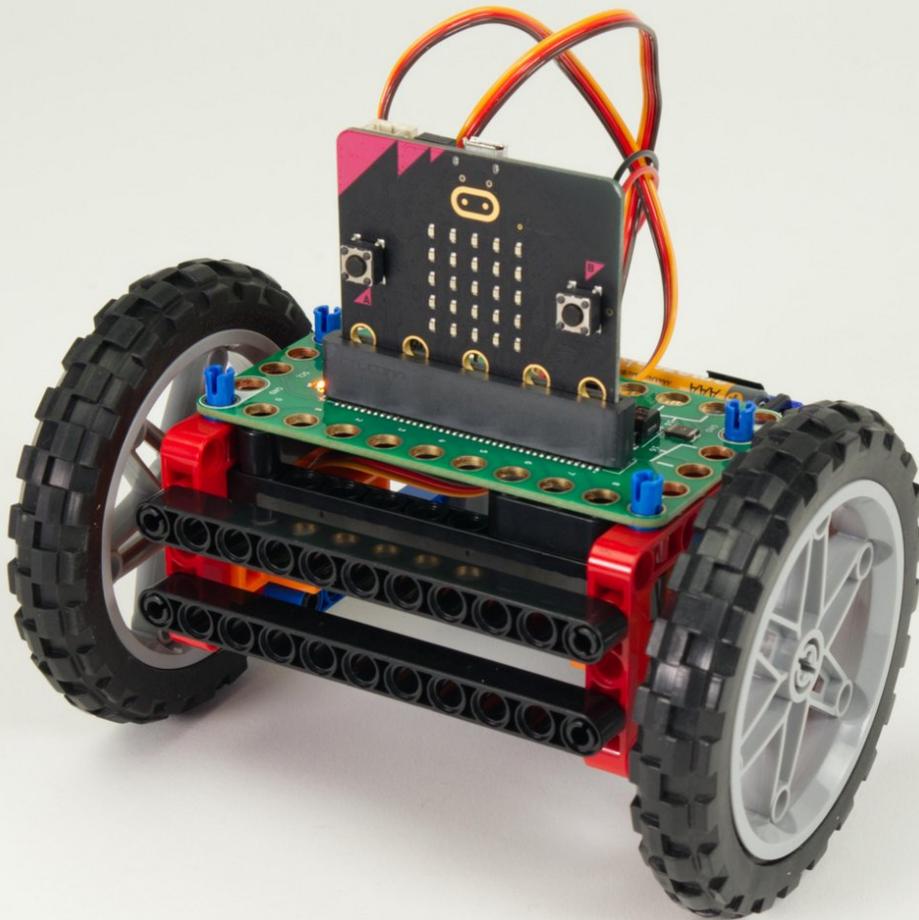




# Rover Main Body

Use LEGO Technic components along with our Bit Board, a micro:bit, and two servos to build and program a rolling rover.

Written By: Pete Prodoehl



## INTRODUCTION

Let's build a Rover! This project uses a set of LEGO Technic components along with our Bit Board, a micro:bit, and two servos to build and program a rolling Rover.

Once you have your Rover built other guides will show you how to extend the programming and add accessories and capabilities to the Rover.



### TOOLS:

- [Computer](#) (1)



### PARTS:

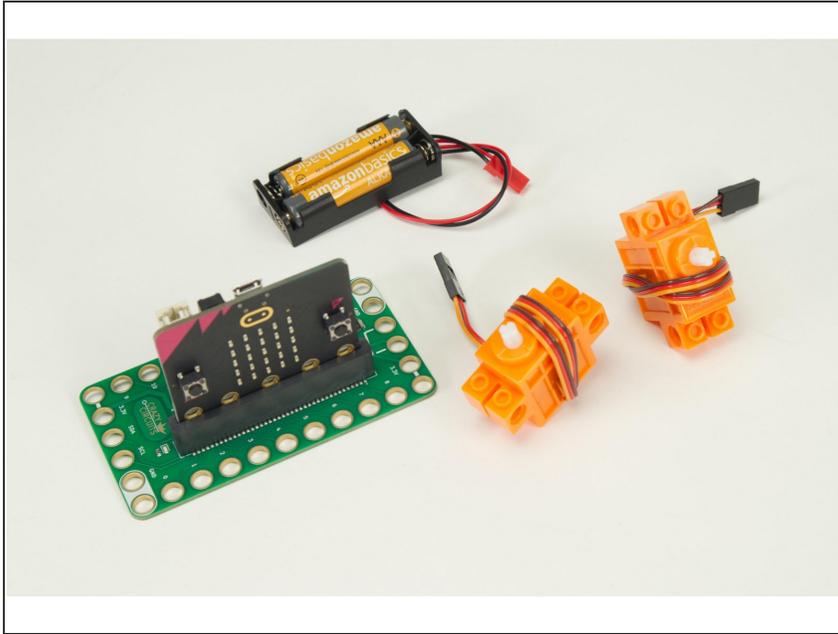
- [Bit Board Rover Kit](#) (1)
- [micro:bit](#) (1)

## Step 1 — Gather LEGO Components



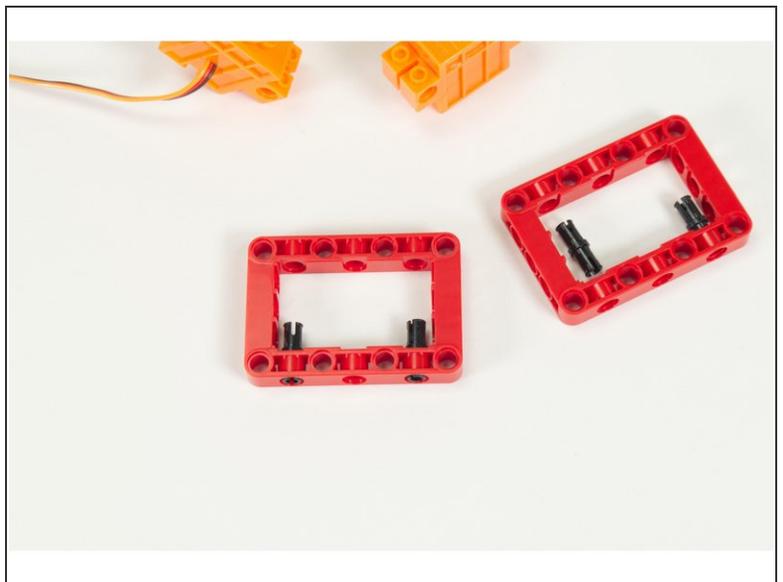
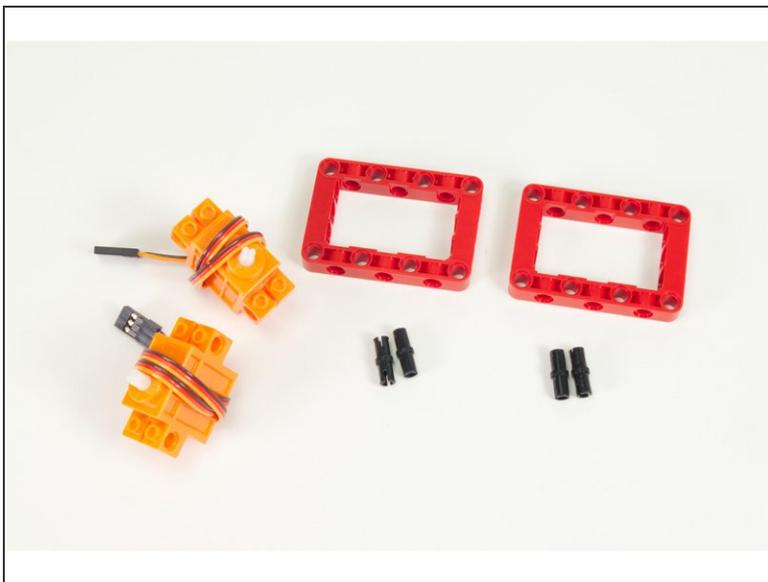
- Gather the parts needed to assemble the rover.
- Besides the beams, pins, frames, and other pieces there are two large wheels, and one 3D printed part.
- The battery pack holder is a Technic-compatible 3D printed part that we'll use to hold the rover's battery pack.

## Step 2 — Gather Electronic Components



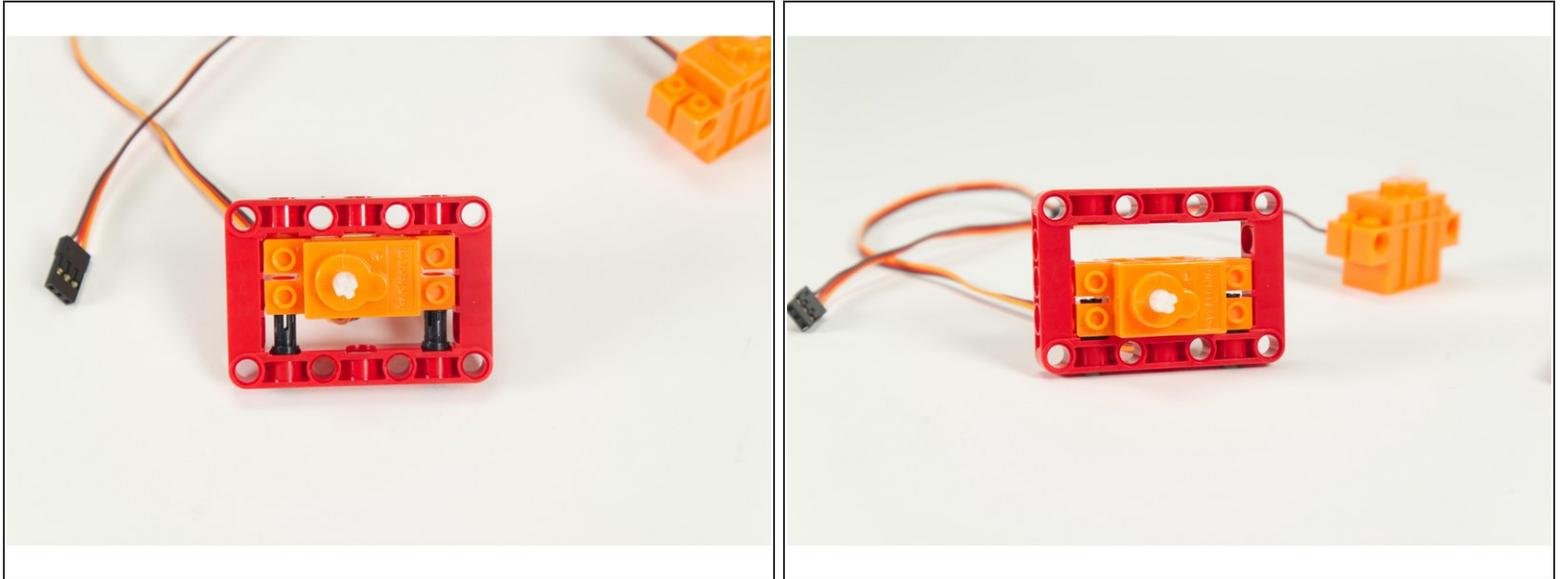
- You'll also need a Bit Board and micro:bit, along with two Brick Compatible Continuous Rotation 360 Degree Servos, and a Battery Pack.

## Step 3 — Prepare Servos



- We'll start by attaching the servos to frame pieces using pins.
- Each assembly will need one servo, one frame, and two pins.
- Insert the pins on the inside of the frame as shown.

## Step 4 — Attach Servos to Frames



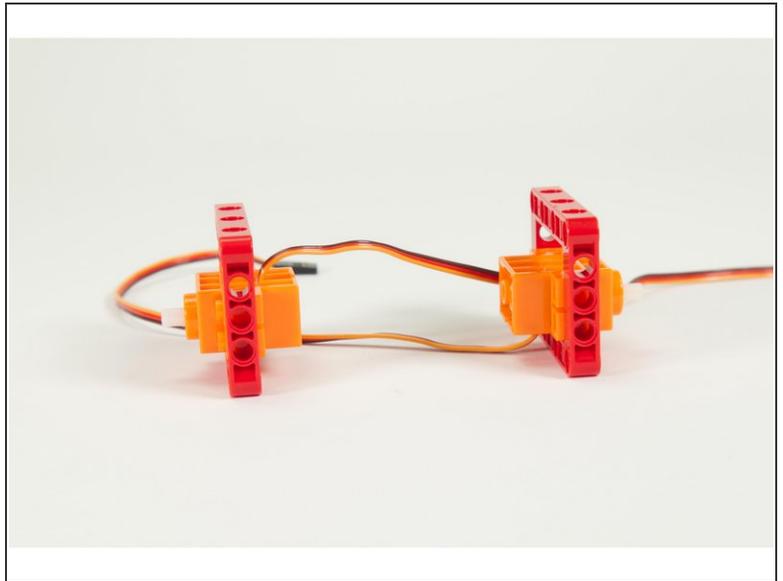
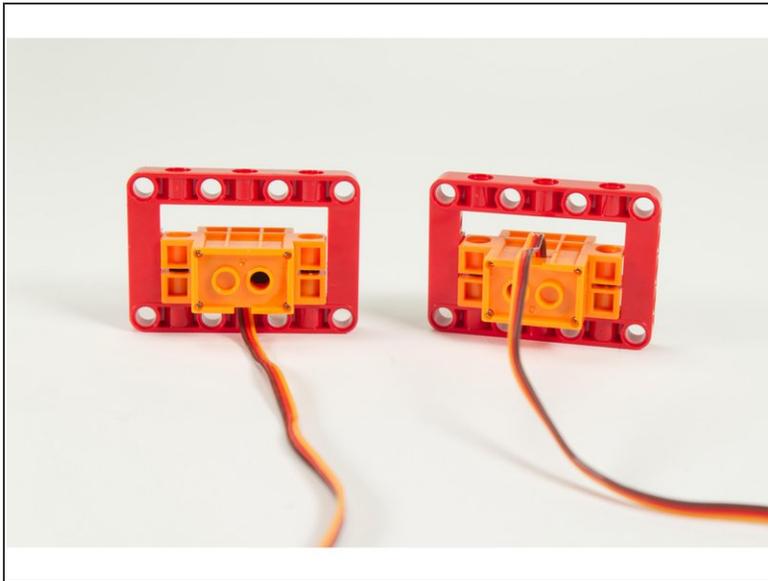
- Slide the servo inside the frame and press it down onto the pins.
- ⓘ Note: For the second servo you'll need to flip it over so the it mirrors the orientation of the first one.

## Step 5 — Check Servo Orientation



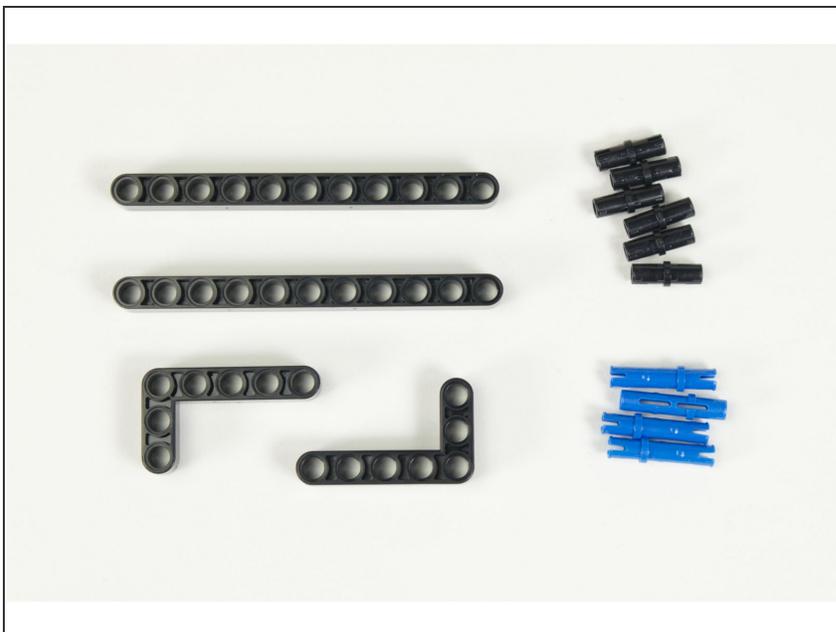
- Your servos should look like this.
- Notice the placement of the shafts on each assembly.

## Step 6 — Check Servo Alignment



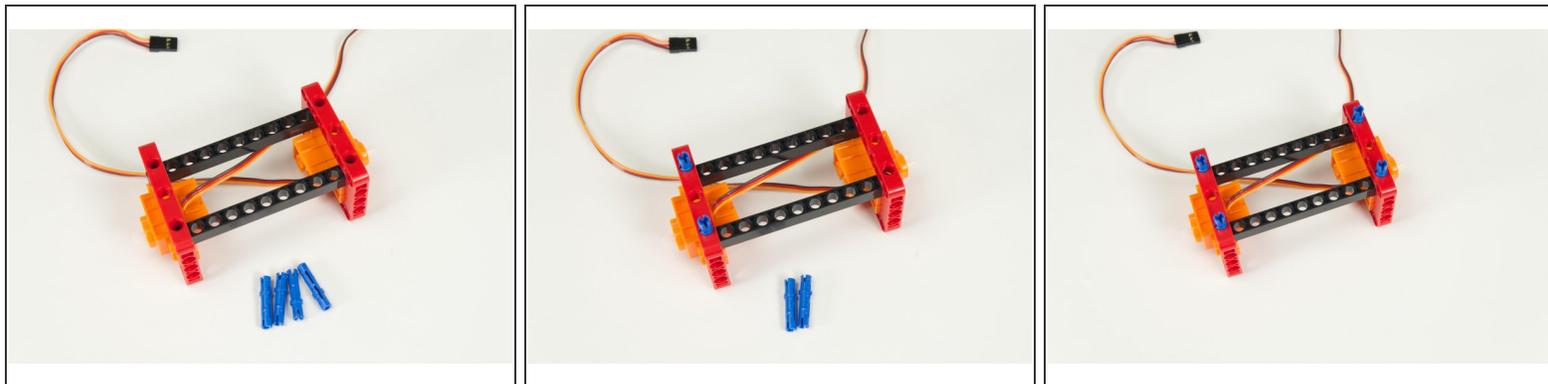
- If you turn them around to view from the back you'll notice how one set of wires is on top and one set is on the bottom.
- ⓘ If they don't match this configuration make the needed changes before moving on.

## Step 7 — Prepare Frame Stabilizers



- We'll use two long beams to connect the servos together into a frame, and then two L-shaped beams to stabilize the frame a bit more.

## Step 8 — Add Stabilizer Beams



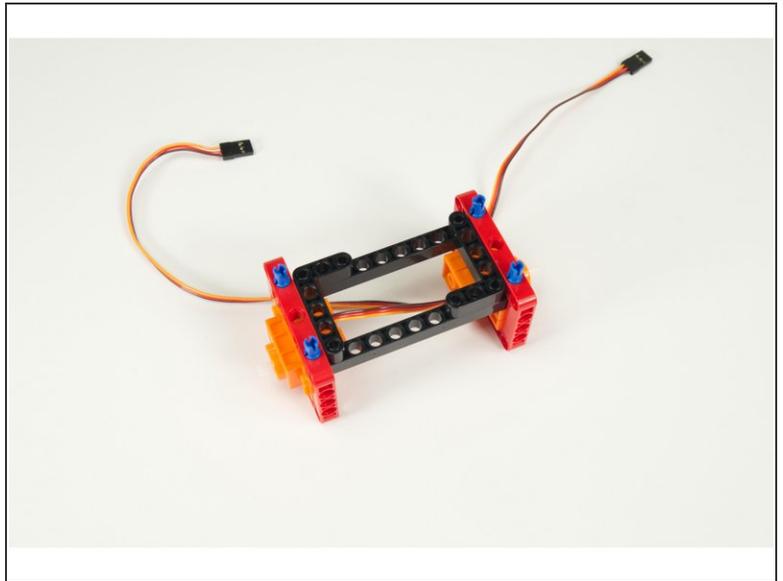
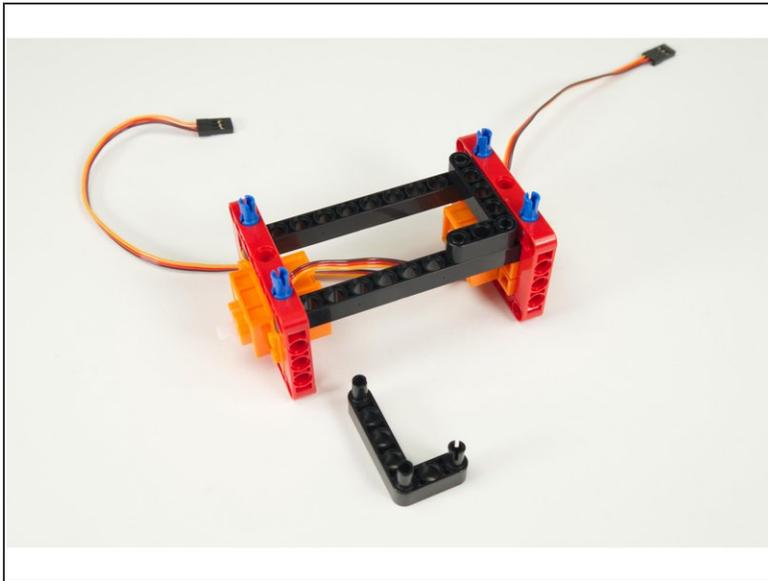
- Slide the long beams in place inside the frame on top of the servos.
- Use the long pins to hold the beams into place.
- Note: The long pins should go in 2/3rds of the way, so make sure you have the orientation correct. (1/3rd should stick out the top.)

## Step 9 — Prepare L-Shaped Beams



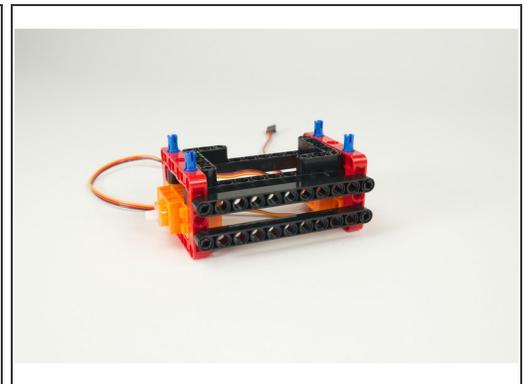
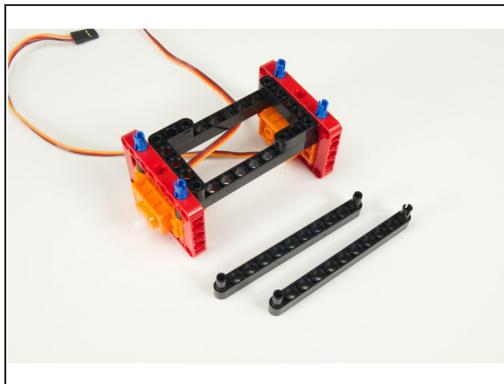
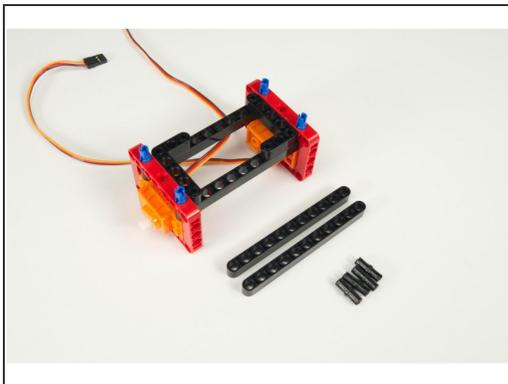
- Place pins at the ends and the corner of the two L-shaped beams as shown.

## Step 10 — Add L-Shaped Beams



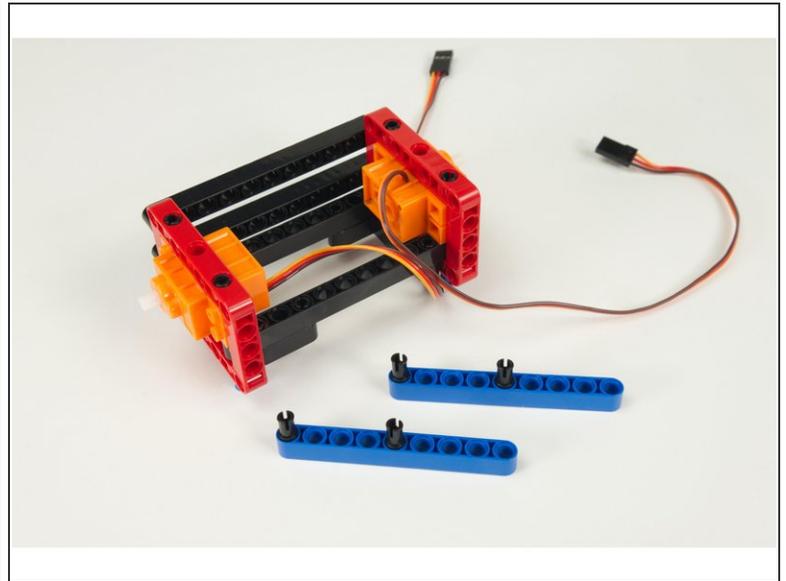
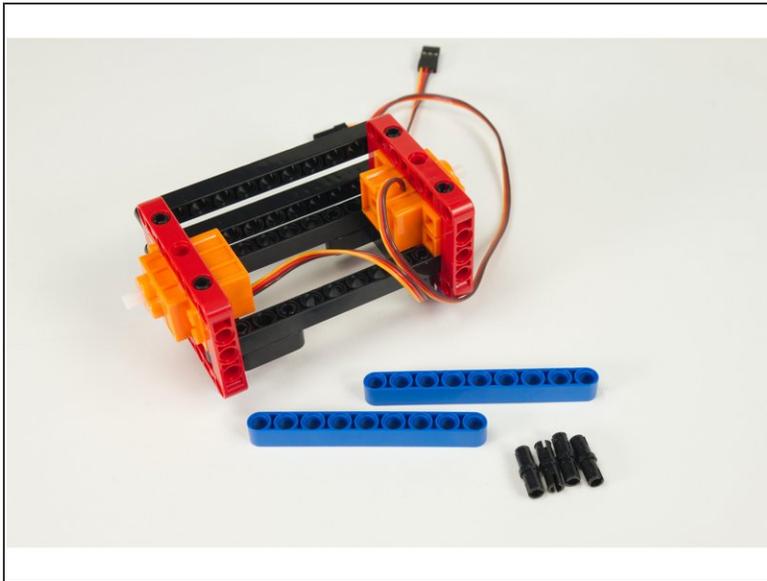
- Press the L-shaped beams into place.
- These will help keep the frame squared up so it doesn't wobble in the X & Y axes.

## Step 11 — Attach Front Beams



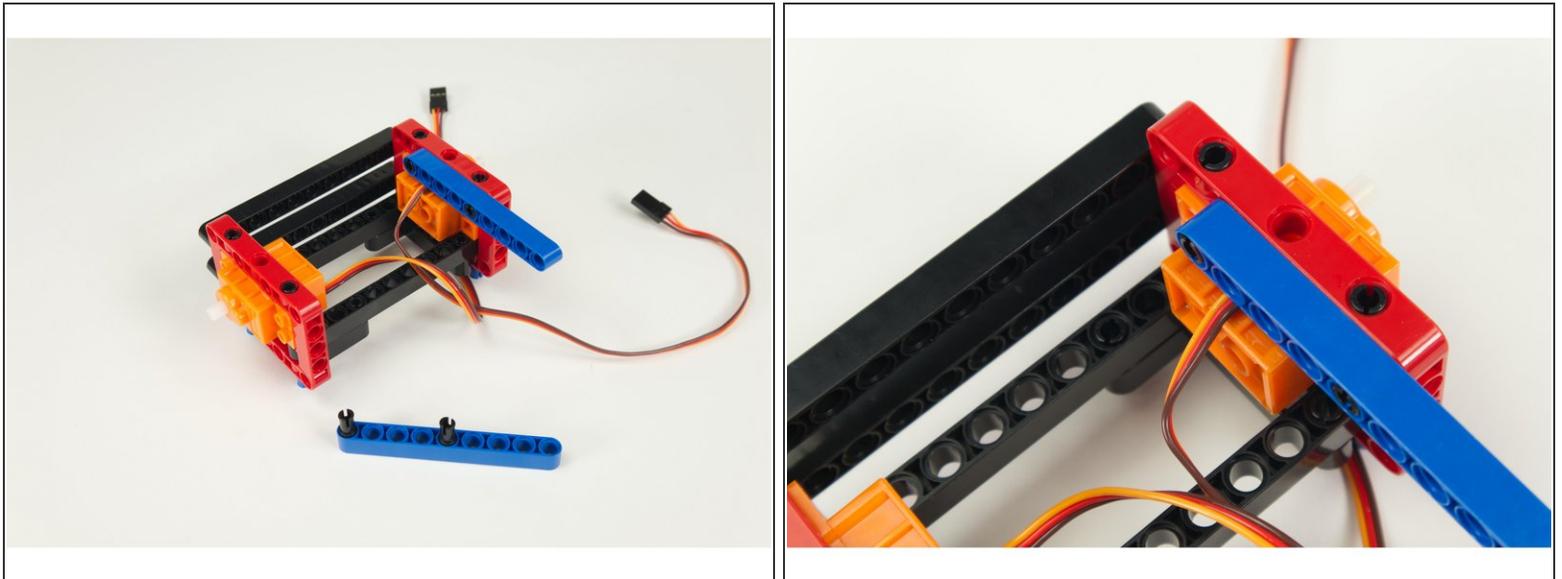
- We've got two more long beams to add. These will go on the front.
- Add two pins to each beam and attach them as shown.
- ⓘ These beams will be used as connection points later on when we add accessories to our rover.

## Step 12 — Prepare Rear Stabilizer Beams



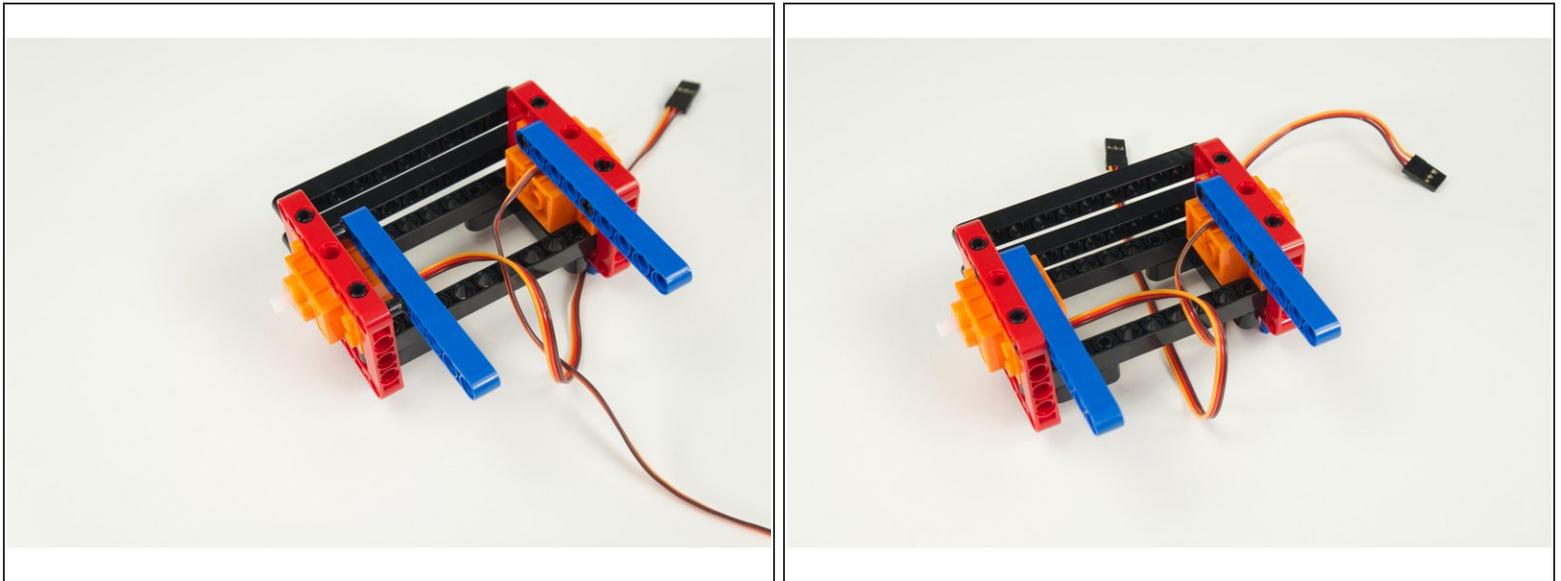
- Now that we've got the main frame assembled, and the front beams in place, let's turn the rover **around and upside down** to work on the back side.
- Place pins into the first and fifth holes of the two beams.

## Step 13 — Add First Rear Stabilizer Beam



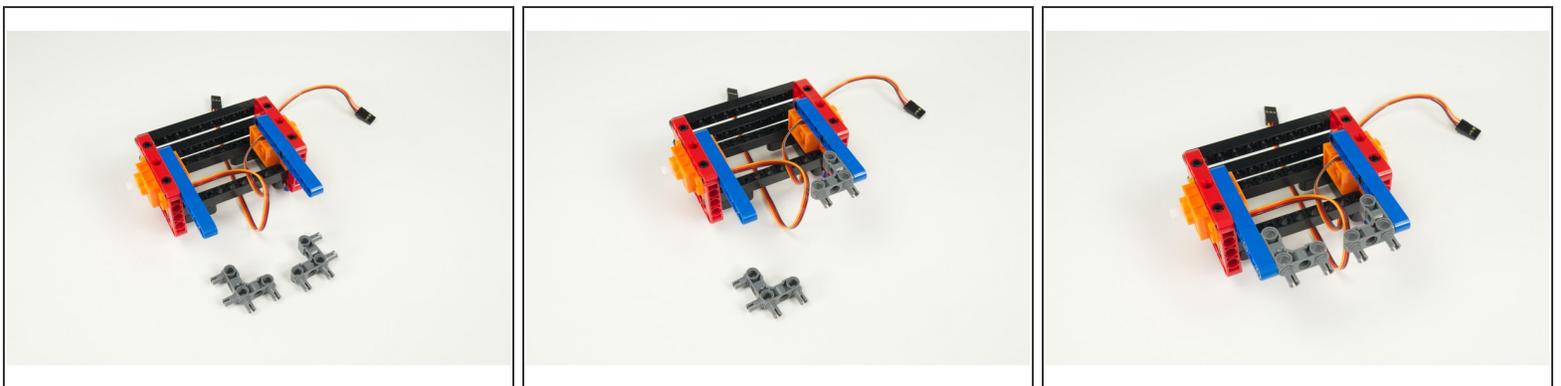
- Press one of the beams into place on the inside of the frame as shown.
- ⓘ Make sure to lay the servo wire flat against the body of the servo and into the groove for the wire before attaching the blue beam.
- ☒ Remember, we're now working on the rover upside down. Don't worry, we'll flip it back to *right side* up soon.

## Step 14 — Add Second Rear Stabilizer Beam



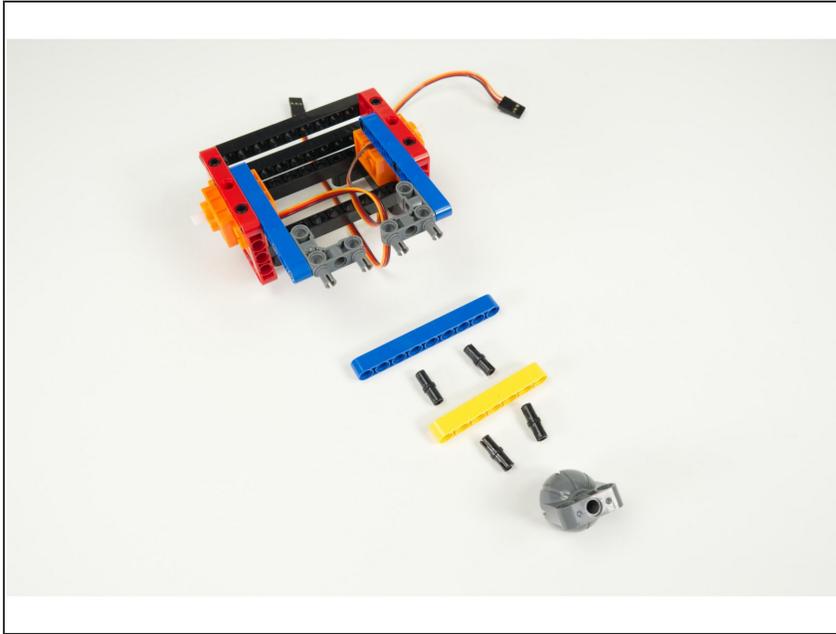
- Add the second beam, pressing it into place opposite the previously added beam.
- Once both beams are snapped securely into place we can move on to the next step!

## Step 15 — Add 90 Degree Connectors



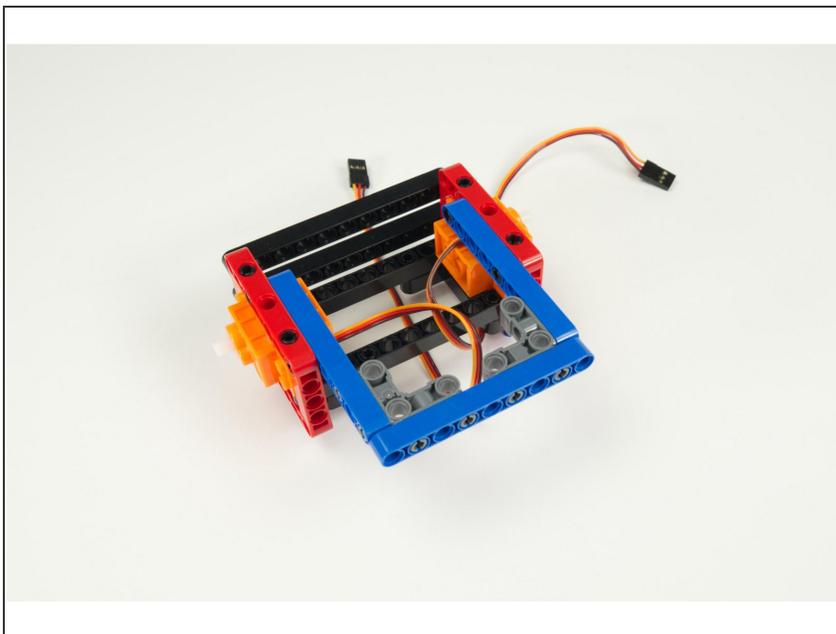
- Add the two 90 degree connectors to the rear stabilizer beams as shown so the pins are facing outwards.

## Step 16 — Prepare Rear Caster Wheel Assembly



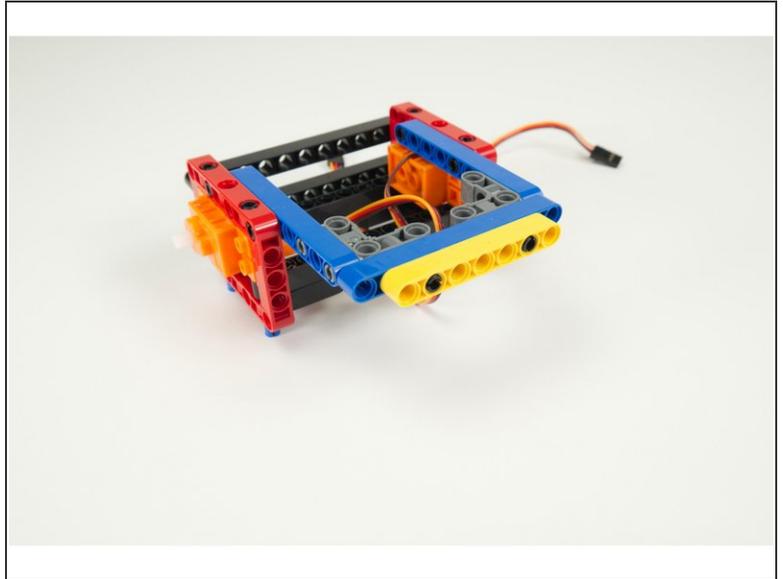
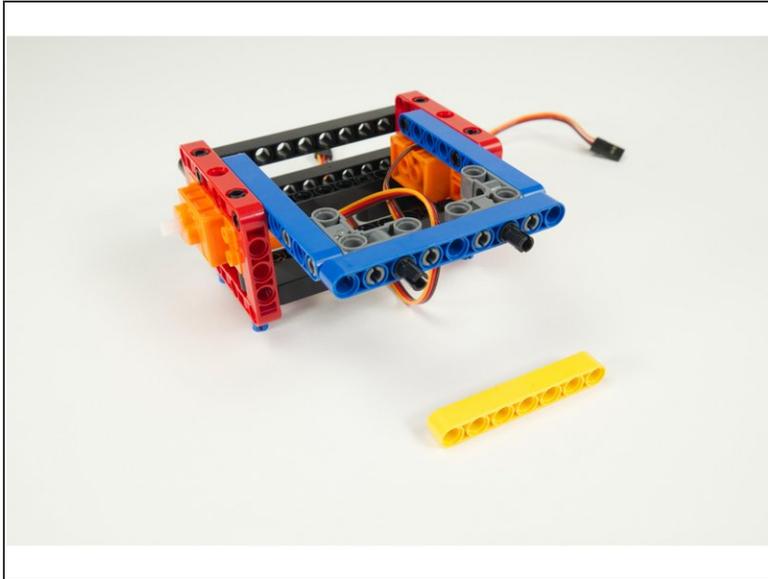
- There are two more beams to attach, each using two pins, and then we can add the caster wheel to the back of the rover.

## Step 17 — Add Third Rear Stabilizer Beam



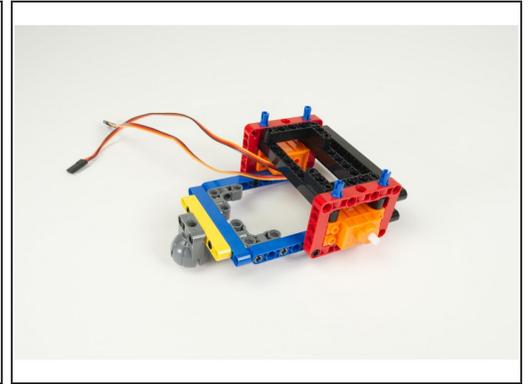
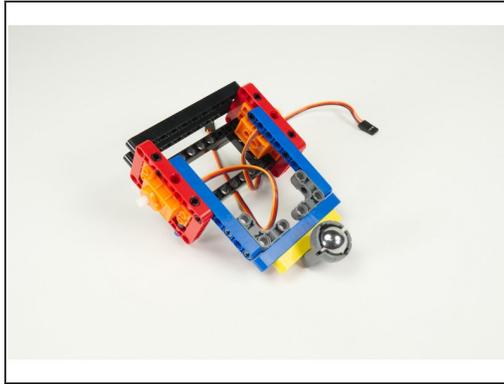
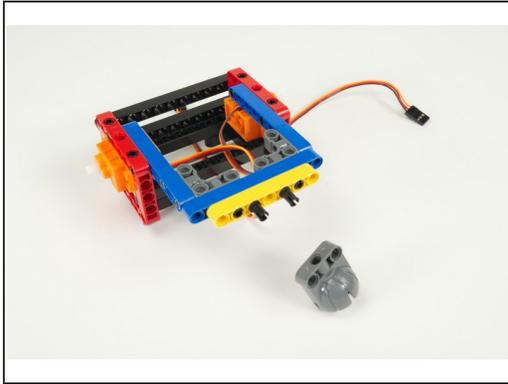
- Add the third beam to the 90 degree connectors by pressing it into place on the exposed pins.

## Step 18 — Add Forth Rear Stabilizer Beam



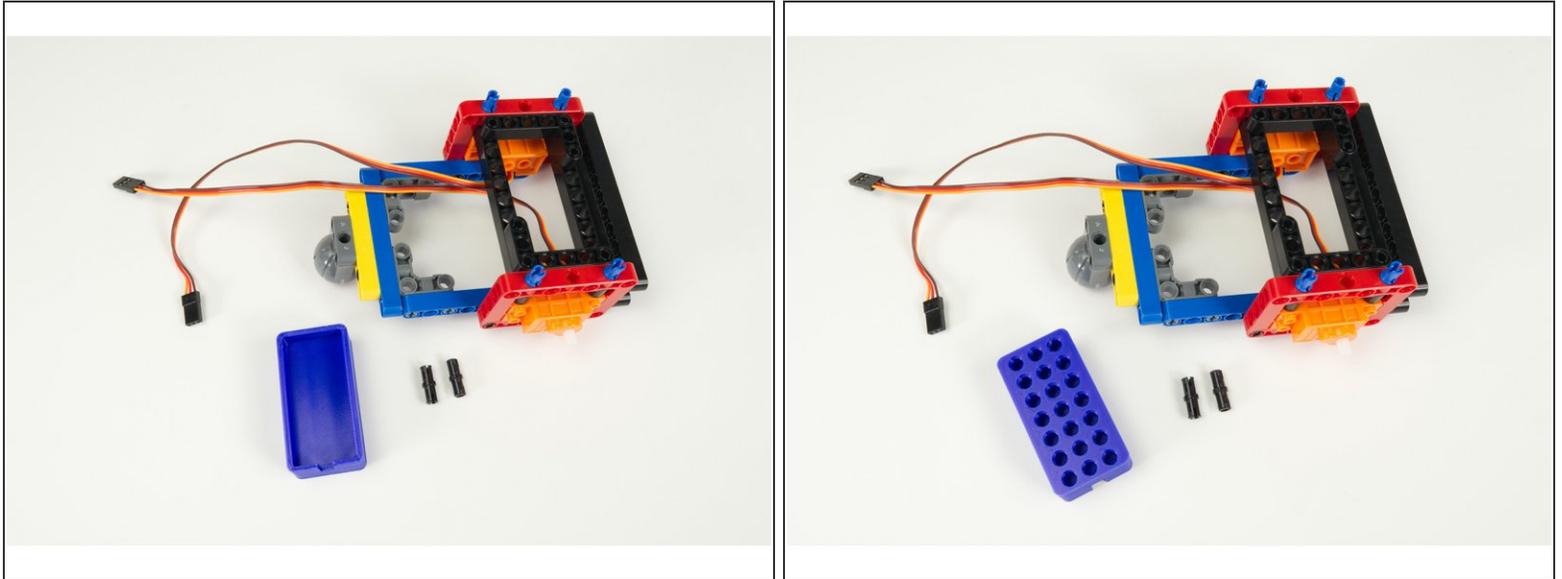
- Place two pins into the beam we just added, in the third hole from each end.
- After adding the pins you can attach the final rear beam.

## Step 19 — Add Caster Wheel



- Add two pins onto the shorter beam, in the third hole from each end.
- Press the castor wheel into place.
- ☑ Remember to add the castor wheel **upside down** since our rover is currently upside down.
- Once the wheel is attached the rover should tip down due to the weight of the steel ball.
- Now is a good time to flip the rover over so it's right side up.

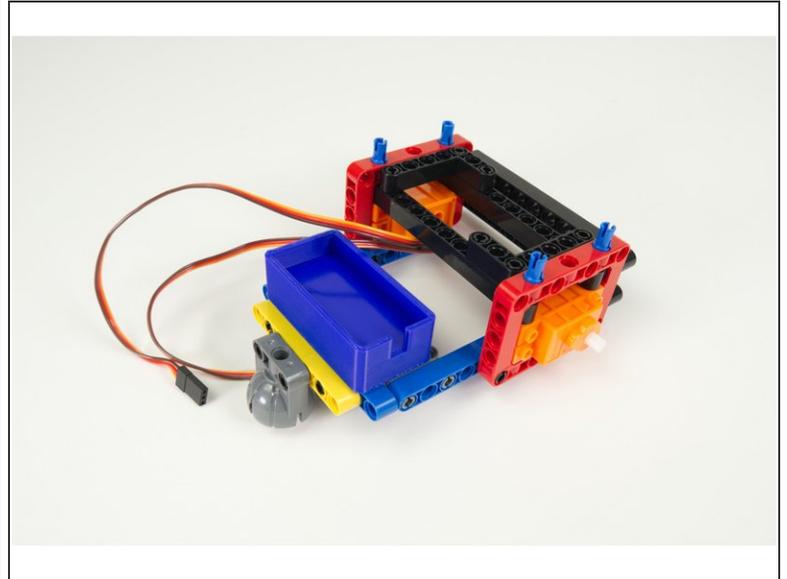
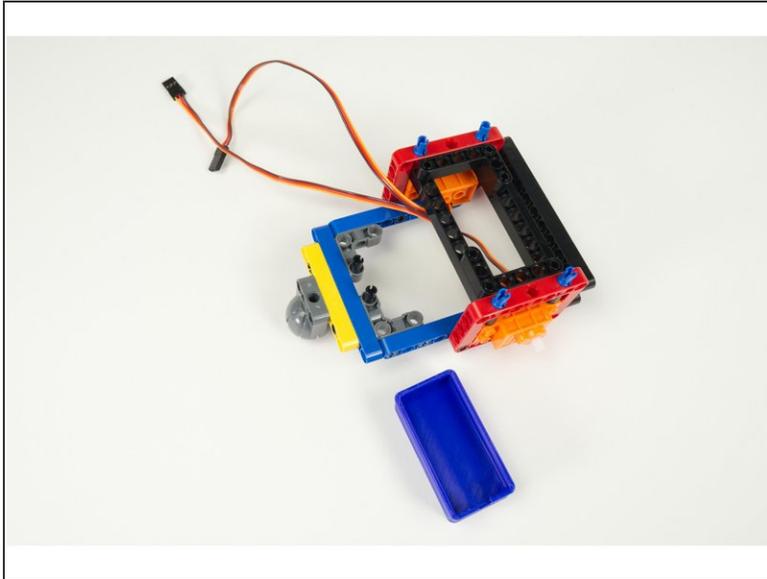
## Step 20 — Prepare Battery Holder



**⚠ Note:** The Battery Pack has been upgraded to use two AA batteries so it will look slightly different than the one shown in these photos.

- Next up we'll add the battery holder. (This is the 3D printed part.)
- You'll need two pins to attach the battery holder.
- ⓘ If you are building the Rover from our kit the Black Battery Holder will probably already be permanently attached to the blue printed battery holder.

## Step 21 — Add Battery Holder



- Place two pins into the 90 degree connectors, facing upwards.
- Add the battery holder by pressing it down onto the pins as shown.

## Step 22 — Add Wheels



- Our rover still doesn't look very Rover-ish... because it needs wheels!
- You can add the wheels now. They just press fit onto the servo shafts.
- Now it's looking more like a rover.

## Step 23 — Prepare Electronics



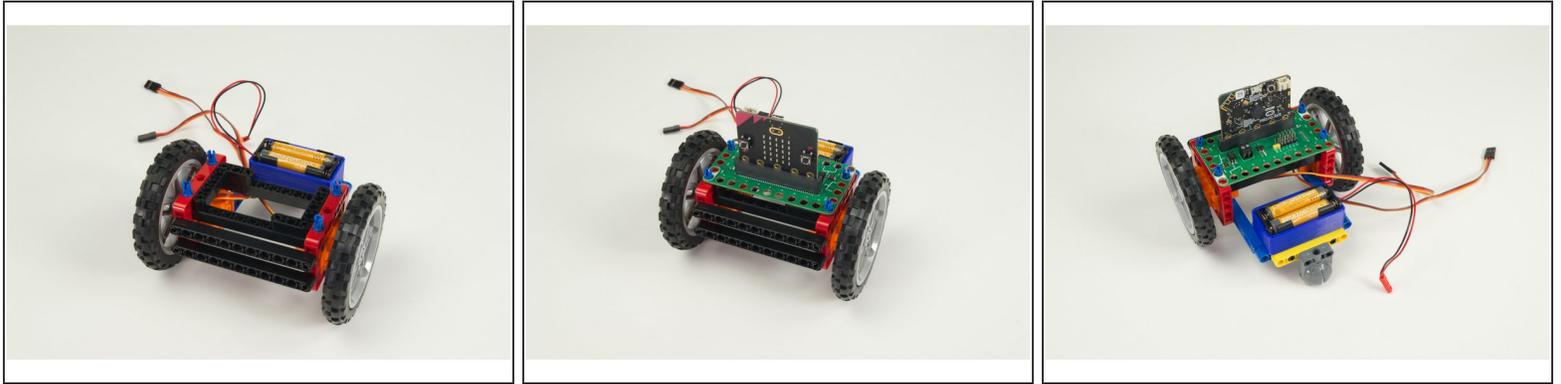
- Now that we've got the rover built we can add in the electronics to make it go.
- If you haven't already, place the micro:bit into the Bit Board (in the proper orientation) and grab a Battery Pack.

## Step 24 — Add Battery Pack



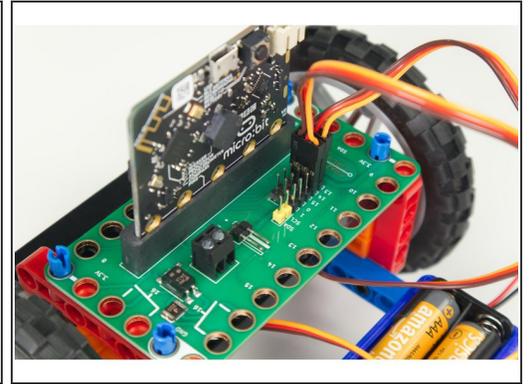
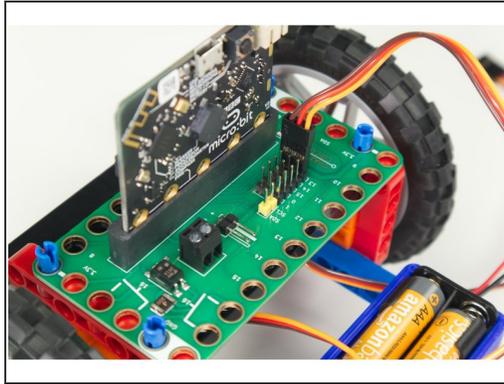
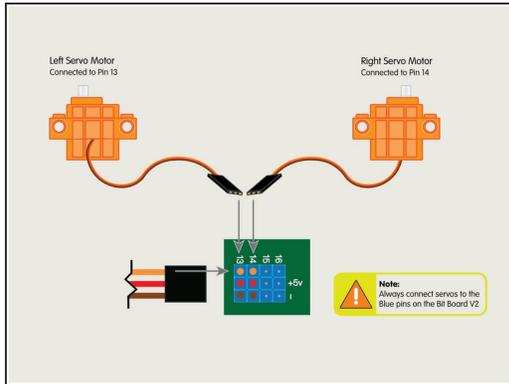
- We'll start with the battery pack. It fits into the 3D printed battery pack holder we added to the back of the rover.
  - ⓘ If you purchased a kit from us this step should already be done.
- Note the slot on one side of the battery pack holder where the wires go.

## Step 25 — Add Bit Board



- With the battery pack in place let's turn the rover around to the front so we can add the Bit Board.
- We've already got four pins sticking out of the top that we added in Step 8. The Bit Board will fit right onto those pins.
- Make sure the front of the Bit Board (and front of the micro:bit) are facing forward on the rover.
- Once the Bit Board is in place we can turn it around to the back so we can plug things in.

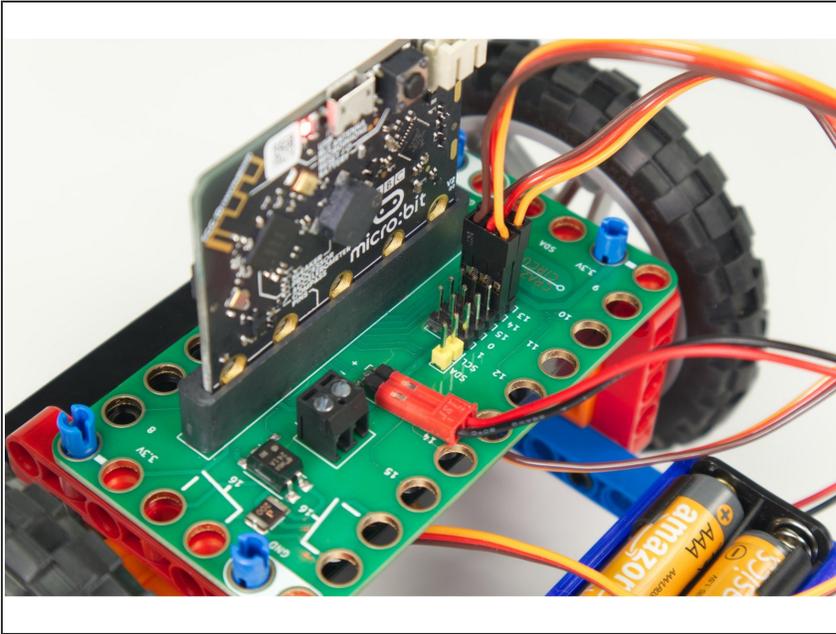
## Step 26 — Connect Servos



**Note:** Please refer to the illustration of the servo connections showing the Blue Pins on the Bit Board V2.

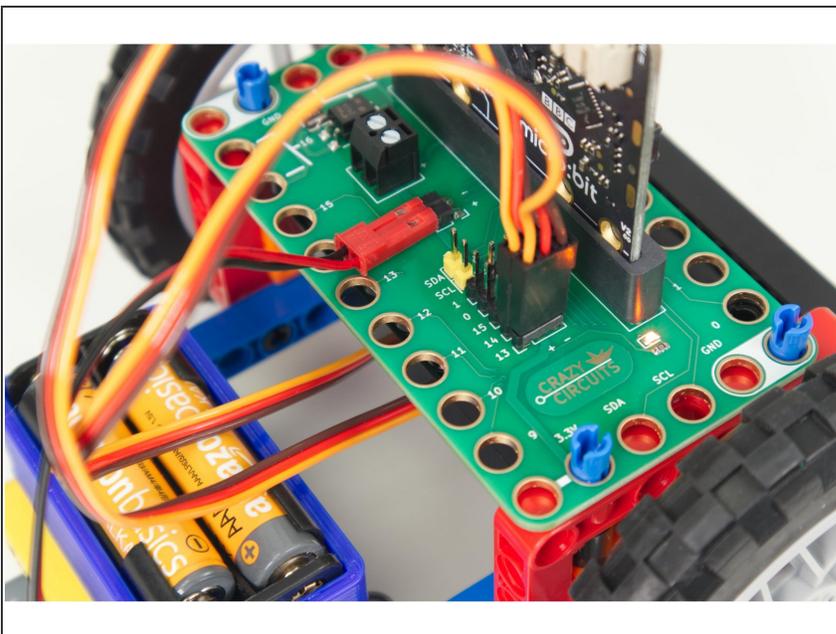
- i** The photos were taken with a Bit Board V1 during development and it lacks the Blue Pins. (We are in the process of updating the photos.)
- Plug the left servo connector into the row for **Pin 13**. The **orange** wire should go to the pin closest to the **13** on the board, the **red** wire goes into the **+5v** row, and the **brown** wire goes into the **-** row, which is ground.
- Plug the right servo into the row for **Pin 14**, matching the orientation of the servo connector for the left servo.
- i** Make note of **Pin 15**. We're not connecting anything to it now, but other guides will use **Pin 15** to connect a third servo for additional accessories.

## Step 27 — Connect Battery Pack



- The last connection is the battery pack. It connects to the Bit Board as shown to provide power to the micro:bit and the servos so your rover can move.
- ⓘ We recommend a fresh set of Alkaline batteries (not rechargeable) for maximum performance.

## Step 28 — Check Wiring



- Take a moment to double check your wiring.
- Are the servo connector oriented the right way? Hint: Make note of where the **orange wire** is.
- Is the battery pack plugged in properly? The **red wire** should align with the **+** symbol behind the connector pins.
- If everything looks good, keep going!

## Step 29 — Admire Rover!



- You've just built the Rover! Take a second to admire your work.
- The great thing about this rover is that it's easy to modify it, to add or remove parts, and experiment.
  - For instance, you could replace the caster wheel with a [Pen Holder](#) so the rover can draw while it rolls.
  - We've added another guide for a [Rover Gripper](#) you can attach and control, as well as a [Lifter](#) and [Sweeper](#).
  - We've got a distance sensor we can add to the front to make the rover avoid running into things.
  - You can add two sensors to make a line following robot.
- But first... Let's add some code so the rover can move.

## Step 30 — Load the Code

```

on start
  set speed to 50
  pause (ms) 3000

forever
  call goForward 2000
  call turnRight 1800
  call goBackward 2000
  call turnLeft 1800
  call stopMoving 4000

function goForward theDelay
  spin one way pin P13 (write only) with speed speed
  spin other way pin P14 (write only) with speed speed
  pause (ms) theDelay

function goBackward theDelay
  spin other way pin P13 (write only) with speed speed
  spin one way pin P14 (write only) with speed speed
  pause (ms) theDelay

function turnRight theDelay
  spin one way pin P13 (write only) with speed speed
  spin one way pin P14 (write only) with speed speed
  pause (ms) theDelay

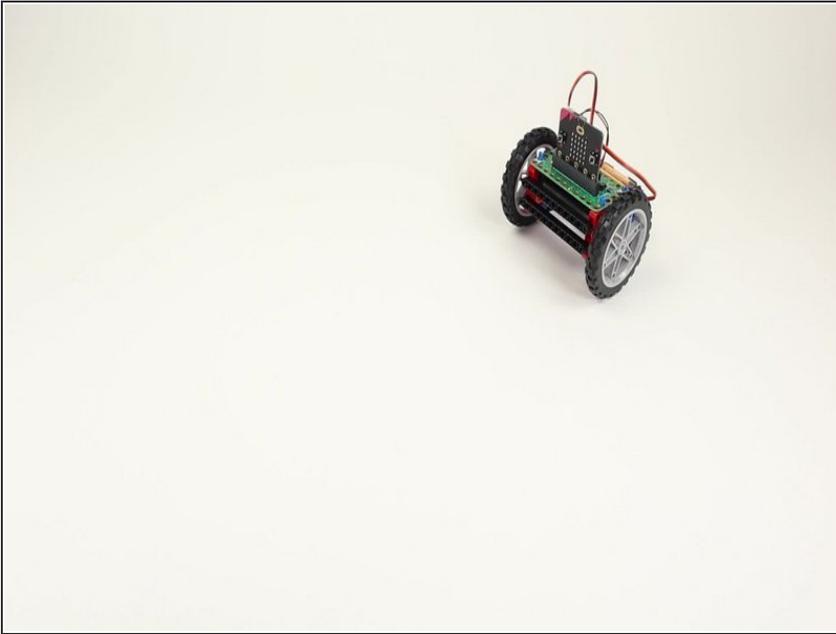
function turnLeft theDelay
  spin other way pin P13 (write only) with speed speed
  spin other way pin P14 (write only) with speed speed
  pause (ms) theDelay

function stopMoving theDelay
  turn off motor at pin P13
  turn off motor at pin P14
  pause (ms) theDelay
  
```

⚠ If you've never used a micro:bit before you'll want to check out this guide: [Bit Board V2 Setup and Use](#)

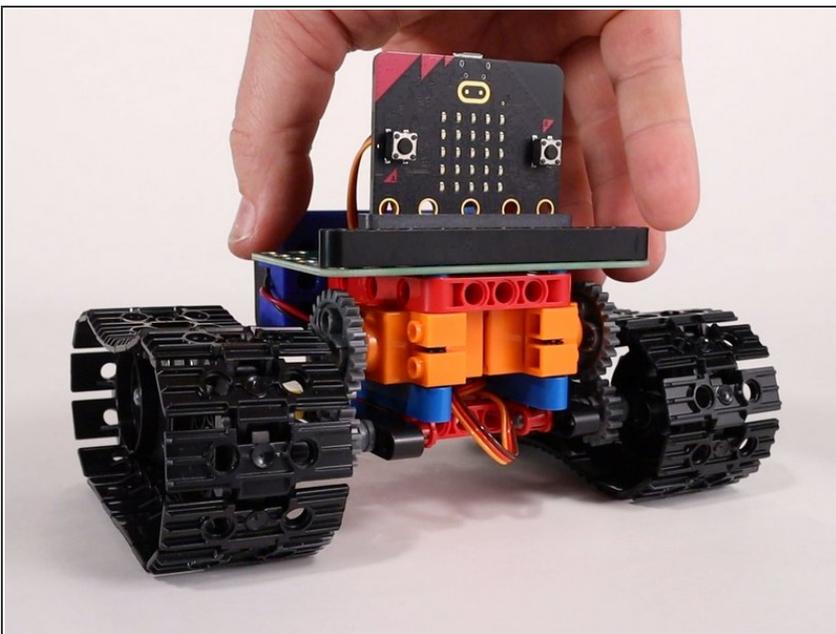
- We're going to load the following code for our **Rover Test Code** program:  
[https://makecode.microbit.org/\\_euKUdXXKq...](https://makecode.microbit.org/_euKUdXXKq...)
- This test code is very simple. Be aware that your rover will start moving three seconds after the code is loaded, so be ready for that!
- If you want to change that just edit the **pause** block in the **on start** section. (Note: 3000 milliseconds equals 3 seconds.)
- Another trick is to just pop the wheels off when you upload the code. :)

## Step 31 — Test it Out!



- With the code uploaded you should be ready to test it out!
- Use a large flat surface. The floor will work well, or a table - just be ready to catch the rover if it gets too close to the edge!
- Plug the battery into the Bit Board, wait three seconds, and your rover should move.
- If your rover moved properly (forward, turn right, backward, turn left, stop) then all is well and you're ready to extend your Rover by adding accessories, remote control, and other capabilities.

## Step 32 — Tip - Add a Beam



- ① If you find that the Bit Board rattles around a bit while the Rover is moving you can add a long black beam onto the blue pins to help secure it down.
- ① Here you can see how we've done this on our [Tank build](#).

