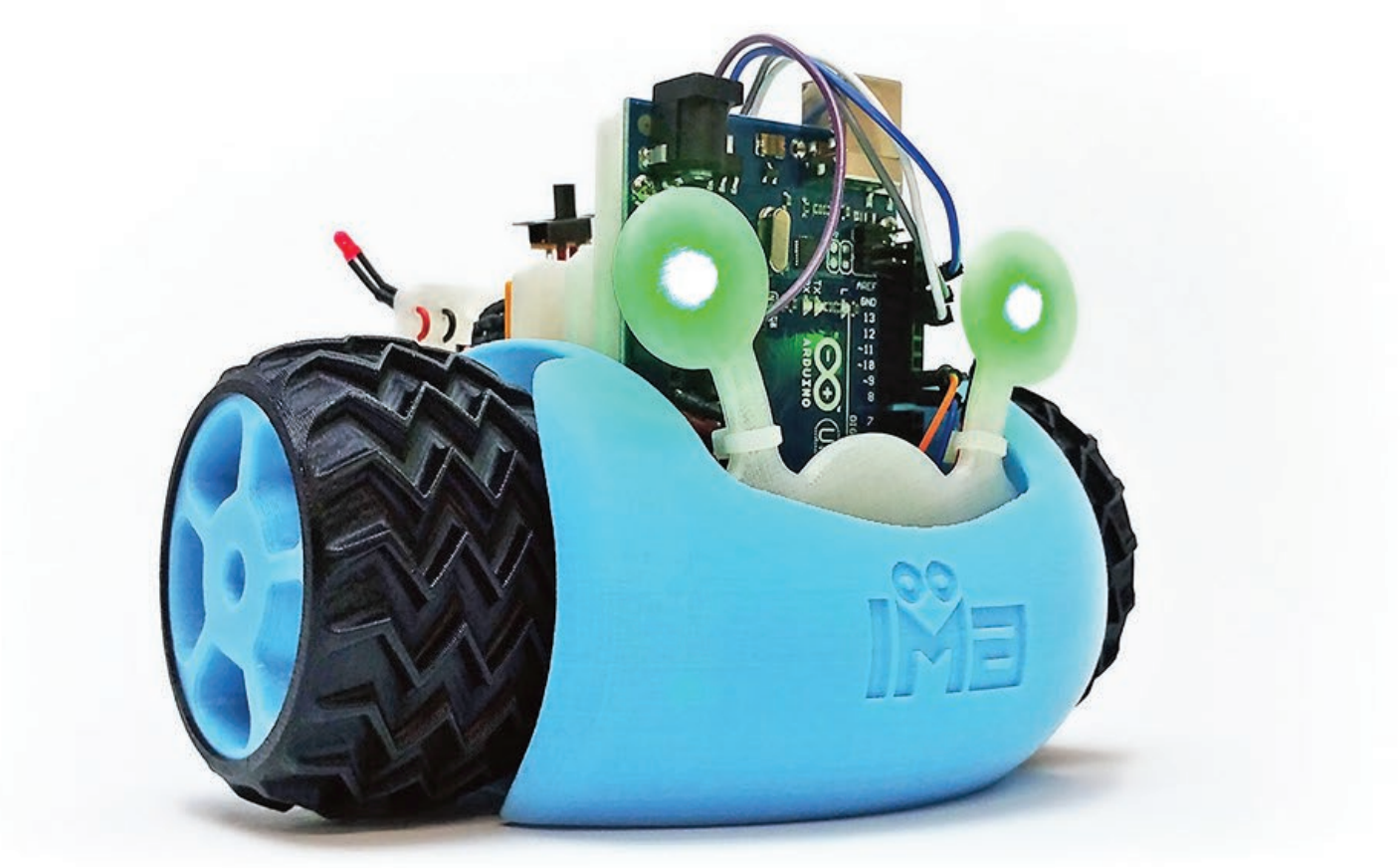
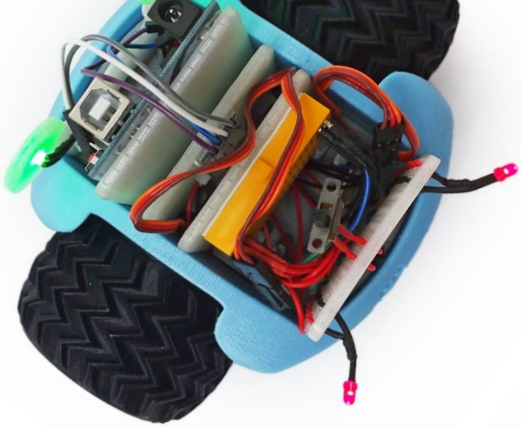


IME JUNO

ASSEMBLY INSTRUCTIONS

explorematking



INTRODUCTION:

IMAs are charismatic and fun vehicles:
I•ma, from 'I-Make', to explore 'I'm a...'

Meet IMA Juno!

Juno is fun, charismatic, and a great introduction to making! Unlike other robot projects, you don't need to have any prior experience with electronics or 3D printing to make Juno.

Follow Juno's step-by-step instructions and you will learn about basic wiring, LEDs, Servo motors, and introductory Arduino code. Juno's 3D printable parts are well designed and optimised for success on any desktop 3D printer. If you're looking for an in-depth 3D printing project, Juno is a great place to start!

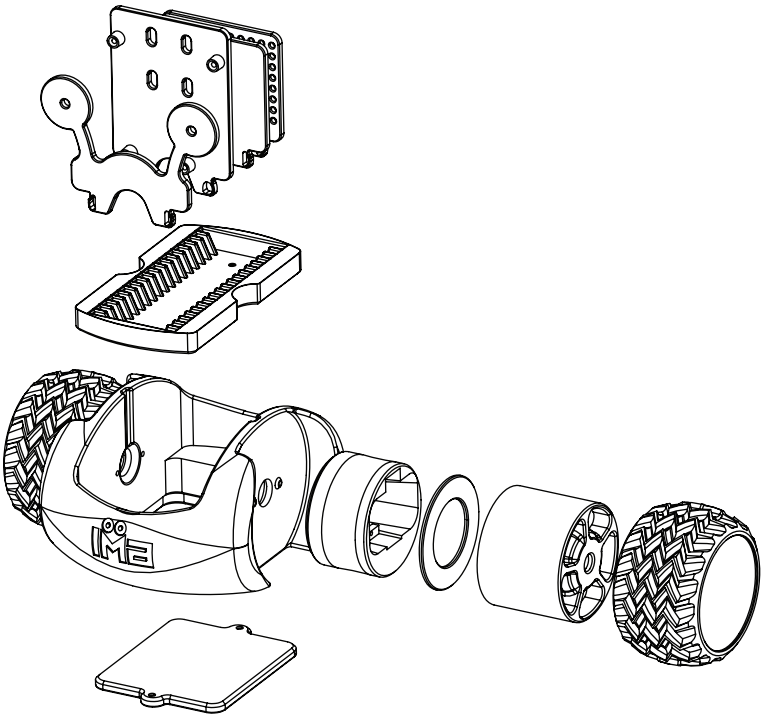
Juno doesn't stop - it's adaptable and expandable. After making your Juno with these instructions, we encourage you to explore:

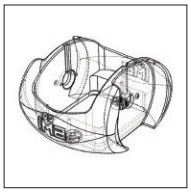
- Changing the look of Juno
  - The interchangeable 3D printed cards can be easily adapted and designed in free 3D design software such as Tinkercad.
- Adding electronics and sensors
  - Add more LED lights or even an ultrasonic sensor for added functionality.
- Learning code
  - Juno's code can be adapted and easily updated, and is a great platform for learning by doing.

3D PRINTED PARTS:

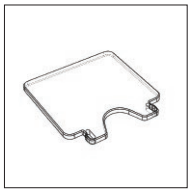
Juno is designed for desktop 3D printing. The largest component is the body, which requires a print bed of 125 x 100 millimeters. Support structure is not required for any pieces.

For best results we reccomend using 200uM or finer resolution. The estimated total printing time for Juno is 15 hours.





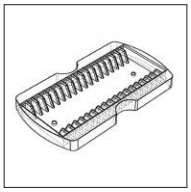
BODY
Est. Printing Time: 6 hours



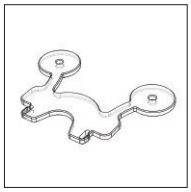
BREADBOARD CARD
Est. Printing Time: 0.5 hours

WHEEL-INSERT
Quantity Needed: 2

Est. Printing Time: 0.5 hours



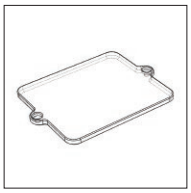
TRAY
Est. Printing Time: 2 hours



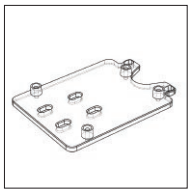
FRONT FACE CARD
Est. Printing Time: 0.5 hours

WHEEL
Quantity Needed: 2

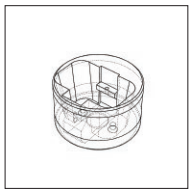
Est. Printing Time: 2 hours



COVER
Est. Printing Time: 0.5 hours



UNO CARD
Est. Printing Time: 0.5 hours

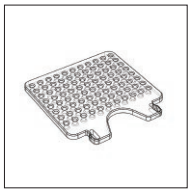


WHEEL-HUB
Quantity Needed: 2

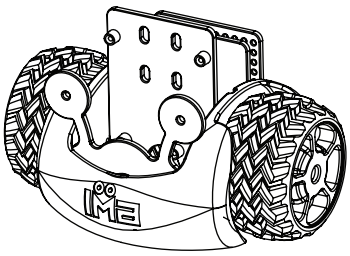
Est. Printing Time: 2 hours

TIRE
Quantity Needed: 2

Est. Printing Time: 3 hours



PEGBOARD CARD
Est. Printing Time: 0.5 hours



GETTING STARTED:

The ready to assembly Juno kit includes everything needed to start "Making".

3D printed parts:
body (blue), tray (grey), cover (black), 2 wheel hubs (grey), 2 wheels (blue), 2 wheel inserts (grey), 2 tires (black),
4 cards (white)

Note: we will identify the colour of pieces as seen in the photos but your kit may have colour variations in these parts.

Electronics and related pieces:
Arduino Uno
HC-06 bluetooth module
2 servo motors
LEDs: 2 red for back, 2 green for front
jumper wires – 4 male/female; 10 male/male
small breadboard
switch
screws (12)
battery holder for 4xAA batteries
pin connectors
shrink tube
zip-ties

Tools you will need:
Phillips screwdriver
pliers or wire crimpers

Optional tools:
wire stripper
heat gun/hair dryer for shrink tape
soldering
glue (super glue works well)

PREPARE THE 3D PRINTED PARTS:

The body has two tabs that need to be removed. These tabs were used during the printing process to support the material above them. They are circular tabs on the bottom, marked with an X.

The tabs should be easily removed. You can pull them off from the bottom (pictured) or you can pop them off by pushing down on the tab from the top.

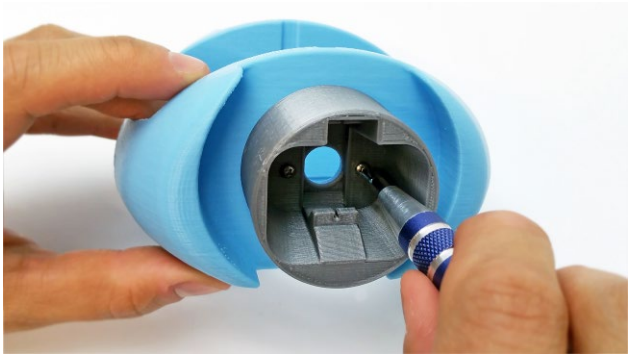
You can discard the two circular tabs.

It is a good time to check your 3D printed parts for rough spots. Sanding the part with mid-grade sandpaper can smooth any errant bits.

If you have pre-printed pieces, only minimal sanding should be necessary.

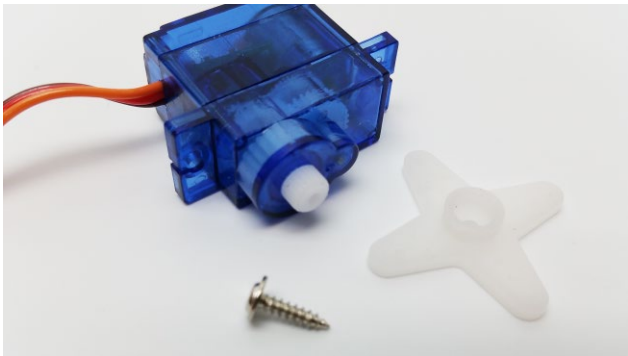
ADD MOTORS TO THE BODY:

Take the grey wheel hub and place next to one of the holes on the side of the body. Screw each sheel hub to the body using 2 screws.



Note: The wheel hubs aren't symmetrical. The orientation doesn't matter for the wheel hubs, but we have put ours 'heavy side' down on both sides.

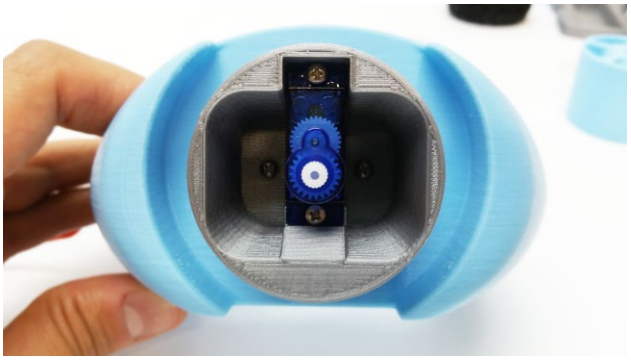
You have received two continuous servo motors, packaged in separate small bags. There are lots of white servo attachments, but you only need to keep the one that looks like a + and one silver screw. The other pieces can be put back into the bags and saved for another project.



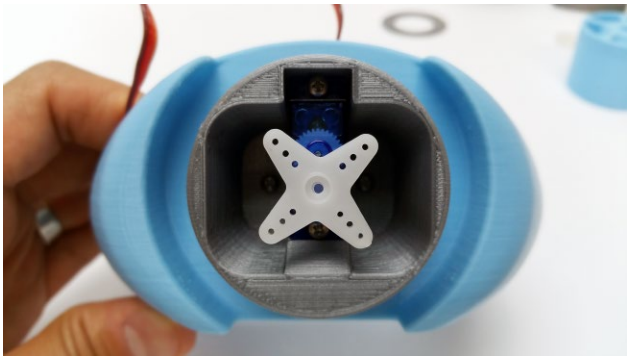
To place the servo motors in the wheel hubs, feed the wires through the opening. The motor will snap into the casing.

Attach with two screws at the top of the motor. Use regular screws and save the screw that came with the servo motor for later.

Place the servo horn on the servo motor but do not screw it in place yet.



Important: make sure the white circle is placed in the centre of the wheel.



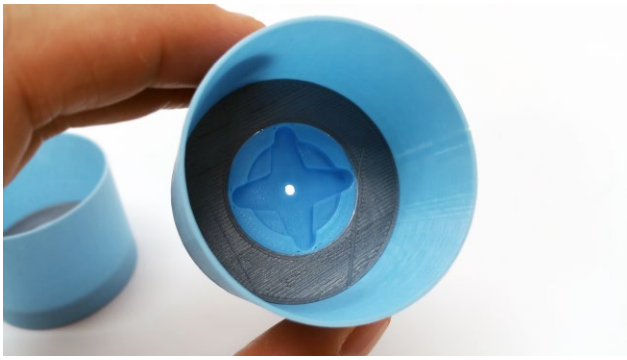
THE WHEELS AND TIRES:

Now you will prep your wheels to add on top of the wheel hub and servo motor.

Place the insert (grey) into the wheel (blue). Place the tire onto the wheel.

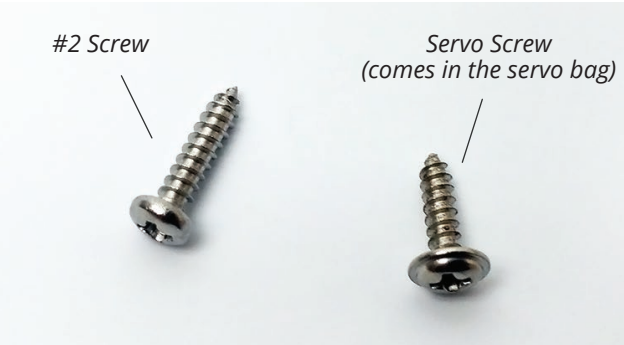
Note: there is a lip on one outer face of the tire. This lip must be facing outward on teh wheel and tire assembly. In our photo, the tire lip is on the left, so the wheel slides in from the right.

Tip: you can glue the tire to the wheel by adding a dab of glue (hobby glue or super glue) before inserting the tire.



Now you can add your wheels to the body over the wheel hubs.

Use servo motor screw to keep wheel in place. This is where you use that servo motor screw!



IMPORTANT!
use the servo screws that came with each servo to connect the wheels to the servos.

Screw the wheel to the wheel hub.

Do not tighten the screw too much. The wheel and servo motor should turn freely.

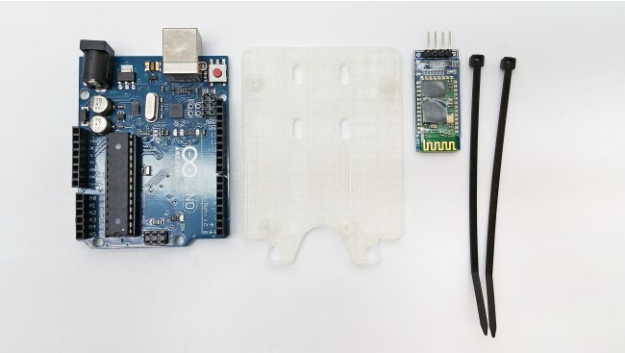
IMPORTANT!
The servos contain very small motors and gears that can be damaged if handled incorrectly.

Always be gentle when manually turning a servo. Turn them slowly and without excessive force.

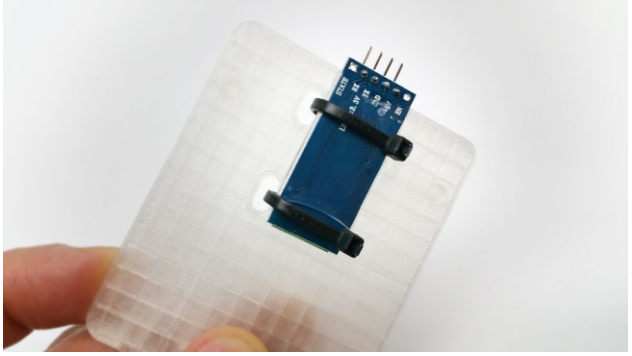
Take a break - admire what you have done so far!

ASSEMBLE THE CARDS:

Collect the Arduino Uno, 3D printed Arduino Card, HC-06 Bluetooth module and two zip ties. These are the starting points for the 'brain' of your Juno.

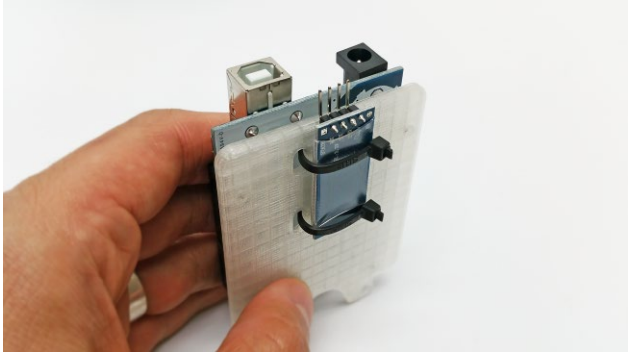


Collect the Arduino Uno, 3D printed Arduino Card, HC-06 Bluetooth module and two zip ties. These are the starting points for the 'brain' of your Juno.



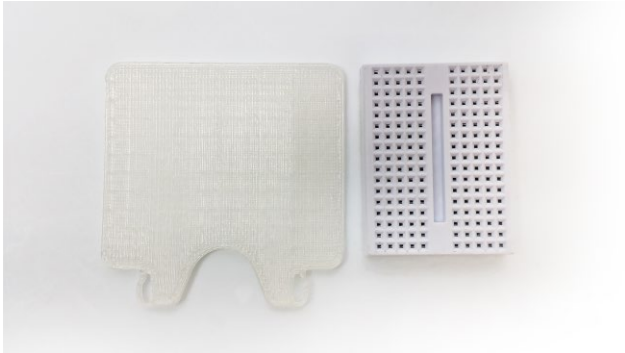
Place the Bluetooth module on the flat side of the Arduino Card. You will want to have the pin information facing out because you will need to read this information later.

Use two zip ties to hold the Bluetooth module in place. You should tighten the ties until the module stays on the card but be wary of pulling too hard in case the Bluetooth module breaks. Trim the zip ties by cutting off excess plastic.

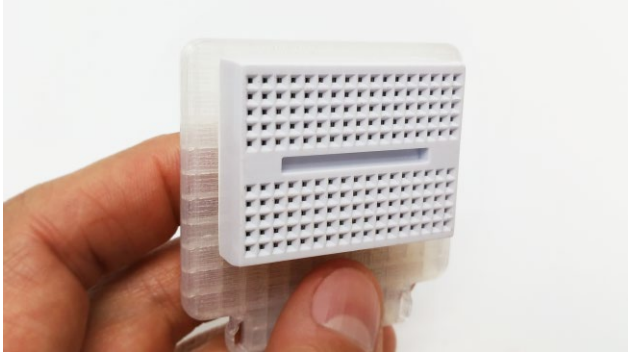


Place the Arduino Uno on the other side of the 3D printed card with the electronics and labeling facing out. Use four screws (one in each corner) to attach the Arduino Uno.

Collect the 3D printed Breadboard Card and the small breadboard.

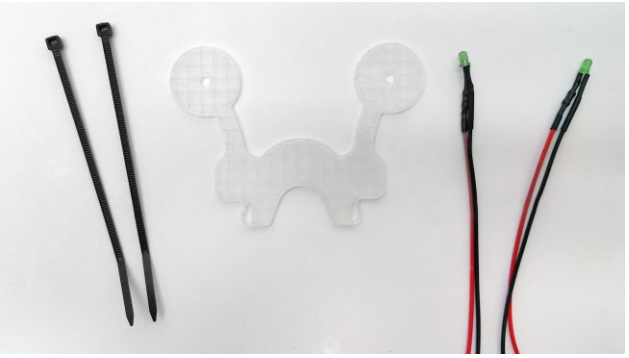


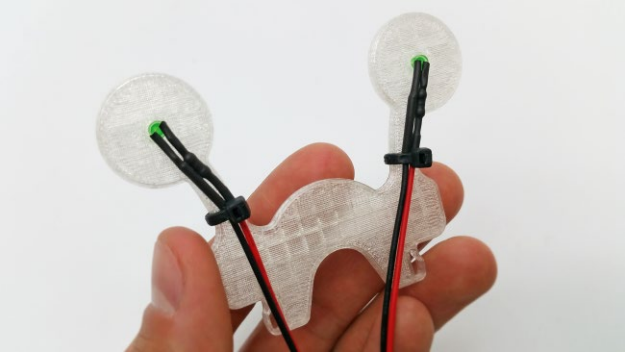
Place the breadboard onto the card towards the top (wider portion) and centred in the width (see photo). The breadboard comes with a sticky backing, so you just need to peel off the protective layer and press it to the breadboard card.



Collect two zip ties, the 3D printed Face Card, and two LEDs (green).

Push LEDs through the holes for 'eyes', bend the wires so they will go down the back of the face card. Attach the wires to the antennae stalks with one zip tie per wire. Trim the zip ties by cutting off excess plastic.



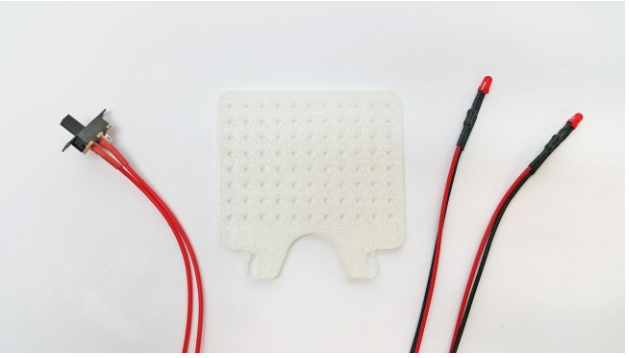


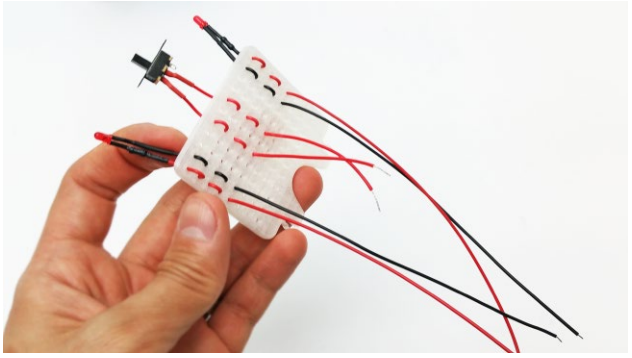
Collect the switch, 3D printed pegboard card, and two LEDs (red).

Tip: We recommend placing the switch at the centre top of pegboard and the LEDs on the top corners.

Add the switch first. Feed both wires through two holes at the top. To contain the wires, you can then continue to put them through other holes and create a pattern.

Add the two LEDs. Add each wire through a different hole in the pegboard card and then continue to weave the wires to create your favourite pattern. Note: All wires should be facing the same way at the end of placement, where the LEDs and switch come out the same side and the end of the wires end on the other side.



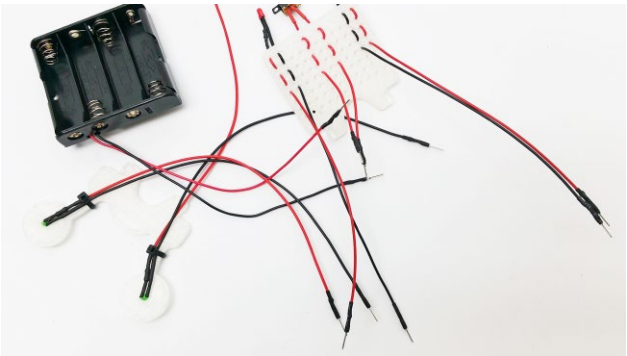


Use shrink tube and pin connectors to make it easier to attach wires to the Arduino and bread-board.

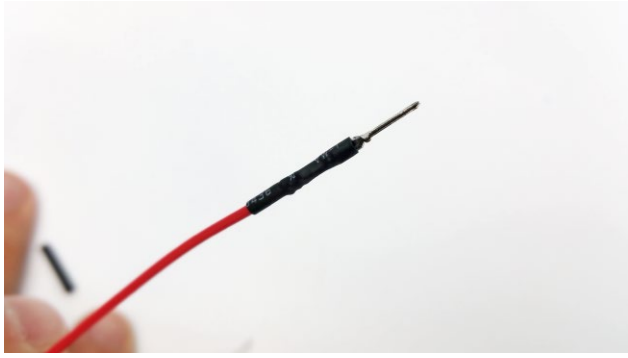
Strip the wires back so about 1 cm of silver wire is showing. Add the pin connector, crimp in place by using a pair of pliers to squeeze the pin connector. Make sure there is firm metal to metal contact betwen the wire and pin connector so that it will conduct electricity.

Slide over heat shrink tubing to cover the connection. Heat up the end so the tubing shrinks in place.

Do this step for all wires on:
- 4 LEDs
- switch
- battery holder.



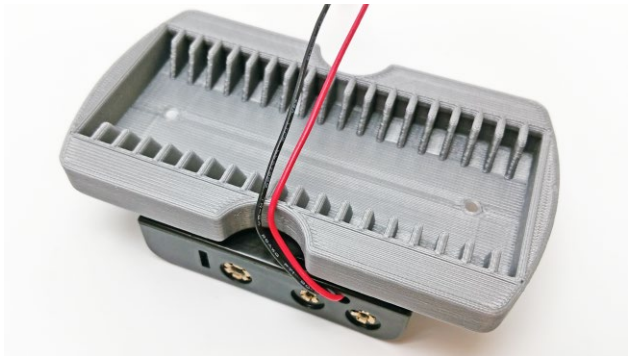
NOTE: you can solder the wires to the pin connectors, and cover the soldered connections with shrink tube.

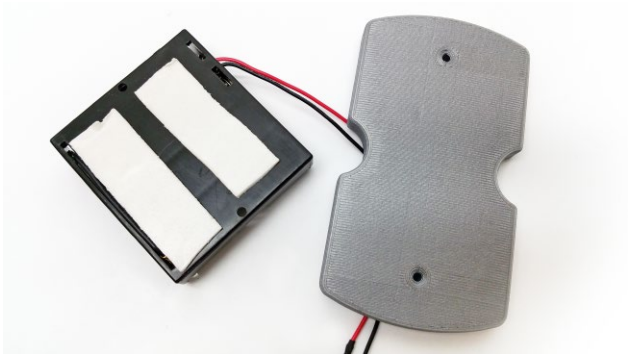


ASSEMBLE THE TRAY:

Add two pieces of double-sided tape to the battery holder (on left).

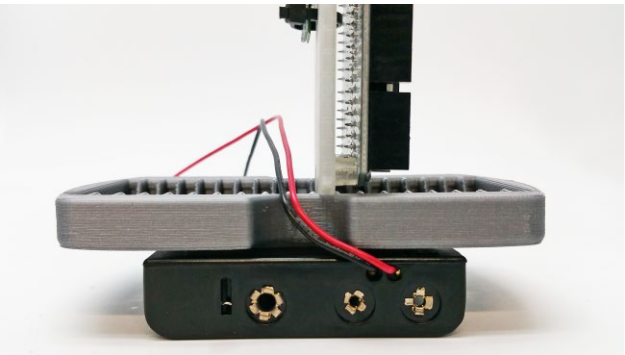
Attach the battery holder to the bottom side of the tray. Make sure the battery holder is centred so the tray/battery holder will still fit inside the 3D printed body.

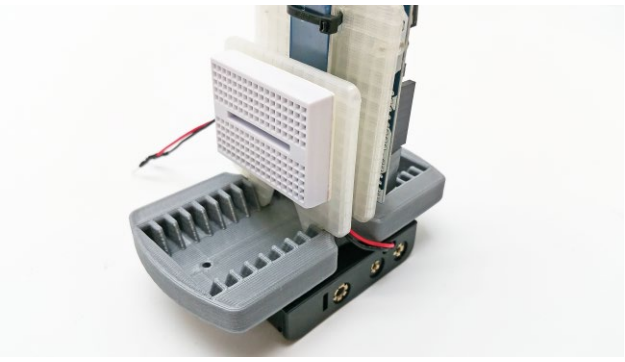




CONNECT THE ELECTRONICS:

Note: There is a complete Wiring Diagram on page 20 that can be used to supplement the following instructions.





It's time to start connecting everything!

Clip the arduino card to the tray. We suggest that the Arduino card be placed one slot off-centre, and the front of the arduino faces forward.

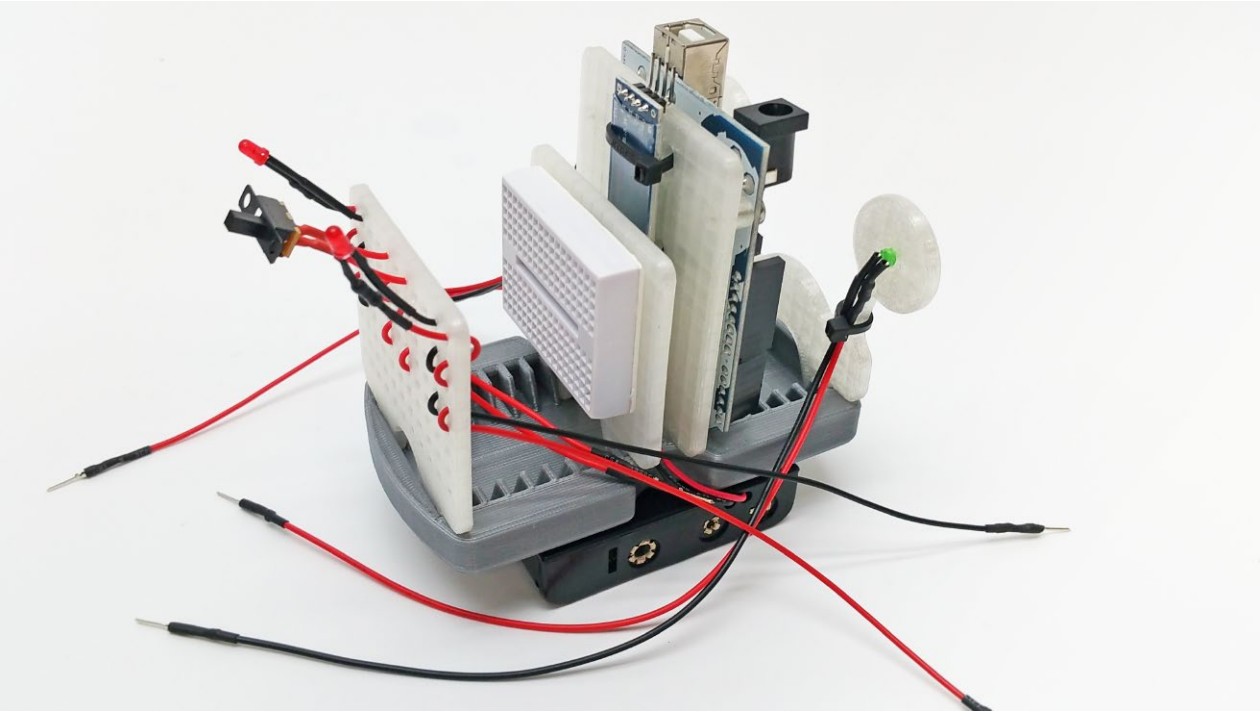
Clip the breadboard card into the tray behind the Arduino. The breadboard should be facing the back for ease of use later.

Put the face card in front of the Arduino card with the LED wires towards the back.

Clip the pegboard card in the back of the tray with the LEDs and switch facing the back. Leave lots of room between the pegboard and breadboard cards so there is room to attach wires easily.

Organize the wires so that all the pins are near the bread board.

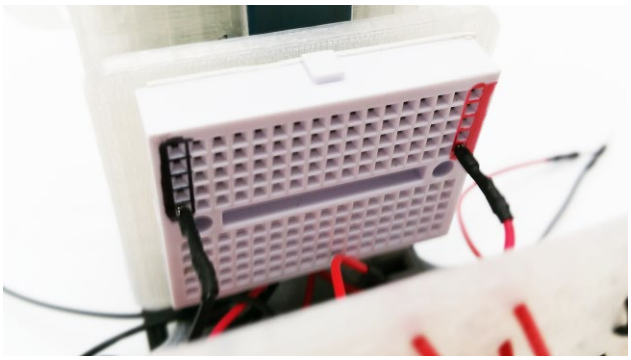
Note: there is a tunnel underneath the cards where wires can be fed to keep things organized.



Connect the battery wires to the breadboard.

Note: It doesn't matter where the wires go but we have done black (ground) as left and red (positive) as right for these instructions.

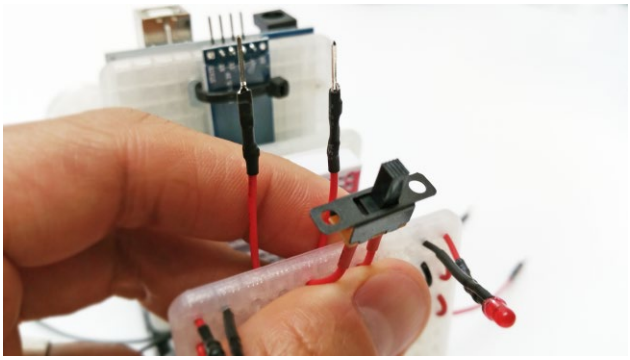
Take the ground (black) wire and attach it to the bottom left of the breadboard. Add the positive wire (red) to the bottom right of the breadboard.



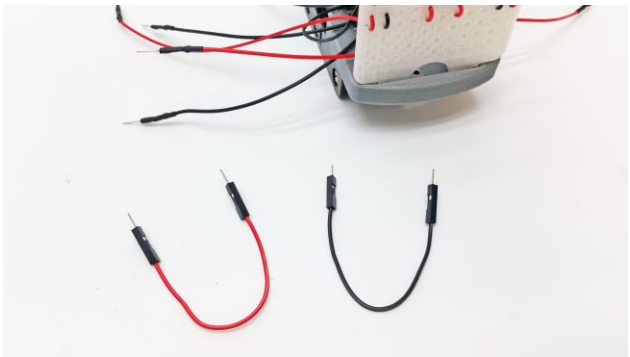
We've coloured in the breadboard to show what holes now have power to them.

Add the switch wires to the breadboard. You will note that the switch has 2 red wires:

- One is placed above the battery wire
- Other is placed in a column to the left.
- The switch will break the circuit when flipped on or off.



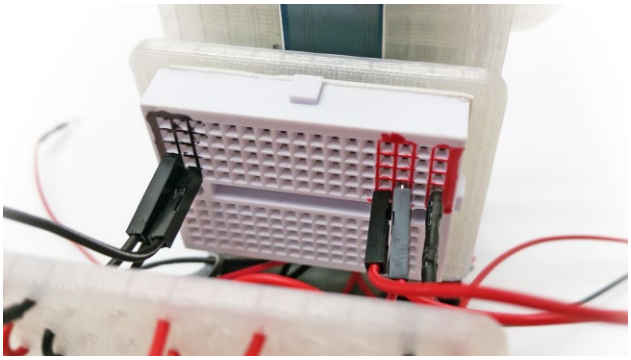
We will use jumper wires to expand the circuit to other holes in the circuitboard. We have one black (ground) and one positive (red) jumper wire. Note: colour of jumper wires doesn't matter but you want to keep track of whether they are positive, ground, or other!



Red: place one end of jumper wire above the switch wire and the other end to a column on the left.

Black: place one end of jumper wire above the battery wire and the other end into a column on the right.

We've coloured in the breadboard to show what holes now have power to them.



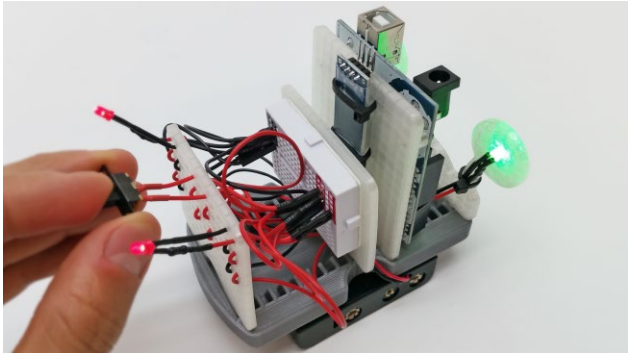
POWER THE LEDS:

You can now add your LED wires!

Place the black wires to the black holes.

Place the red wires to the red holes controlled by the switch. Do not put red wires above the battery wire column, because it will bypass the switch.

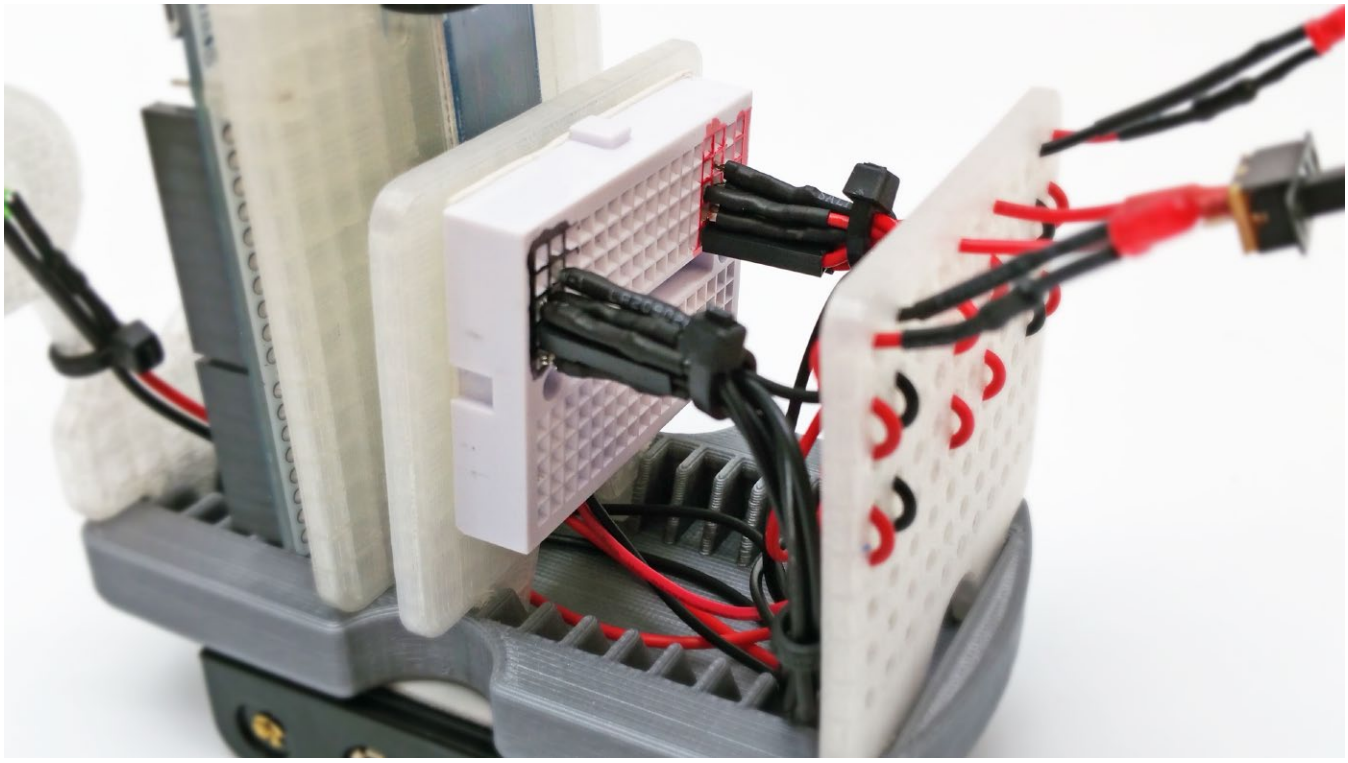
Add 4xAA batteries to the bottom battery holder.



When the switch is on, you should have green LEDs light up in the front and red LEDs at the back.

Use zip ties to tidy up the wires. This will allow you more space to add the rest of the wiring. Plus, the electronics are exposed in the Juno, so people will see the organization of your wires.

Turn the switch off, so the LEDs are now off.



CONNECT THE ARDUINO TO BLUETOOTH:

To attach the Bluetooth module to the Arduino, you will need to add jumper wires. Because the Bluetooth has pins sticking up, these wires need to be male/female (one side has holes and the other has pins). There are different colours of wires so it is a good idea to write down what wire is going where.

We are going to start from the left of the Bluetooth when looking at the Arduino and the Bluetooth behind the card. Please check the pin orientation for your set up.

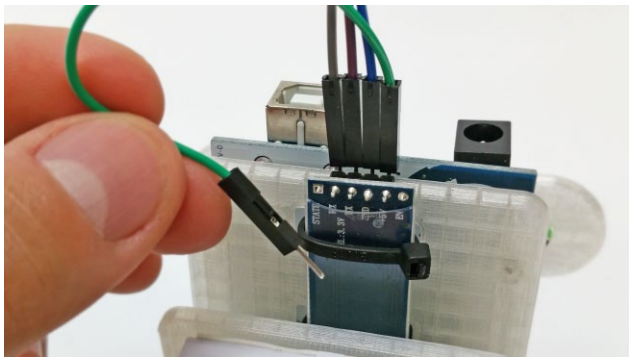
Place your wires:

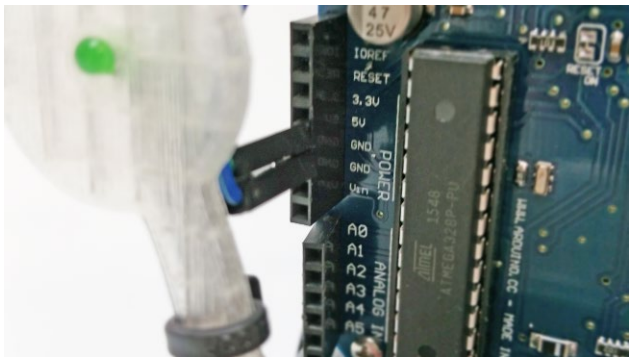
a. First is labeled 5V on the Bluetooth and that wire goes to the hole on the Arduino labeled 5V

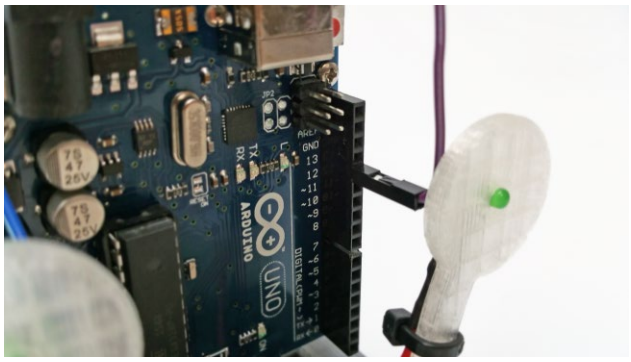
b. Second is the ground so plug it into one of the ground holes on the Arduino. We have done the ground just below the 5V hole.

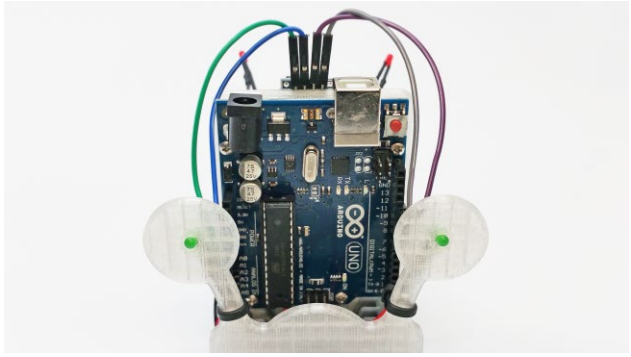
c. Next attached the jumper wire from the Tx on the Bluetooth to pin 13.

d. Lastly, connect Rx from the Bluetooth to pin 12 on the Arduino.

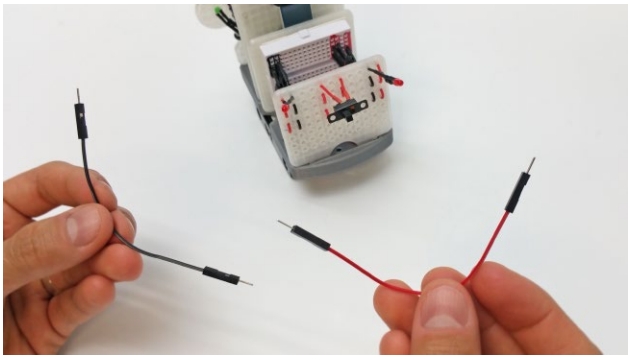




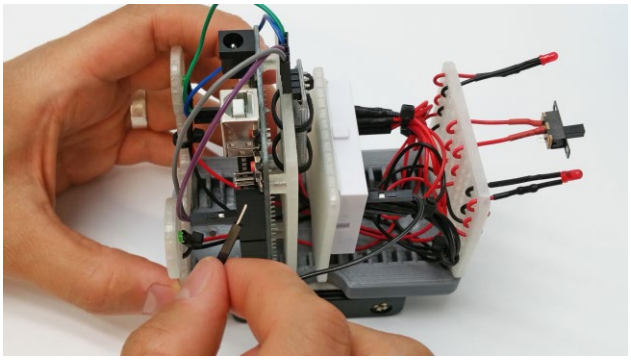




CONNECT THE ARDUINO TO POWER:

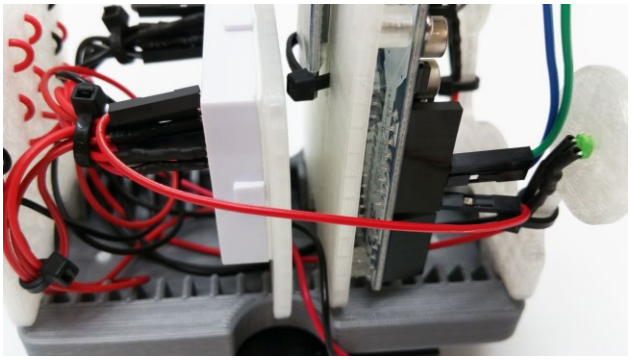


You will need jumper wires to connect the Arduino to power on the breadboard. Use male/male jumper wires with pins on both ends. Again, black is ground and red is positive. You may need longer jumper wires for this step.



Attach the ground from the ground on the Arduino to a ground on the circuit board. This will be one of the circuit board holes that we coloured black earlier.

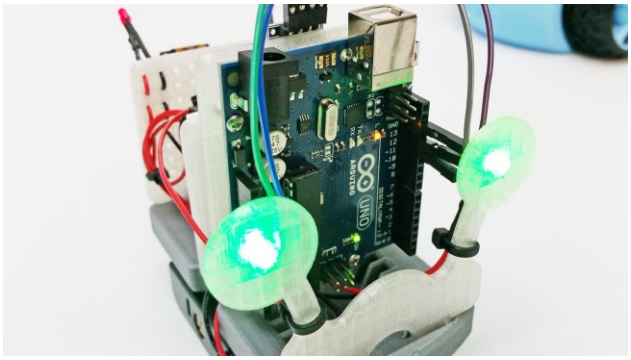
The red jumper wire connects from the positive (red) on the circuit board to Vin on the Arduino.



If you are using short jumper wires they can wrap around the sides of the cards. If you have long jumper wires you can feed them underneath the cards.

TEST THE WIRING:

Turning on the power can help see if everything is connected properly. You can now flip the switch and see if everything is working. You should see:



- Red and green LEDs light up
- Flashing yellow and green lights on Arduino
- Flashing red light on Bluetooth module

If any of the components does not light up, check your connections.

CONNECT THE ELECTRONICS TO THE SERVO MOTORS:

Each servo motor has 3 wires bunched together. We will use pin/pin jumper wires to make the connections from the Arudino and breadboard to the servo motors

You will need 2 sets of 3 jumper wires. Each servo motor needs a positive, negative (ground) and a signal from the Arduino. You should write down what colour of jumper wire is being used for each connection.

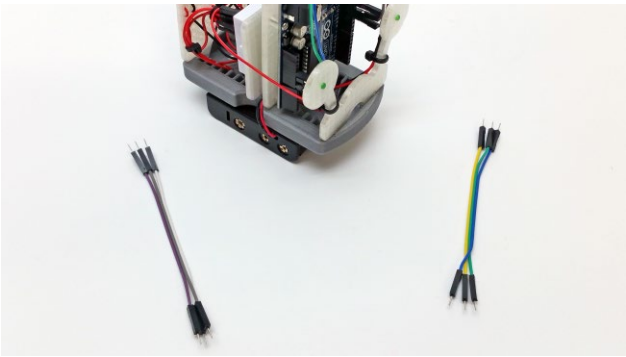
Add the jumper wires to the electronics:

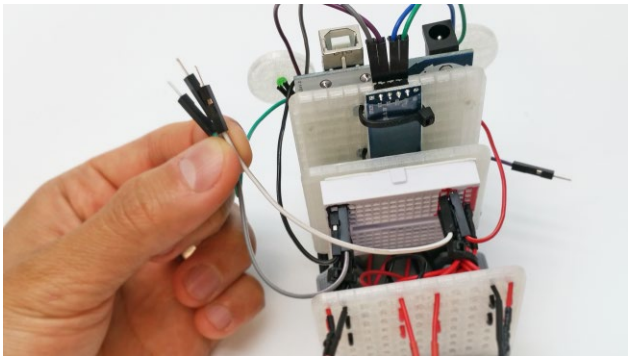
- Positive wire to a red hole on the breadboard (above the switch, not the battery column).

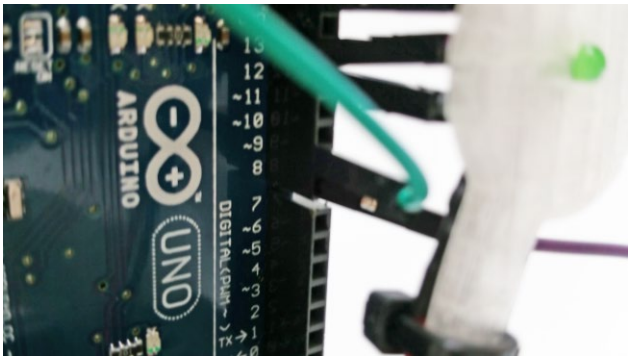
- Negative/ground to a black hole on the breadboard.

- Signal from the Arduino:
    - The wire that will go to the left wheel (as if driving the car) goes to pin 9 on the Arduino.
    - The wire that will go to the right wheel goes to pin 8 on the Arduino.

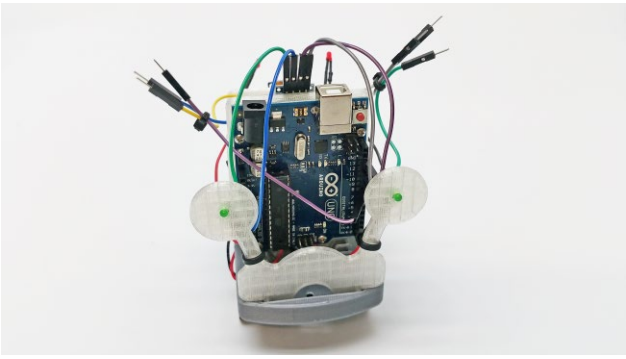
Zip tie the wire together for each side.







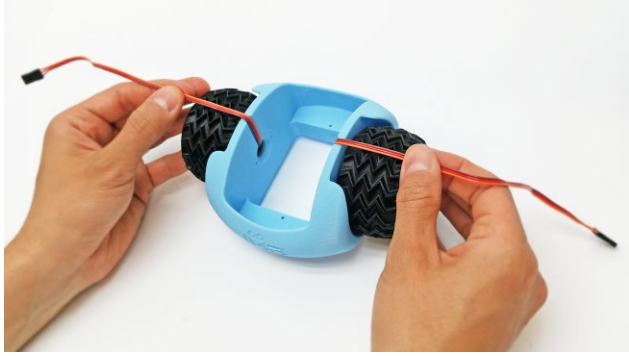
Note: in our example, left is a green wire and right is a purple wire.



CONNECT THE ELECTRONICS TO THE SERVO MOTORS:

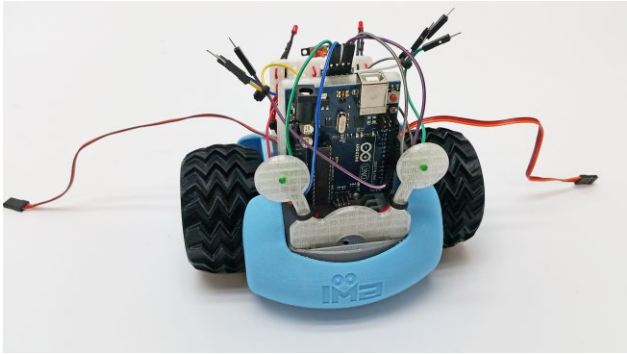
Slide the electronics tray into the body.

Spread the servo motor wires into the grooves on either side of teh body. Make sure that the wires from the servo motor are accessible.



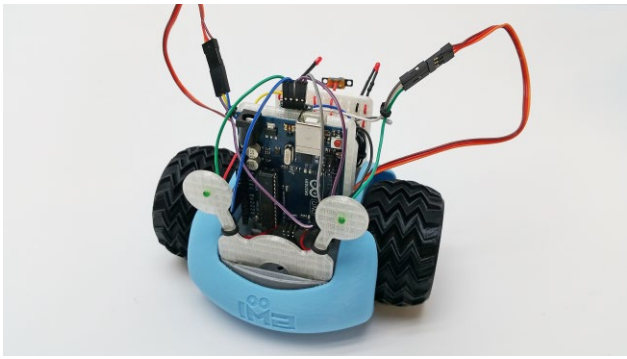
Connect the wires from the servo motors to the jumper wires you connected to the Arduino and breadboard:

- Red on the servo motor connects with the positive wire
- Brown of the servo motor connects to the negative wire
- Orange on the servo motor connects to the signal wire.



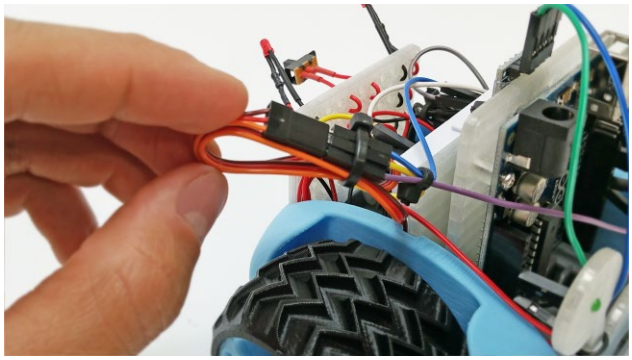
This is where it is important to remember – or write down – the jumper wire colours!

Bundle up wires, zip tie them to hold and can then tuck them into the body. Your Juno should be looking ready to go!

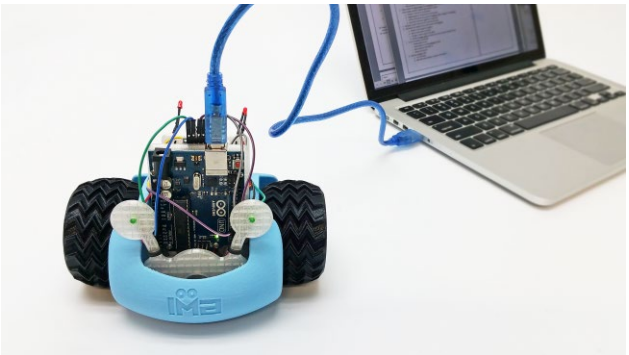


Again, make sure things are connected properly before the next step. When you turn on the switch, the following should happen:

- LEDs should light up
- See 2 flashing lights on the Arduino
- See a flashing light on the Bluetooth
- Wheels should momentarily jerk



LOAD THE ARDUINO CODE:



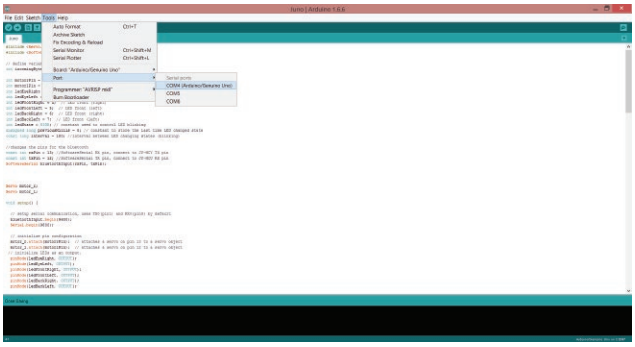
Turn off switch off.

Add the USB cable between the computer and the Juno. The Arduino and Bluetooth module should now be powered from the computer and will light up and start flashing again.

Open the Arduino program on your computer.
You can download the program at:
https://www.arduino.cc/en/Main/Software

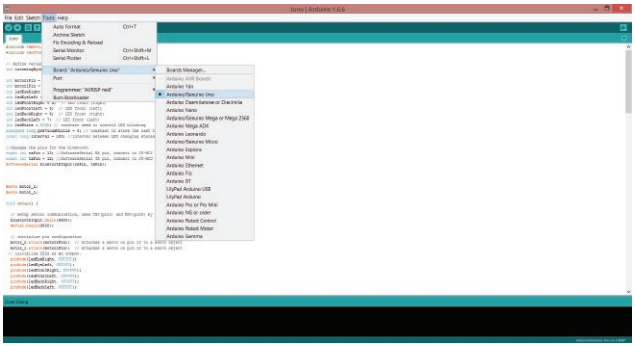
Open your code “Juno.ino”.
You can download the code at:
www.exploremaking.com

Click on the code to open the program.
The program may say that it needs to put the code into a folder, click OK to allow it to happen.



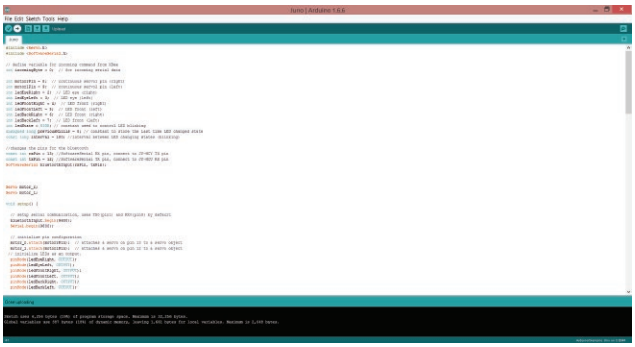
Check the port. You want to use the USB port.

- Go to Tools>port and see what is selected. Arduino Uno should be in the name.



Check your program is using the correct Uno board.

- Go to Tools>Board. It should say what you are using (e.g. Uno). If you need to change it, follow the right arrow and select the board: Uno. Note: it may say Arduino/Genuino Uno



With the Juno.ino loaded on your Arduino program, hit upload (arrow at the top of the program on the upper left). It will say ‘done uploading’ when it is finished. Note: this may take 20-30 seconds.

TEST YOUR JUNO!

You can now test your Juno!

You can drive Juno through Bluetooth with your computer or the IMA Controller Android app.

Note: the app currently works with Android phones only.

Computer Control:

Turn on Juno

- Pair your computer through Bluetooth
  - The Bluetooth module is HC-06.
  - You may need to input the code 1234 to finish pairing.
- In the Arduino program, change your port to be the Bluetooth port (not the previous USB)
- Open the serial monitor. This is the magnifying glass on the upper right of the Arduino program.
- The light should stop blinking on the Bluetooth module.

Fast movement:
w = forward, a = left, s = backward, d = right
Space bar = stop

Slower movement:
i = forward, j = left, k = backward, l = right
Space bar = stop.

Phone Control:

- Turn on Juno.
- Open the app. Select Juno as the vehicle.
  - First time you open it, it will show up as 'null' and then will ask for a password. (Password: 1234)
  - Hit pair
  - Use the arrows to drive your Juno

CONGRATULATIONS!

You have built a moving robot!

Enjoy showing it off!

Now you can explore ways to make changes and what modules you would like to connect to change Juno.

WIRING DIAGRAM: