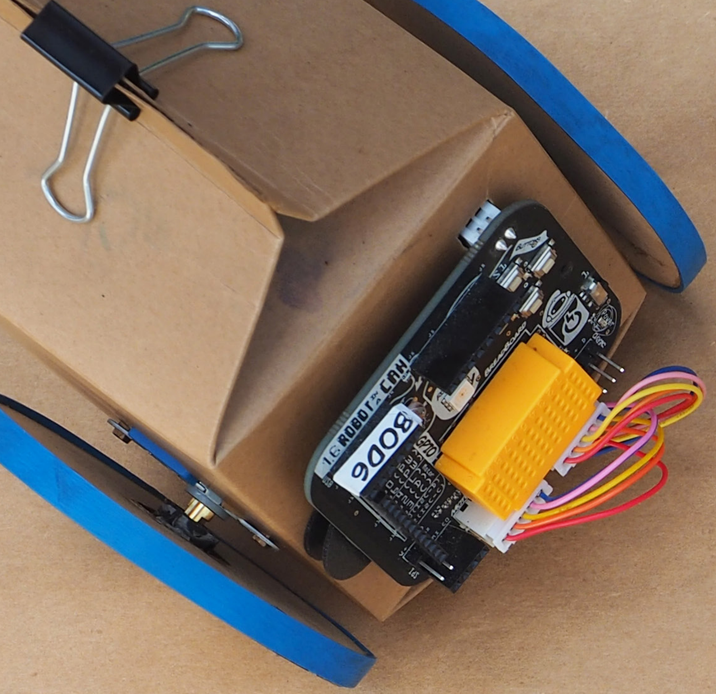


ROBOT IN A CAN

Guidebook 2.1

Designed for exploration

Quick to set up and easy to use, start exploring the world of technology today!

This workbook contains a series of exercises that will get you familiar the the fundamentals of electronics and code.

It'll help you get on your way to adventuring and building robots!

You can follow the suggested curriculum or skip ahead if you prefer.

Fasten your space seatbelts and lets launch!

Table of contents

Preface

Welcome to our super-enhanced Robot in a Can eBrain Guidebook for 2019. Dive in and make your world a better place!

Robot in a Can - eBrain is a phenomena, both in the computing and education worlds. It transforms how we teach computer technology and build things as hobby. If you're looking to join this phenomena you hold in your hands the ideal starting point for growing your knowledge. No matter if you're a bemused beginner or seasoned expert, we've got something you'll enjoy in this Robot in a Can eBrain Guidebook.

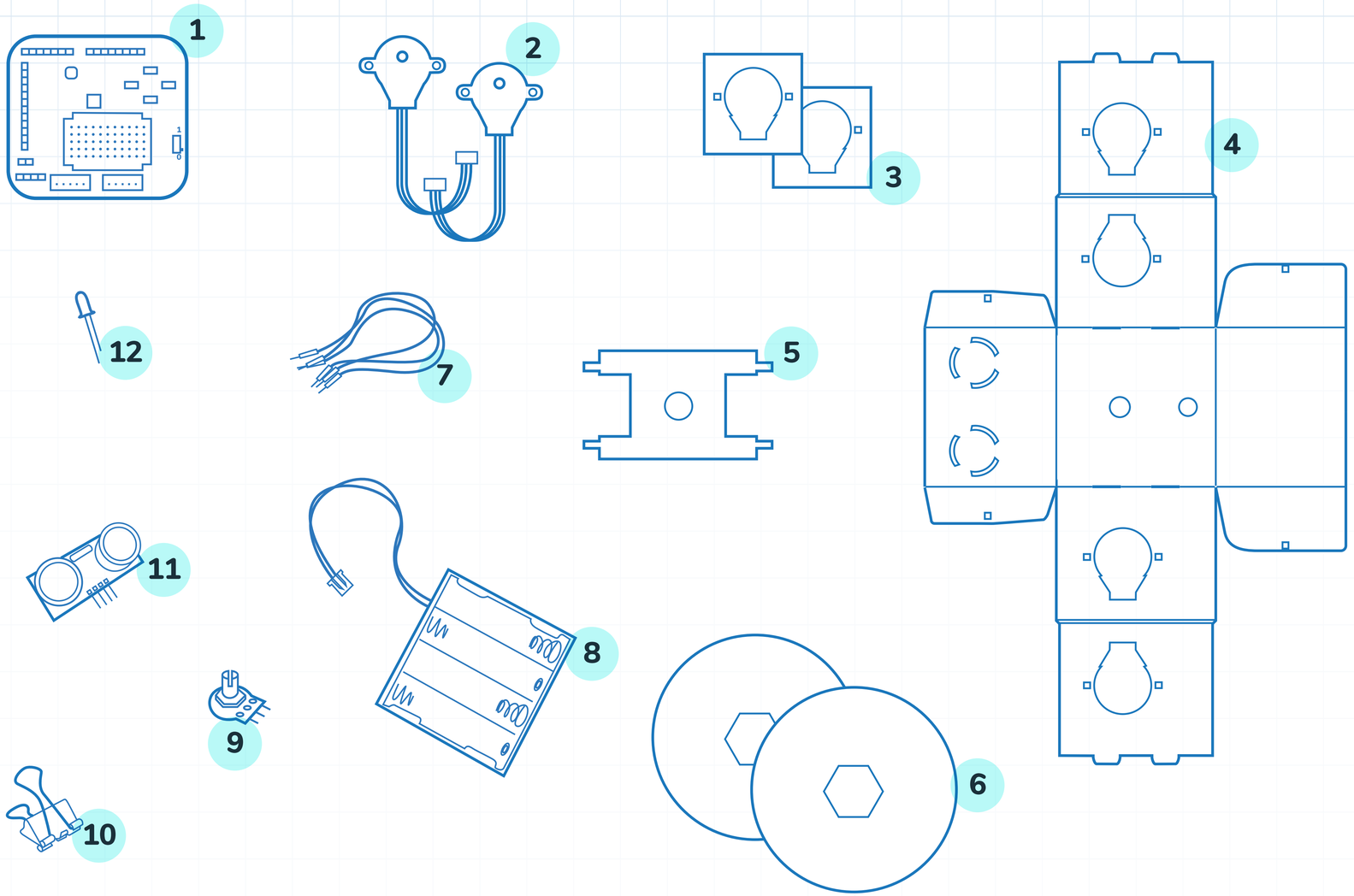
We'll hold your hand through getting up and running and then dive straight in with some classic projects like creating interactive media using the latest AIs, to building your own eBrain-powered security system.

The joy of the RIAC (Robot in a Can) eBrain is its simple elegance. RIAC's open source programming system called "eBran Snap!" offers amazing freedom and allows learners to stand on the shoulders of giants. We'll explain how to get the most from Snap! and your eBrain: combining electronics and programing has never been easier to get into.

You can take your skills to the next level too, with upcoming installments to our complete guide to coding on the eBrain you'll dive into using: Logo, Python, Lua and C. Turning your interest in the eBrain from one of a hobby, to a potential career in development. So what are you waiting for? A world of fun eBrain adventures await you!

"Great things are not done by impulse, but a series of small things brought together."

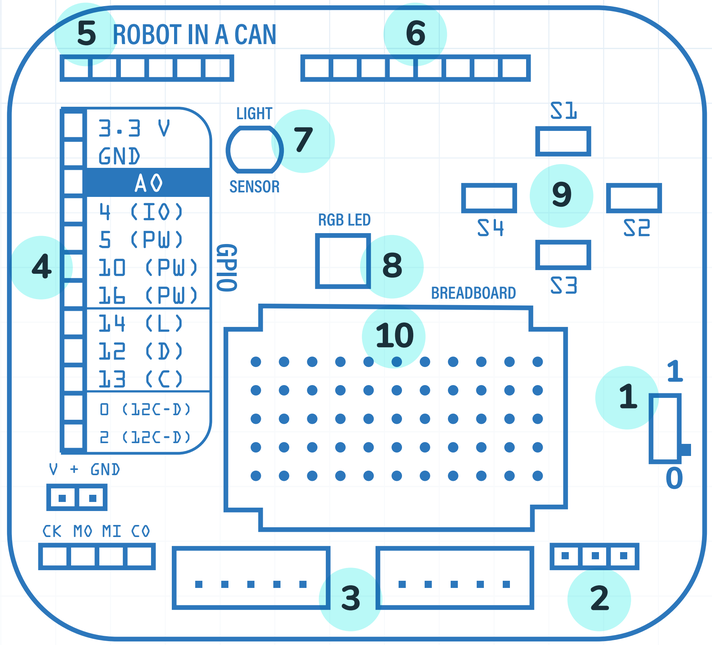
-Vincent Van Gogh



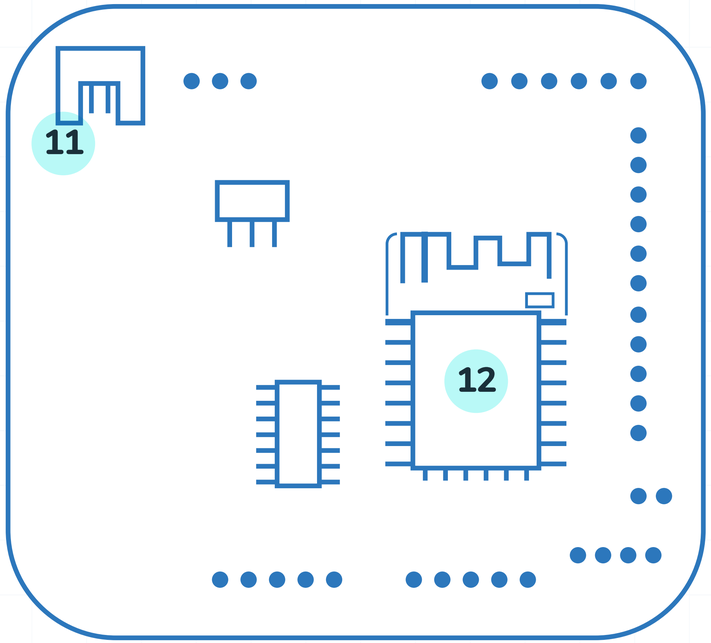
What's in the Can

1	1x eBrain
2	2x motors
3	4x motor holders
4	2x robot body
5	2x chassis
6	2x wheels
7	30x Cables
8	1x Battery pack
9	1x Potentiometer
10	2x Bulldog clip
11	1x Distance sensor
12	3x LED

Front



Back

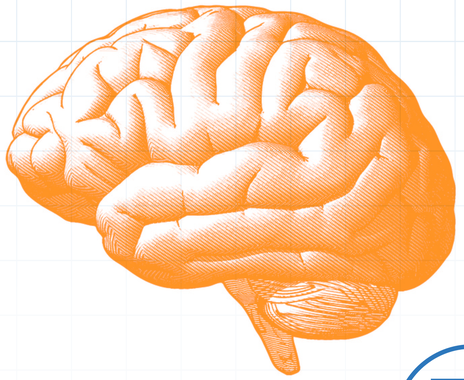


What's on the board

1	On/Off switch
2	Servo Motor Bay
3	Stepper Motor Bay
4	GPIO bay
5	USB FTDI adapter
6	Patch bay
7	Light sensor
8	RGB LED
9	Buttons
10	Breadboard
11	Power
12	eBrain WiFi

Chapter 1

Getting familiar with your eBrain



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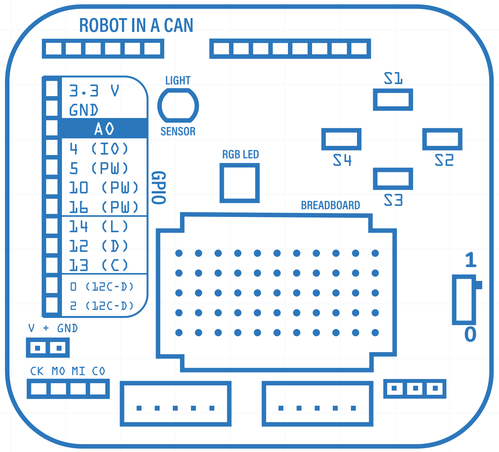
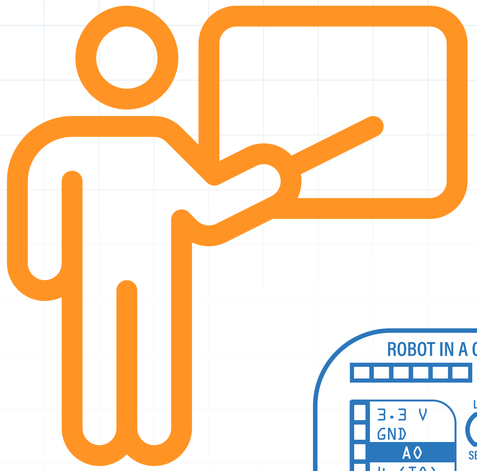


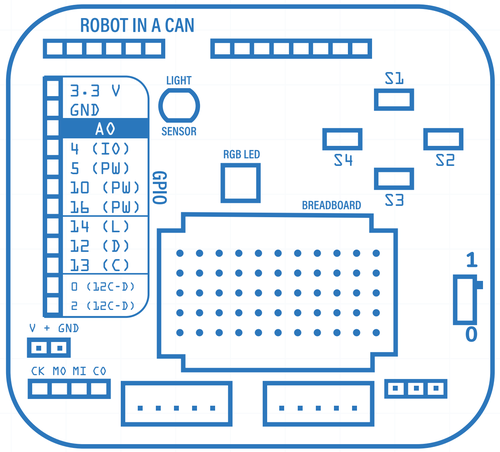
Electronic brains

Everything smart has a brain.

Computers are a lot like electronic thinking machines. And these “brains” aren’t just for laptops, tablets and phones – they can be found in all sorts of places like airplanes, household appliances and industrial equipment. They’re all around us and help run our society!

On this page, you can see an image of your new eBrain. You will learn to play with this technology and control it, allowing you to make an impact on the world around you.

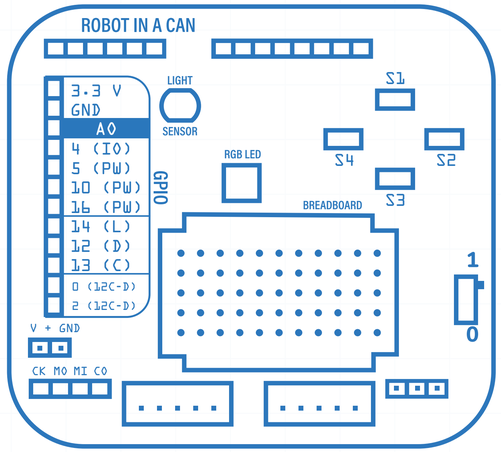




eBrain Superpower #1

eBrain is a good teacher.

Your eBrain is a ‘Development Board’. This means the board can be re-purposed and used for many different tasks. You don’t need to use any advanced tools or learn solder to build your own circuits. Instead our easy to use eBrain design allows you to connect and build circuits by using our patch cable system in the kit.

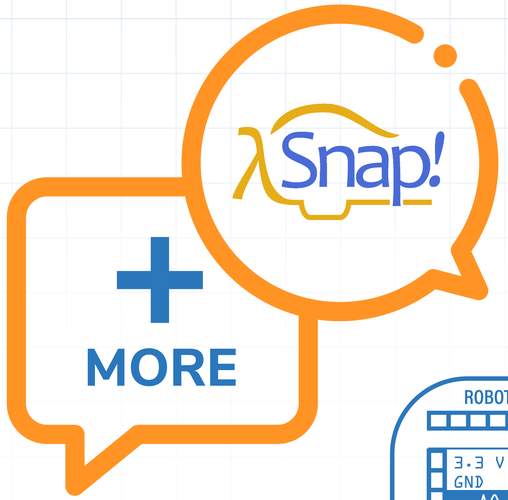


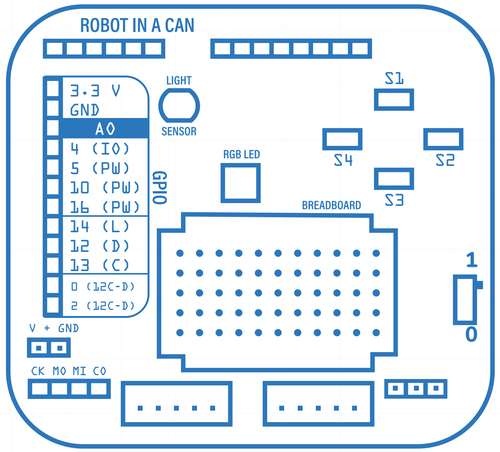
eBrain Superpower #2

eBrain can speak and listen over wifi.

No wires to tether you! You can remote control into your eBrain from your computer or cellphone. Because you can tell it what to do wirelessly, your robot can be in one room while you're in another.

Although the eBrain uses a WiFi radio to communicate it doesn't need the internet to function.

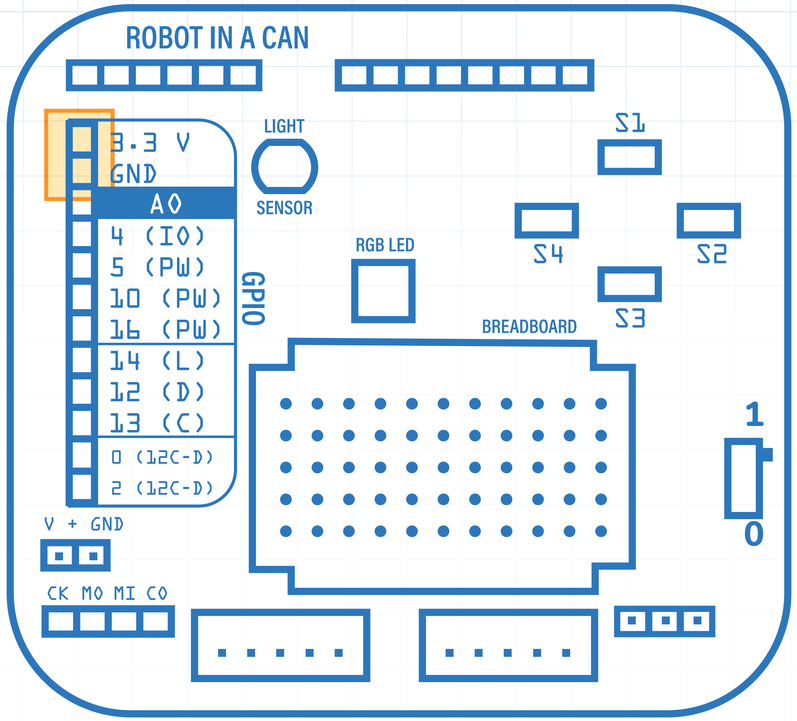




eBrain Superpower #3

eBrain can understand many programming languages.

We'll be going over how to use **Snap!**, our favorite drag and drop software, but you're not limited to it. You can actually program your eBrain with other languages such as Arduino™ C or Python.



3.3V and Ground

Power

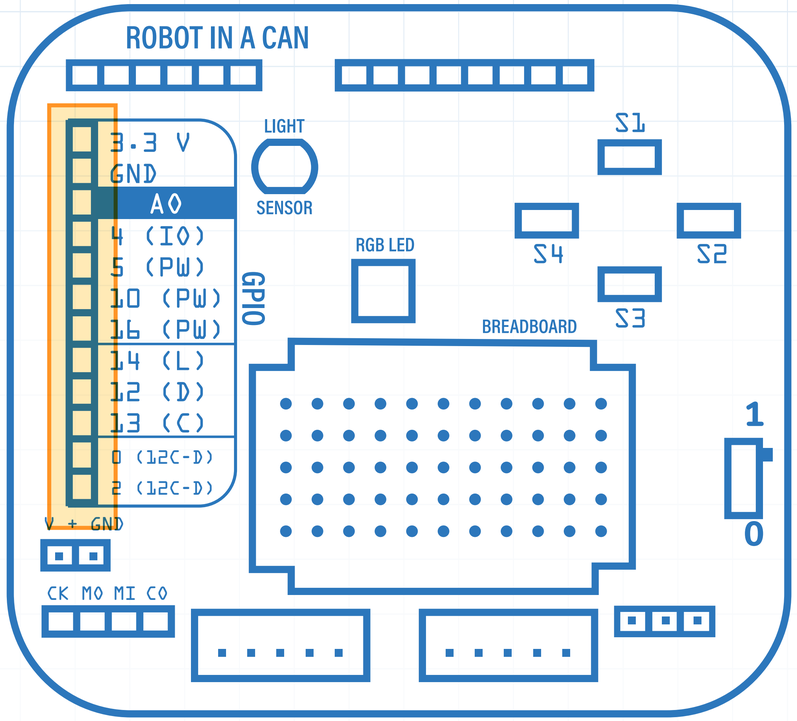
This is your eBrain's power supply

The batteries are connected to the back of the board and extend to these two holes on the front of the board.

Think of them as sides of a battery. The 3.3V is the positive side and the GND (ground) is the negative side.

You can use these two holes to bring power to your projects!

Did you know that each AA battery has 1.5V, so the power pack holds 6V total (4x AA). Your eBrain's power connector runs at 3.3V. The power has been regulated ensuring that there are no spikes or drops in voltage, so you'll always have power when you need it!



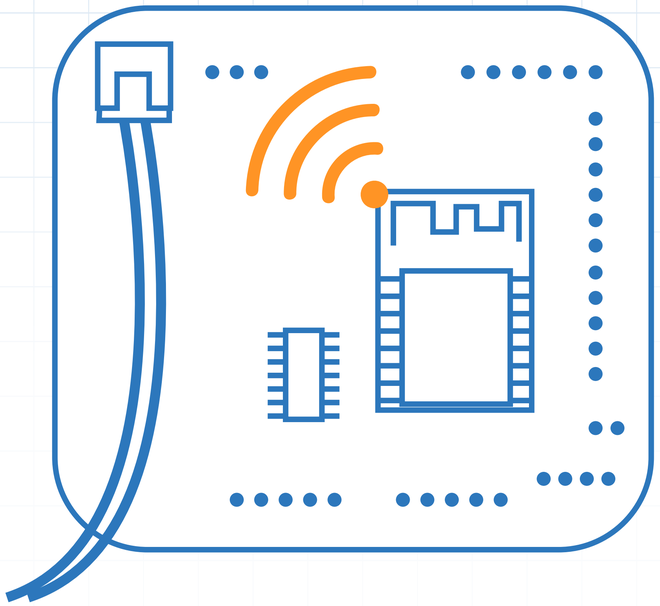
GPIO Bay

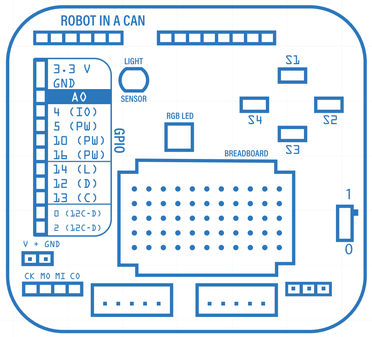
GPIO Bay

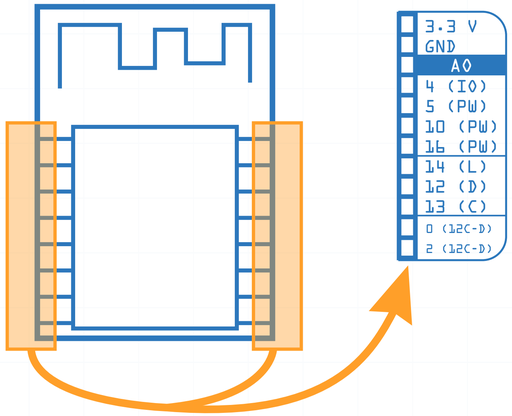
General Purpose Input Output

The most important area! Your computer speaks to your board through the electrical connections on GPIO bay.

This row of holes is almost like a direct phone line into the computer. Using these connections the eBrain computer can talk (out) and listen (in) to other electronics. We will learn to use this more later!





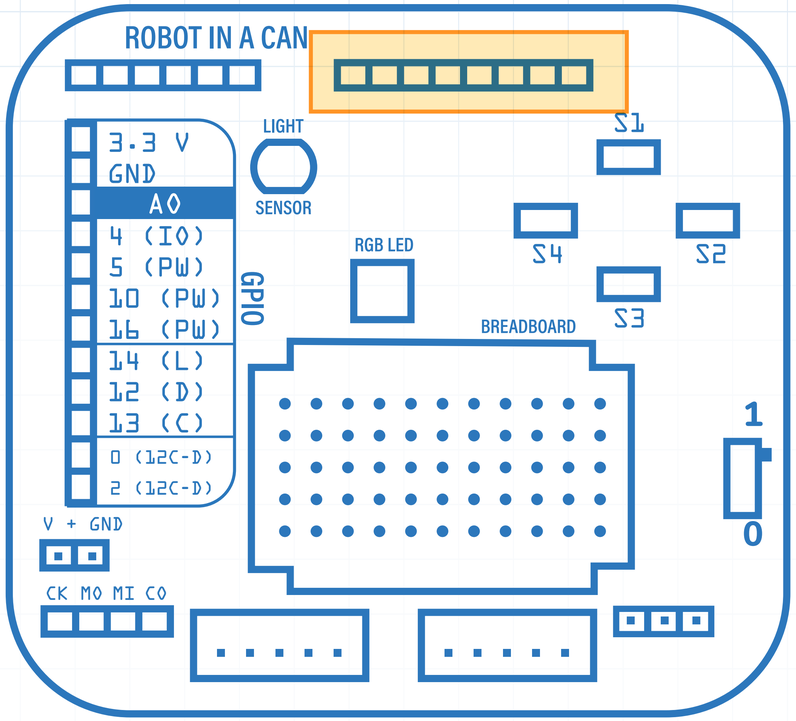


eBrain's Brain

This is the WIFI radio and computer on board the eBrain.

See the squiggly line? That very special shape is the WiFi antenna, it sends electric signals through the air so that it can communicate with other computers. This is also the eBrain's computer where it does it's thinking.

It's called the ESP-8266 and it's connected straight to the GPIO bay.

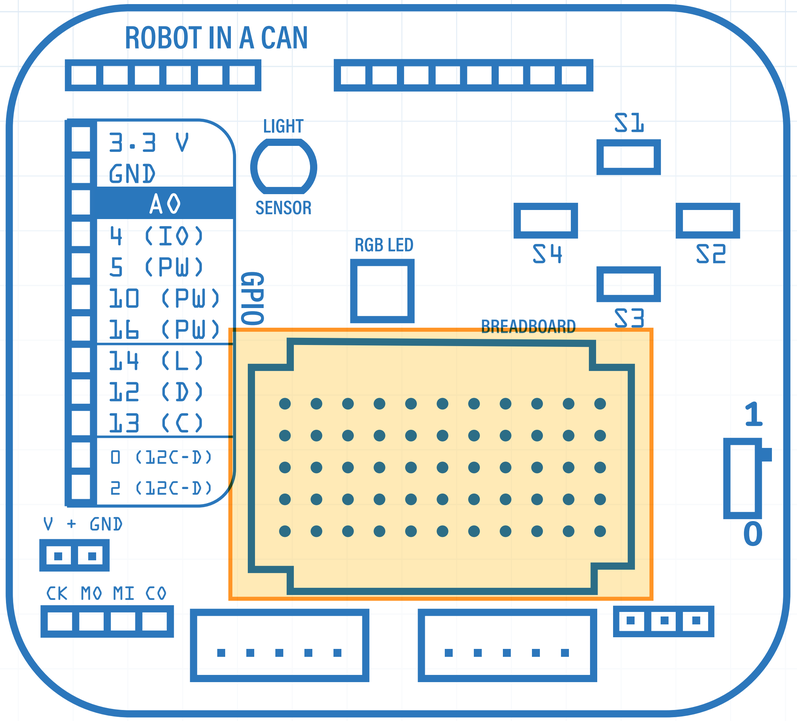


Patch Bay

Patch Bay

The patch bay is connected to the electronic parts on the eBrain.

We can patch the connections between our GPIO pins and the parts on our eBrain to activate them.

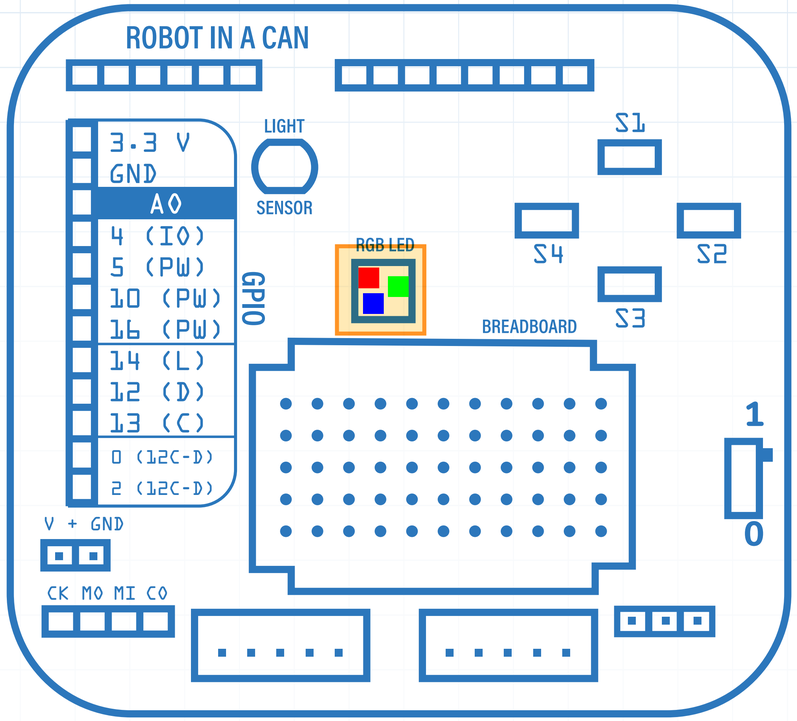


Breadboard

The Breadboard

Not for cutting bread, but instead for making circuits on the go.

Think of it like electrical tape. The breadboard can hold the wires of different components together, allowing your board to talk to them at the same time.



RGB LED

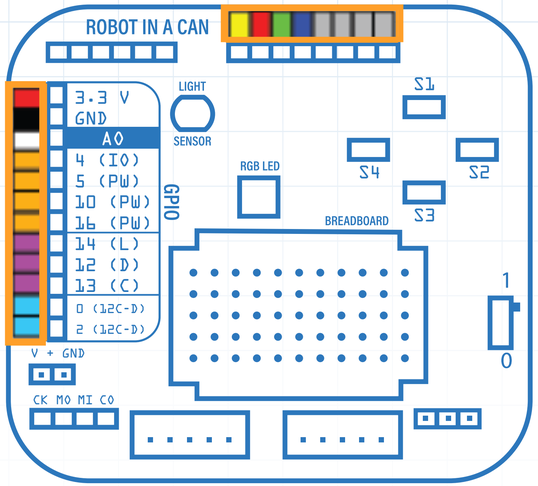
The RGB LED

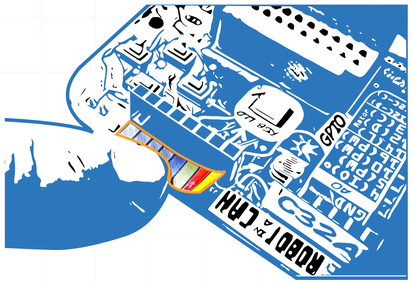
Your eBrain has three tiny lights on it, and we're going to create some circuits to turn them ON.

The tiny lights come in three colours: Red, Green and Blue, or RGB for short.

You've probably heard of RGB before, but did you know that by combining these three colours you can create 255 x 255 x 255 new colours? That's over 16 million different combinations!

More on colour mixing later...





Apply stickers to your eBrain

MATERIALS REQUIRED:

Sticker sheet, 1x eBrain

Cut stickers from sticker sheet

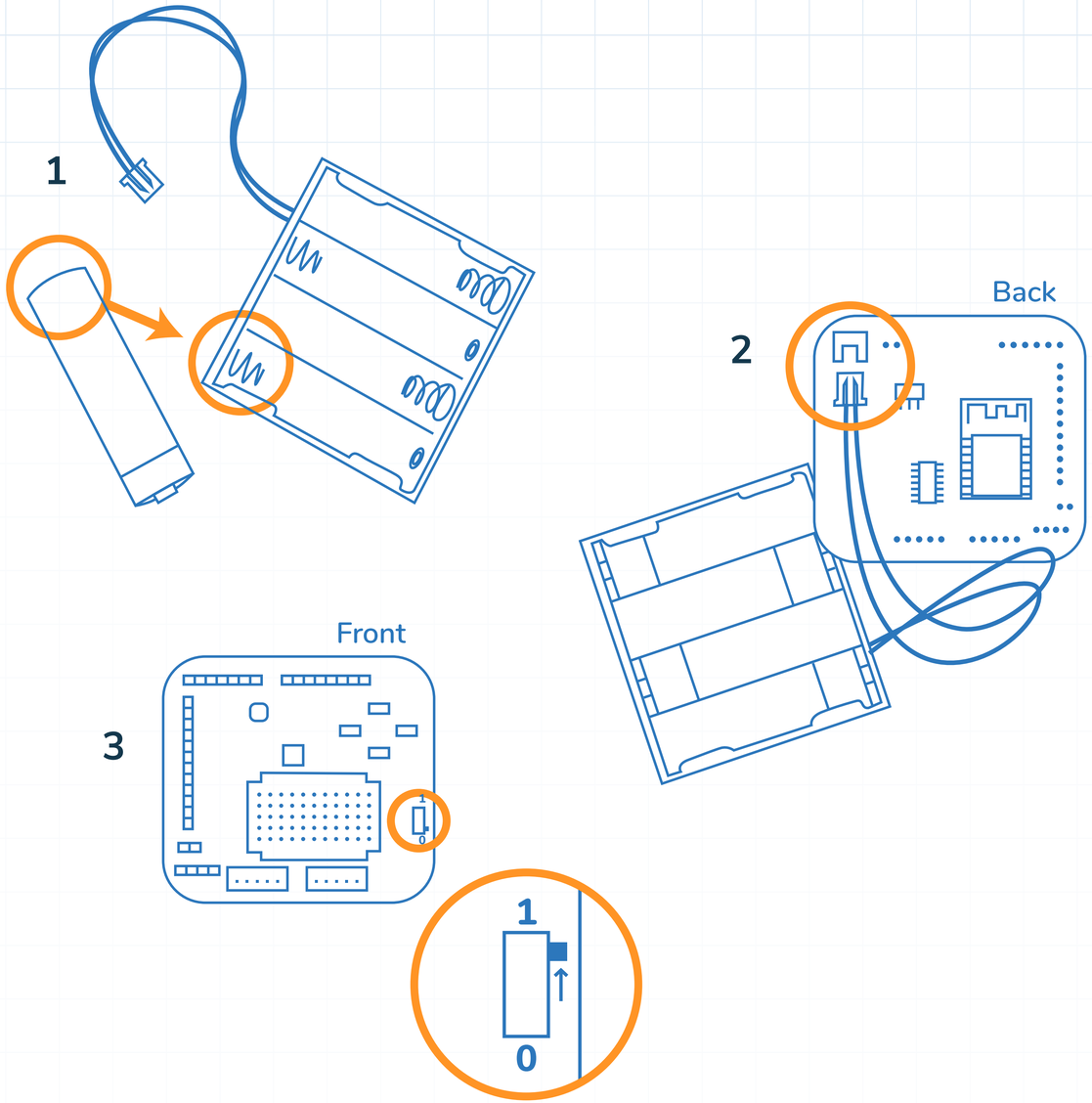
Using scissors cut out all 6 stickers. Try to leave as little white space around the edges.

Apply Patch Bay stickers

Following the illustration apply the Pach Bay stickers. Yellow on the left.

Apply GPIO stickers

Following the illustration apply the GPIO stickers. Red at the top.



Power up your eBrain

MATERIALS REQUIRED:

4x AA batteries, 1x battery pack, 1x eBrain

1 Insert 4x AA batteries

Place the flat side on the springs.

2 Connect the battery pack to the board

The connector is located on the back of the board. Make sure it is the right way and snaps fully in place.

3 Turn it on

The tiny switch is on the front of the board. Slide the switch it from 0 to 1 and you will see the yellow light turn on.

ACTIVITY SERIES 1.1

Getting familiar with your eBrain

EXERCISES:

1.1.1 Light up Red, Green, and Blue

1.1.2 Connect two wires

1.1.3 Connect two wires using breadboard

1.1.4 Mix RGB colors using breadboard

1.1.5 Turn on LED with buttons

MATERIALS REQUIRED:

4x AA batteries

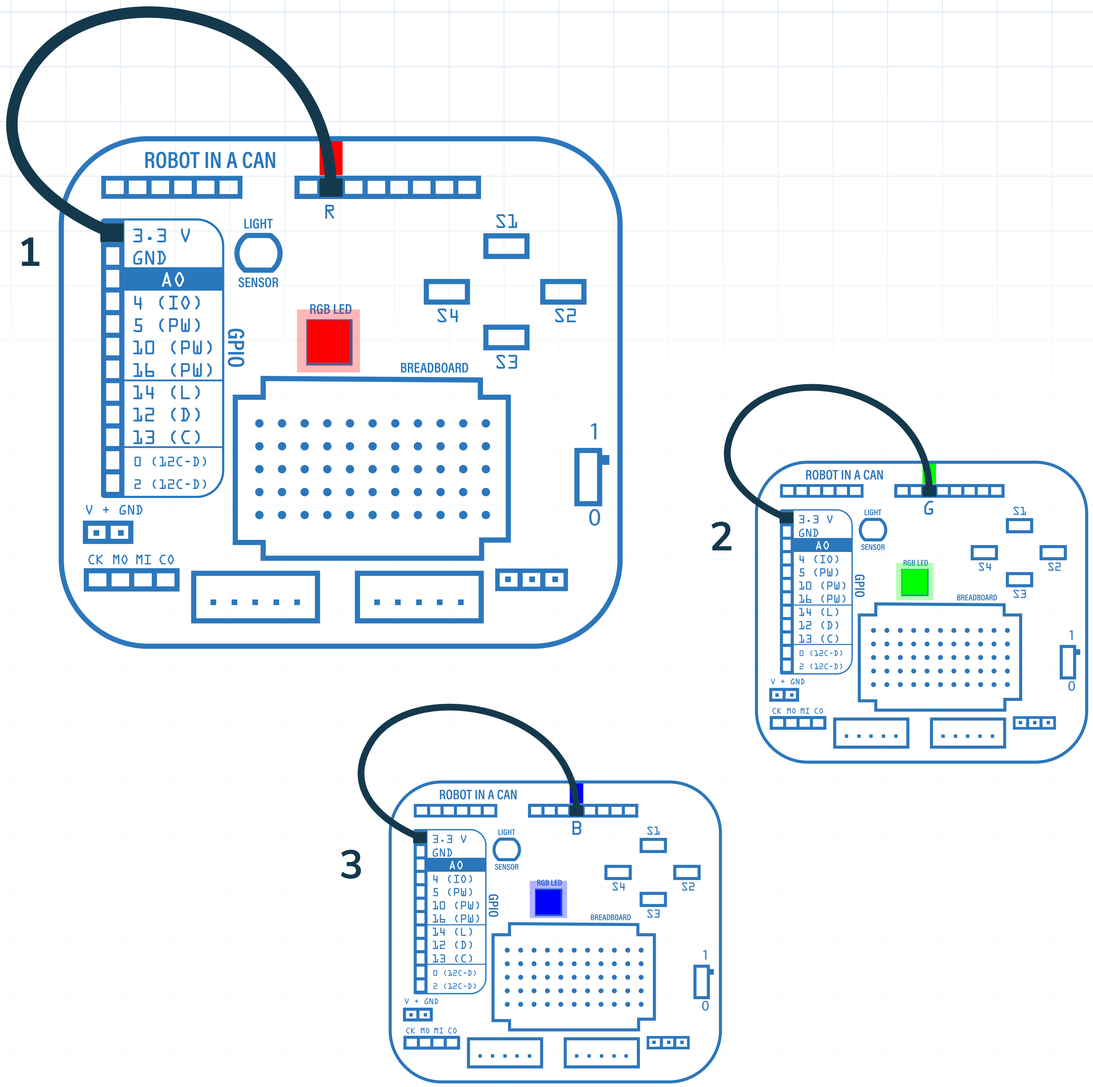
1x Battery pack

1x eBrain

4x Male-to-male wires

EST. TIME:

XX mins



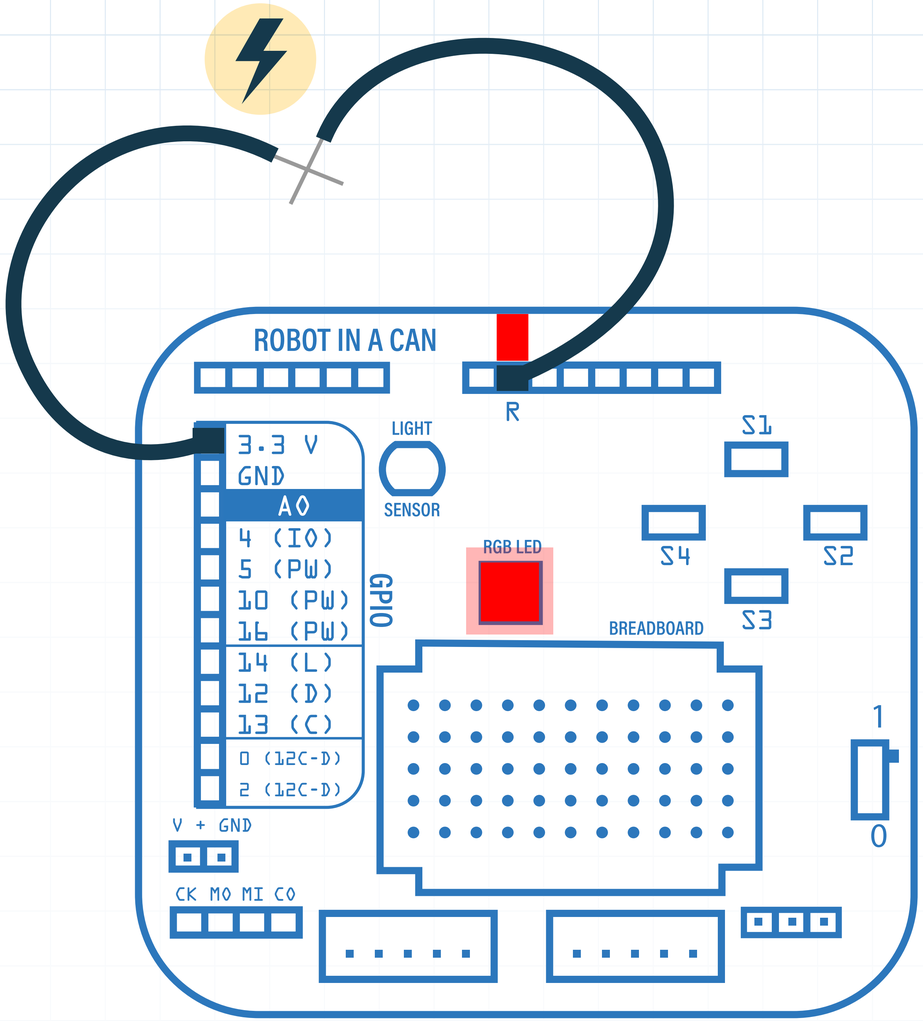
Light up Red, Green and Blue

1. Get a male-to-male wire and place end in the 3.3V power source, located on the GPIO bay.

2. Plug the other end into the hole marked R (Red) on the instrument panel. The LED on your board should light up red. Congrats, you've just made a circuit!

3. Next, remove the pin from the R plug and try the G (Green) and B (Blue) plugs. Sweet, you've just made three circuits!

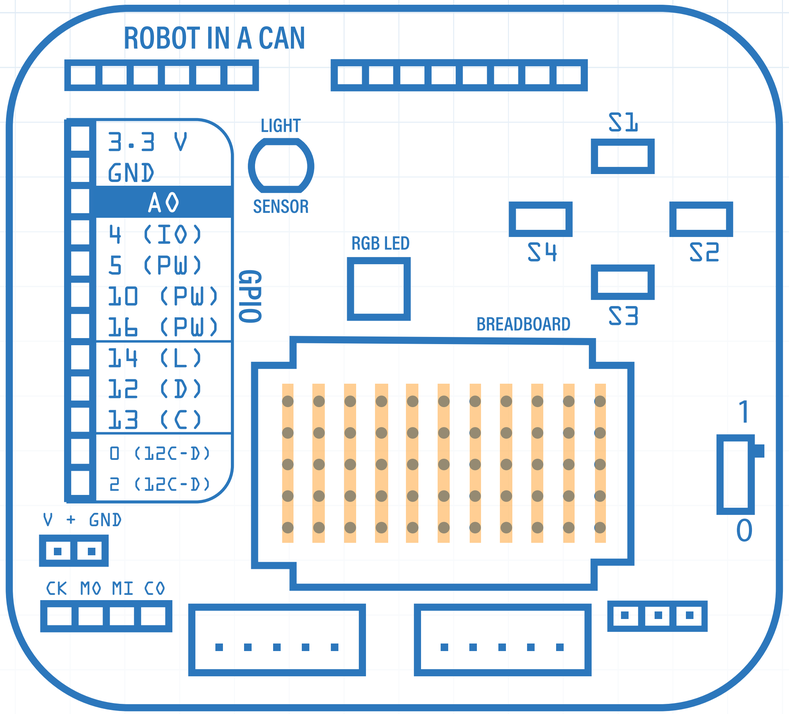
Note that the yellow plug on the far left of the instument panel is NOT a yellow light. This plug connects to the Light Sensor (LS). We'll learn more about this later.

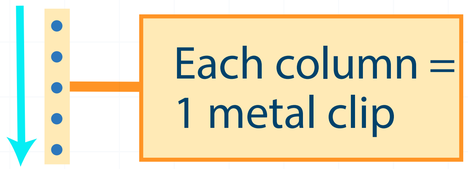


Connect two wires by holding them together

1. Get a second male-to-male wire. Place one wire in the 3.3V plug on the GPIO bay, and the other one in the R plug on the instrument panel.

2. Now take each wire in your hand and hold the two pins together. What happens? Your LED should light up red!



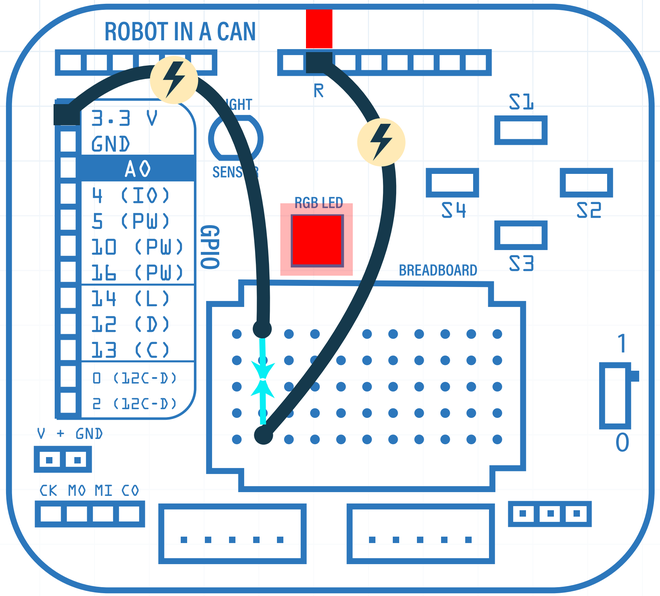


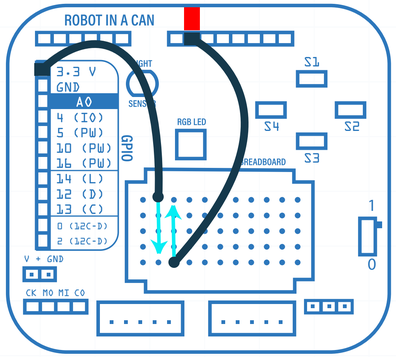
How to use the breadboard

Sure, you can connect wires by holding them together, but luckily there's much easier way, and that's to use the breadboard.

The breadboard let's you clip things together so you don't have to hold them. [link to video]

The breadboard on your eBrain has 11 column. Think of each vertical row being one (electrically conductive) metal clip.

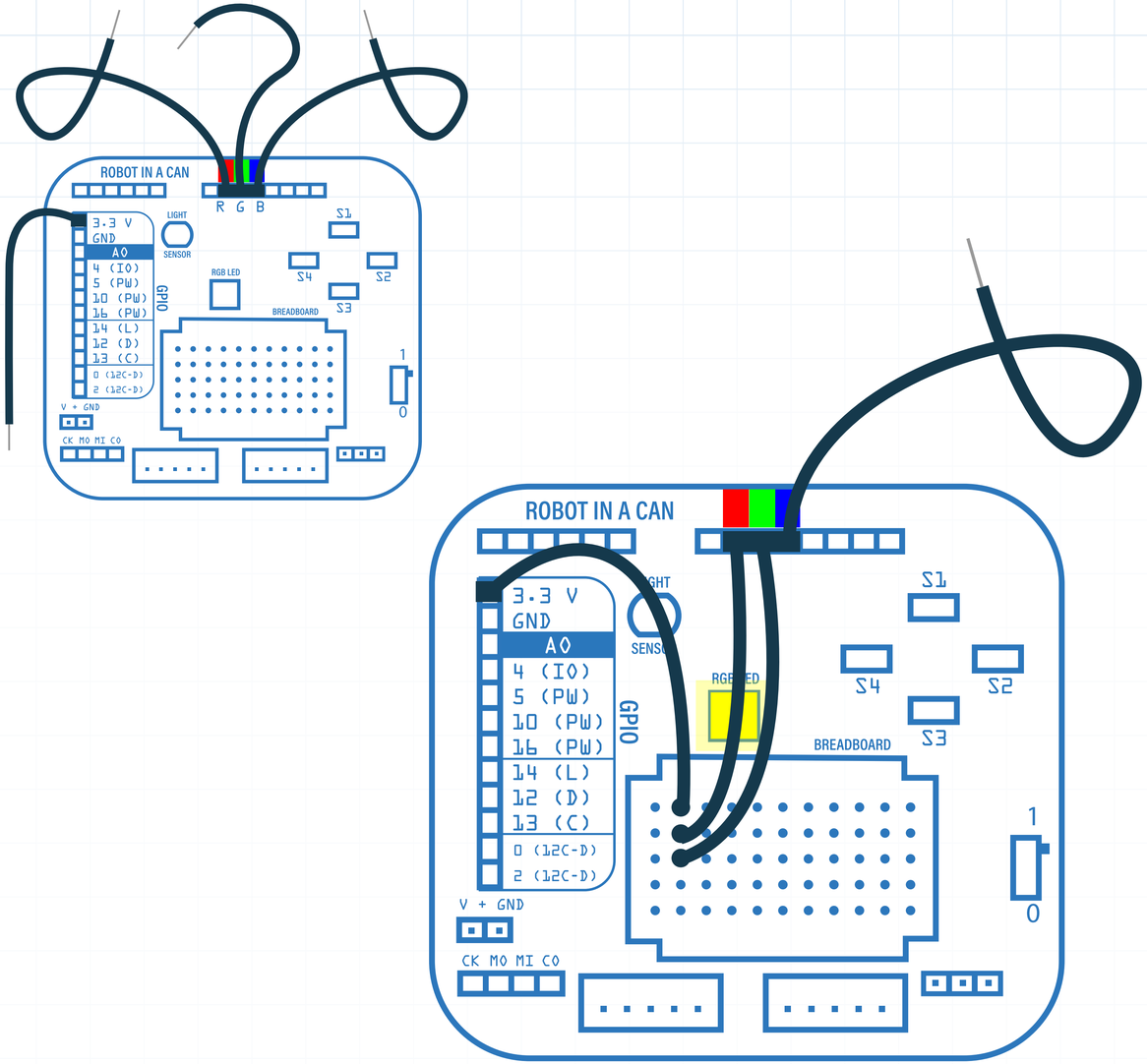




Connect two wires using the breadboard

1 Start with the wiring diagram from Exercise 1.1.2. This time, instead of using your fingers to hold the two wires together, place them in any two plugs in a vertical row on the breadboard. The red light should come on!

2 Next, try plugging the wires into different rows. See? They are no longer connected to the same clip, therefore the light won't turn on.



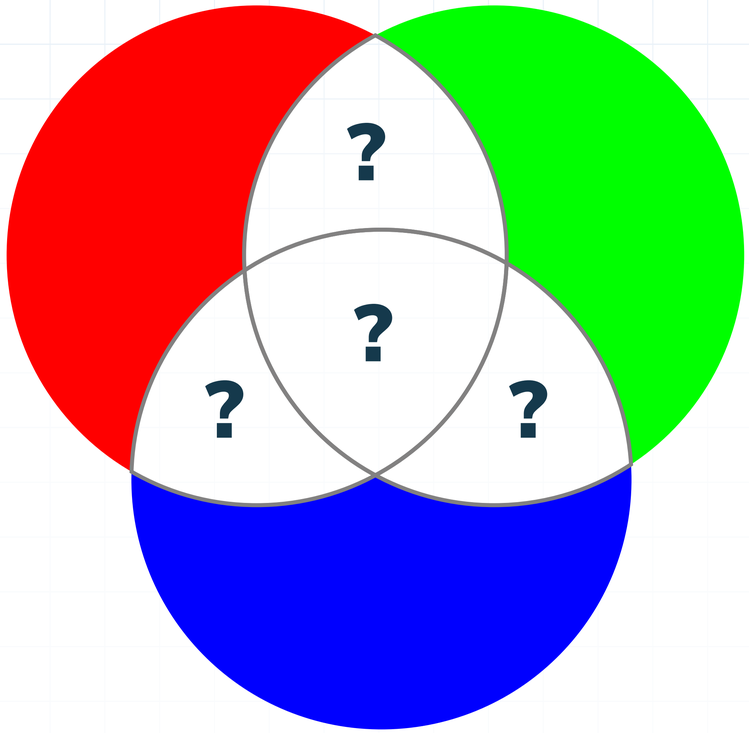
Mix RGB colors using the breadboard

Let's find out what happens when you combine Red, Green and Blue in different ways!

1. Take out four wires from your can. Place a wire in each light plug on the instrument panel and one in the 3.3 V power source.

2. What happens when we wire up multiple colors to a single row on the breadboard at the same time?

Continued on following page...



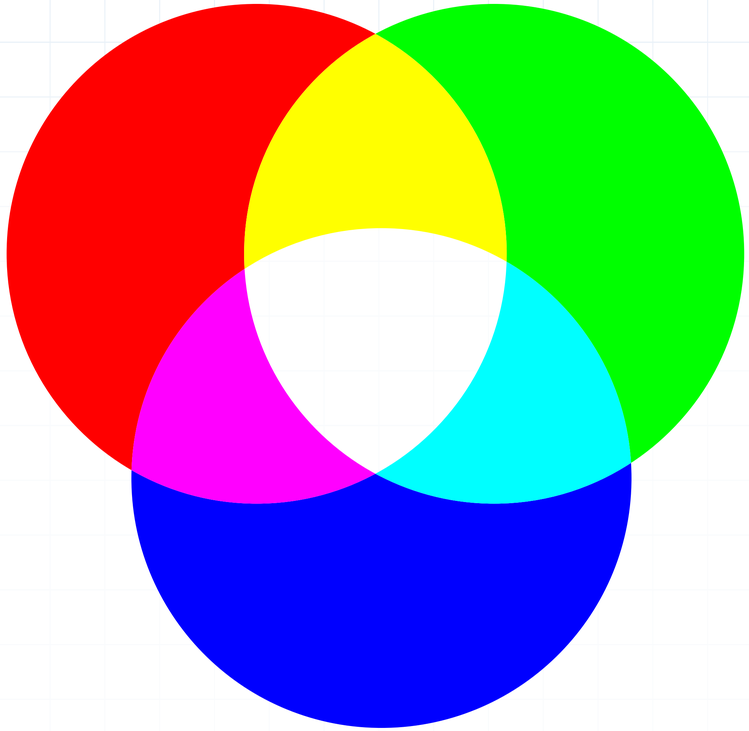
3 Try the following combinations:

Red + Green =

Red + Blue =

Green + Blue =

Red + Green + Blue =



RGB color mixing results

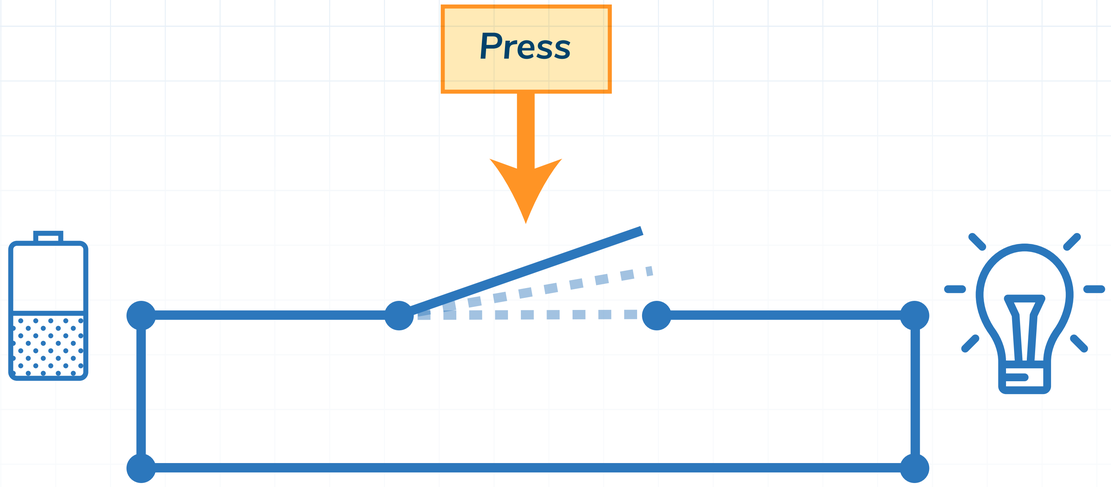
Red and green make **Yellow**

Red and blue make **Magenta**

Green and Blue make **Cyan**

Red, Green and Blue make **White**

These colour results might be a little surprising! Mixing lights isn't like mixing paints! [Click here] to learn more about additive vs subtractive colour.

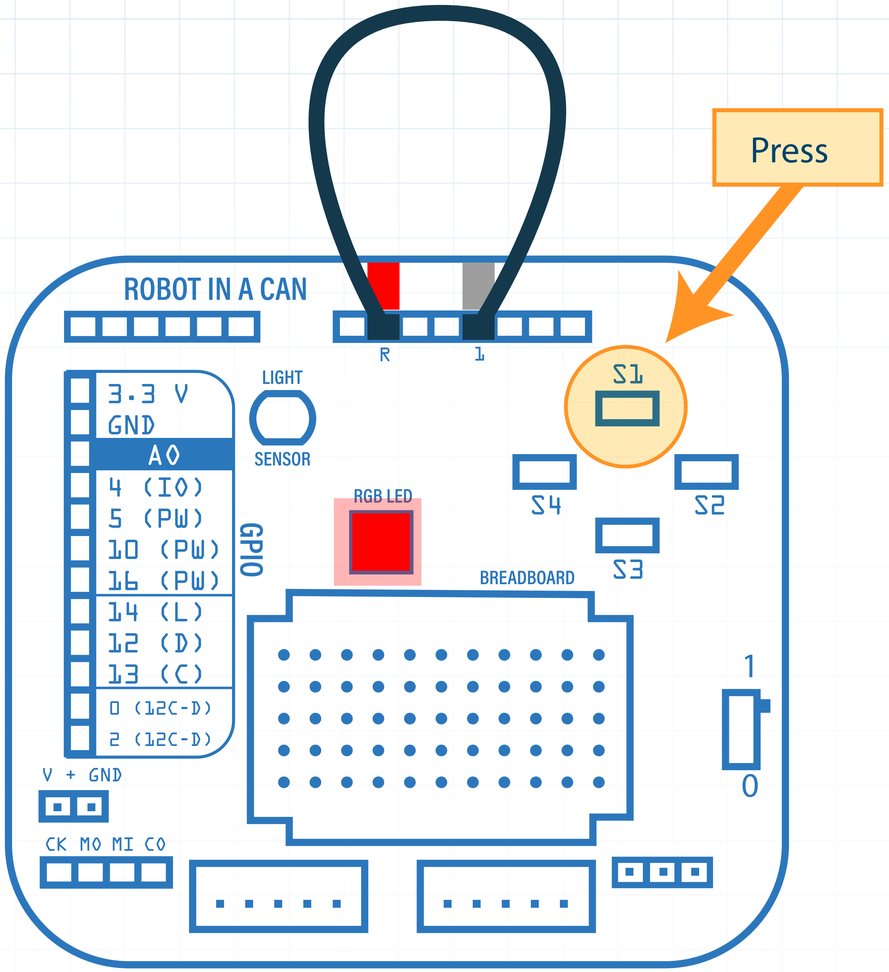


eBrain's buttons

When you press a button you allow electricity to flow in a complete circuit, sending power to whatever is attached!

Your eBrain has 4 buttons, each with their own plug in the patch bay.

The buttons are directly connected to the battery, so you don't need to connect to the 3.3 V plug!



Turn on the LED by using a button

Now let's try hooking up a button so we can turn our light on and off without unplugging any cables!

1. Use a male-to-male wire to connect R and 1 on the patch bay.

2. Hold down button S1 - The light turns on!

Great job!

You've just learned how to use three very essential parts of your eBrain.

Review

GPIO bay

You plugged in the battery pack and used it's power via the 3.3 V plug on the GPIO panel.

Patch bay

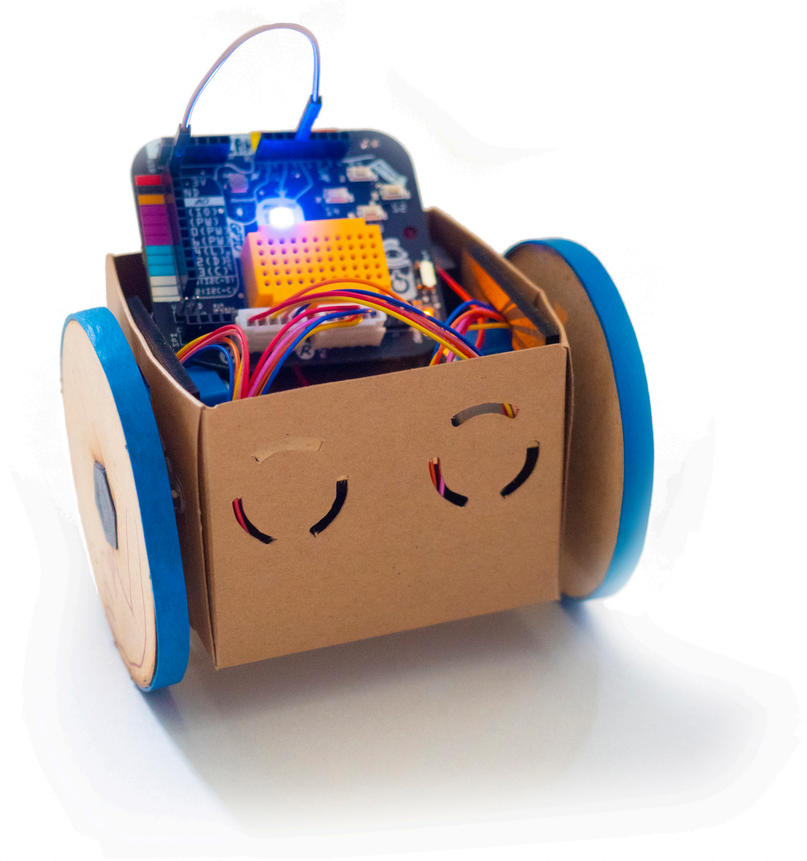
You explored the RGB LED and the buttons on the patch bay.

Breadboard

You learned how to use the breadboard and connect various wires together and create new colour combinations!

Chapter 2

Your first robot



Your first robot

What's a robot anyway?

Robots are awesome! Chances are you like robots or you wouldn't have bought this kit.

In this Chapter 2 you will build your first robot, and in the following chapter you will learn how to give it commands and make it move using Snap!

Keep in mind, building a moving robot is just one small application of what you can do with the kit. In this exercise you will use the two motors to propel the robot forward, but as you get more comfortable with the various components, you can build other projects like a light switch flipper or a pet feeder!

But let's not get ahead of ourselves...

Make your own robot

EXERCISES:

2.1.0 Prepare your workspace

2.1.1 Decorate robot body

2.1.2 Fold robot body

2.1.3 Prepare wheels and skeleton

2.1.4 Attach motors and wheels

2.1.5 Hook up eBrain and battery

2.1.6 Place it all inside

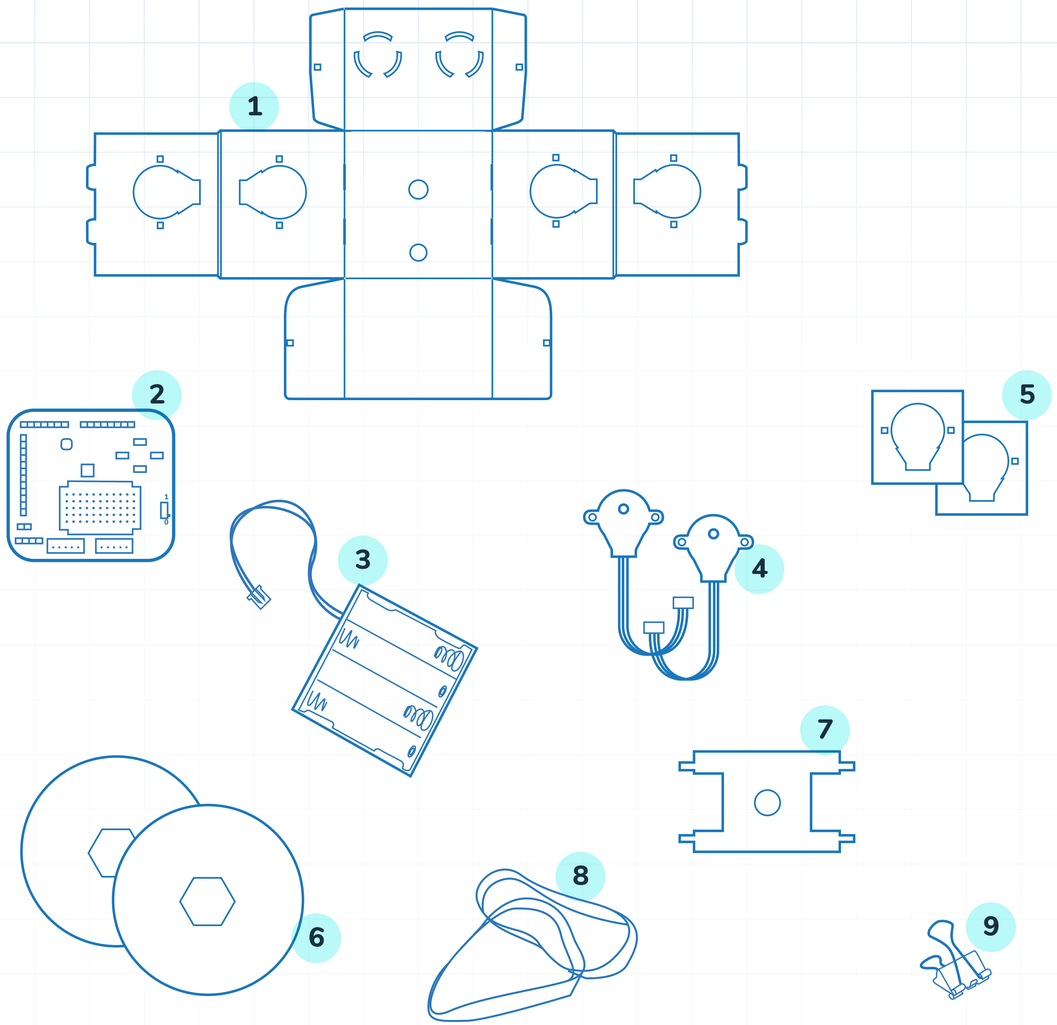
MATERIALS REQUIRED:

Robot Can

Art supplies for decorating

EST. TIME:

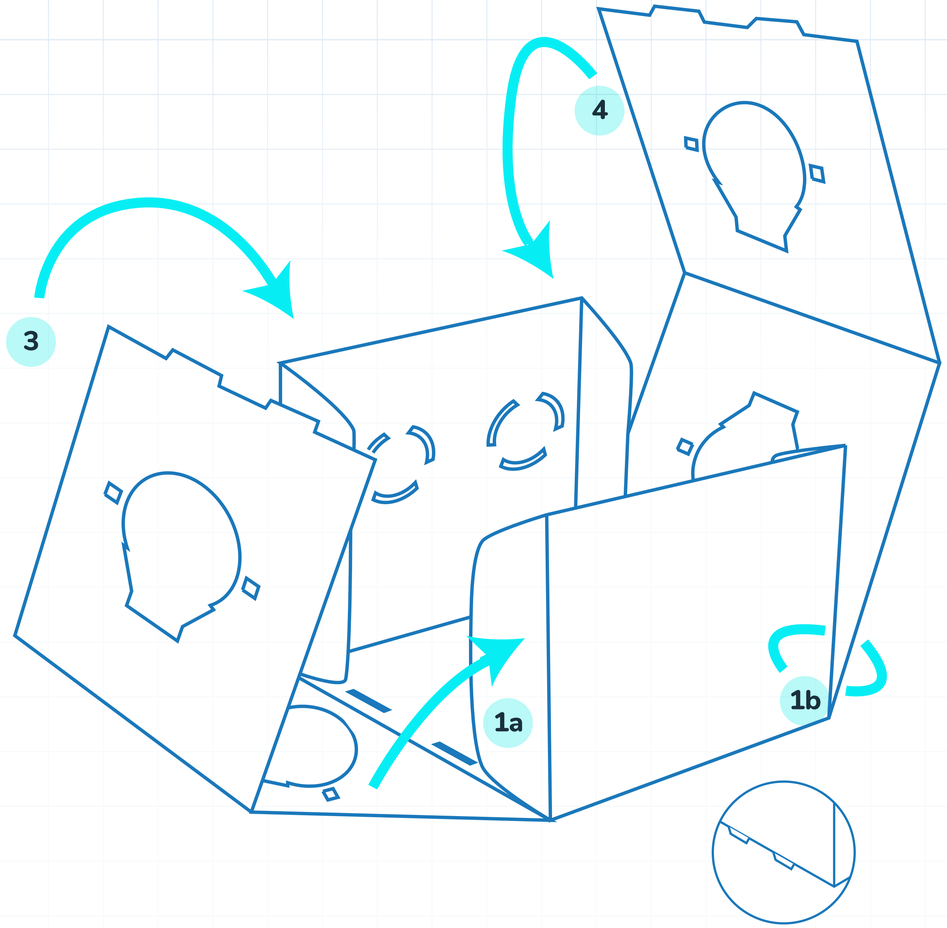
XX mins



Prepare your workspace

Remove these items from your can and place them on your table:

1. 1x Carboard Robot Body
2. 1x eBrain
3. 1x Battery Pack
4. 2x Motors
5. 2x Motor Holders
6. 2x Wheels
7. 2x Elastics
8. 1x Chassis
9. 1x Bulldog Clip



Fold your robot body

1 **Start with a dry run!** Don't tape anything until you've gone through the instructions at least once!

Once you've finished the dry run, start over and remove the film from the double-sided tape to attach the edges permanently.

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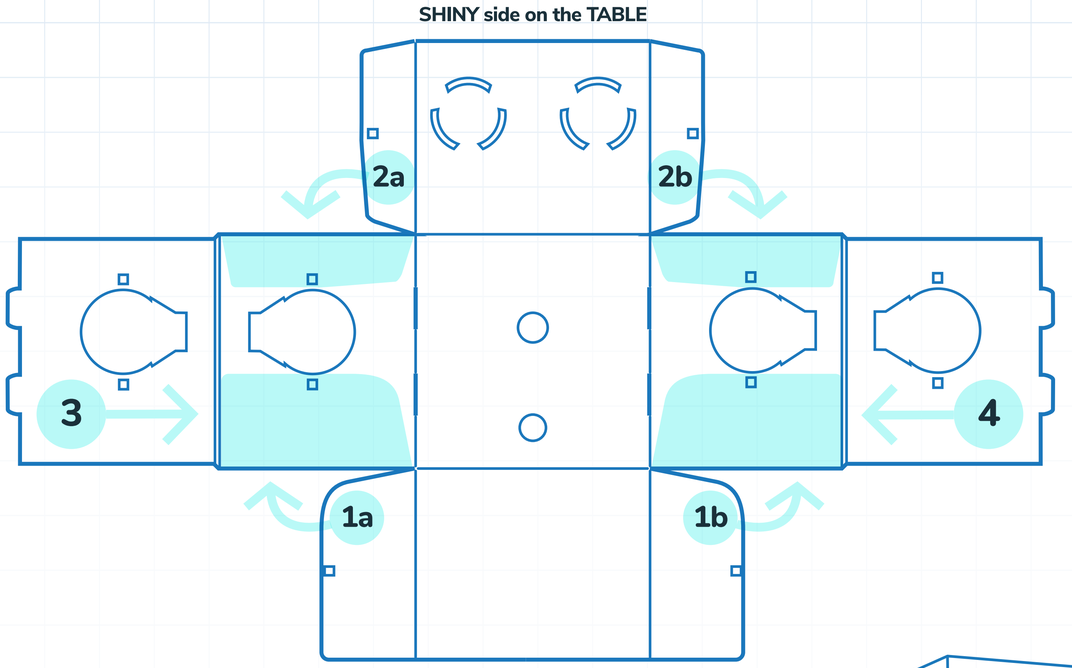
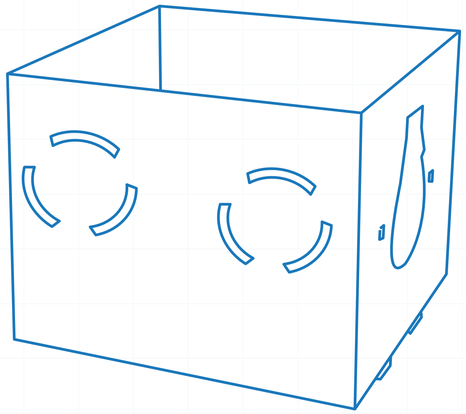
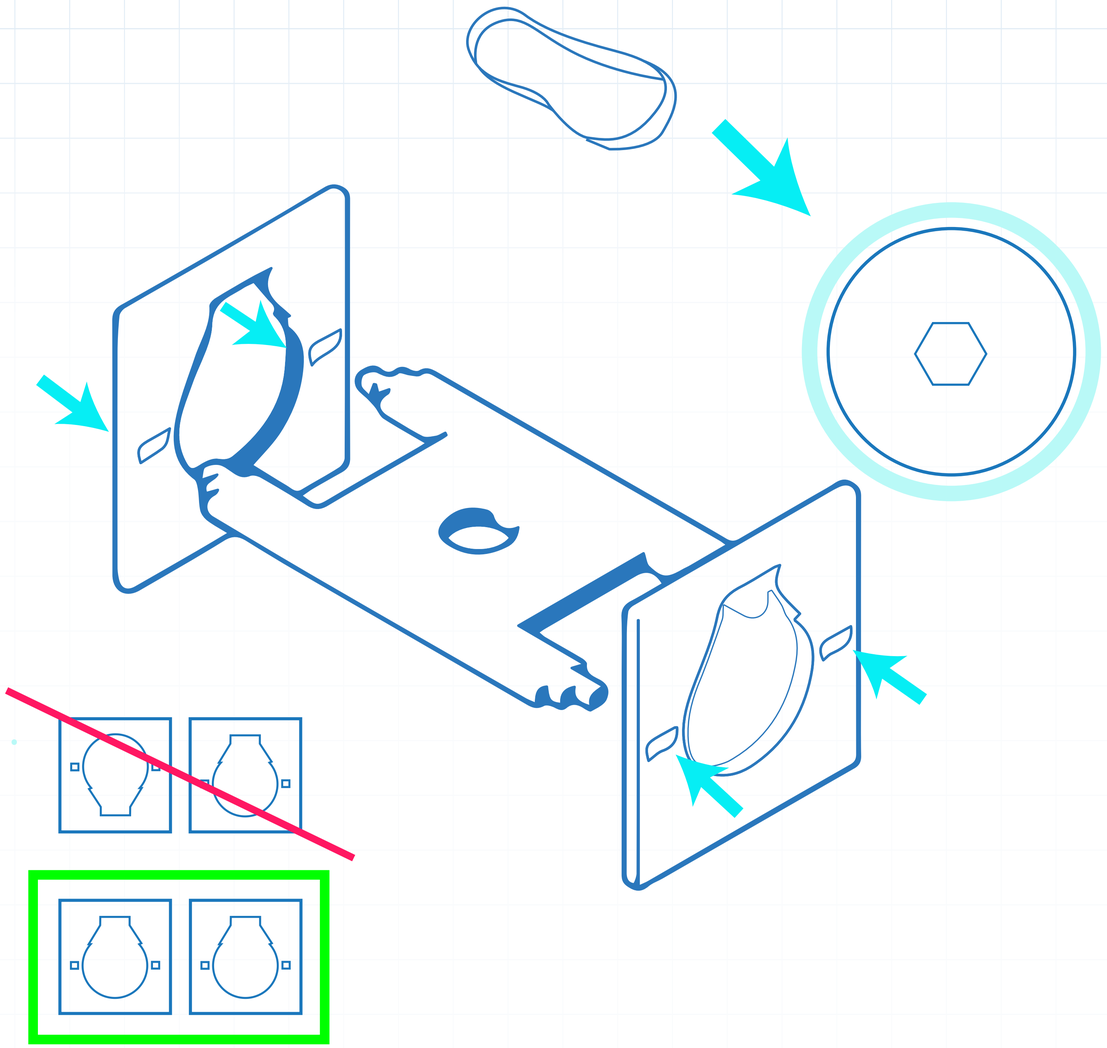




2 Place your cardboard robot body on your workspace **shiny side down**. The shiny side will be the outside of the robot and the matte side will be the inside. If you'd like to decorate your robot you can do this before assembly.

3 Following the image on this page, attach tabs 1a and 1b to the long horizontal panel. Then attach 2a and 2b. This should create 4 sides and a base.

Next, fold down flaps 3 and 4, making sure to plug them into the tabs at the bottom.

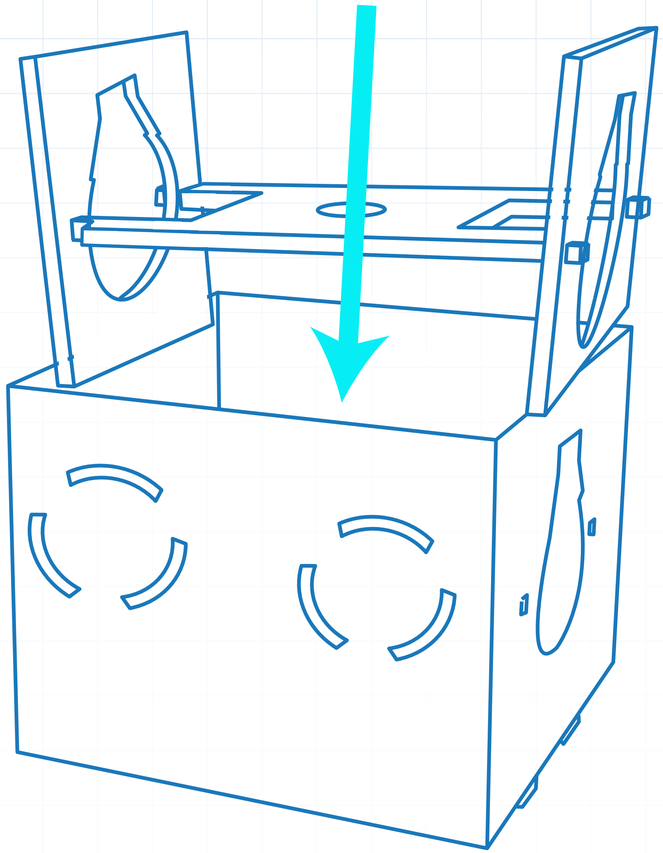


Prepare the wheels and skeleton

1. Place the elastic bands along the outer edge of the wheels. The elastics add friction and prevent your wheels from slipping around when the robot is moving.

2. Create the skeleton by attaching the two motor holders to the chassis. Make sure the openings on the motor holders lineup!

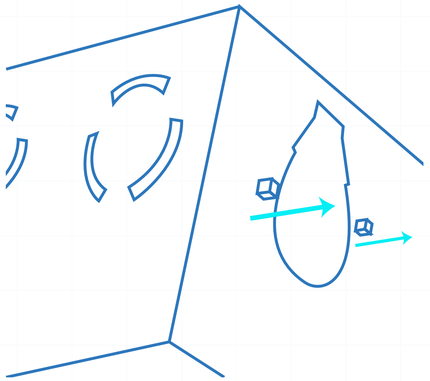
You can reinforce your wheels by glueing the elastics to the wheels. We recommend 5-minute epoxy. Just make sure not to glue the wheel to the motor!

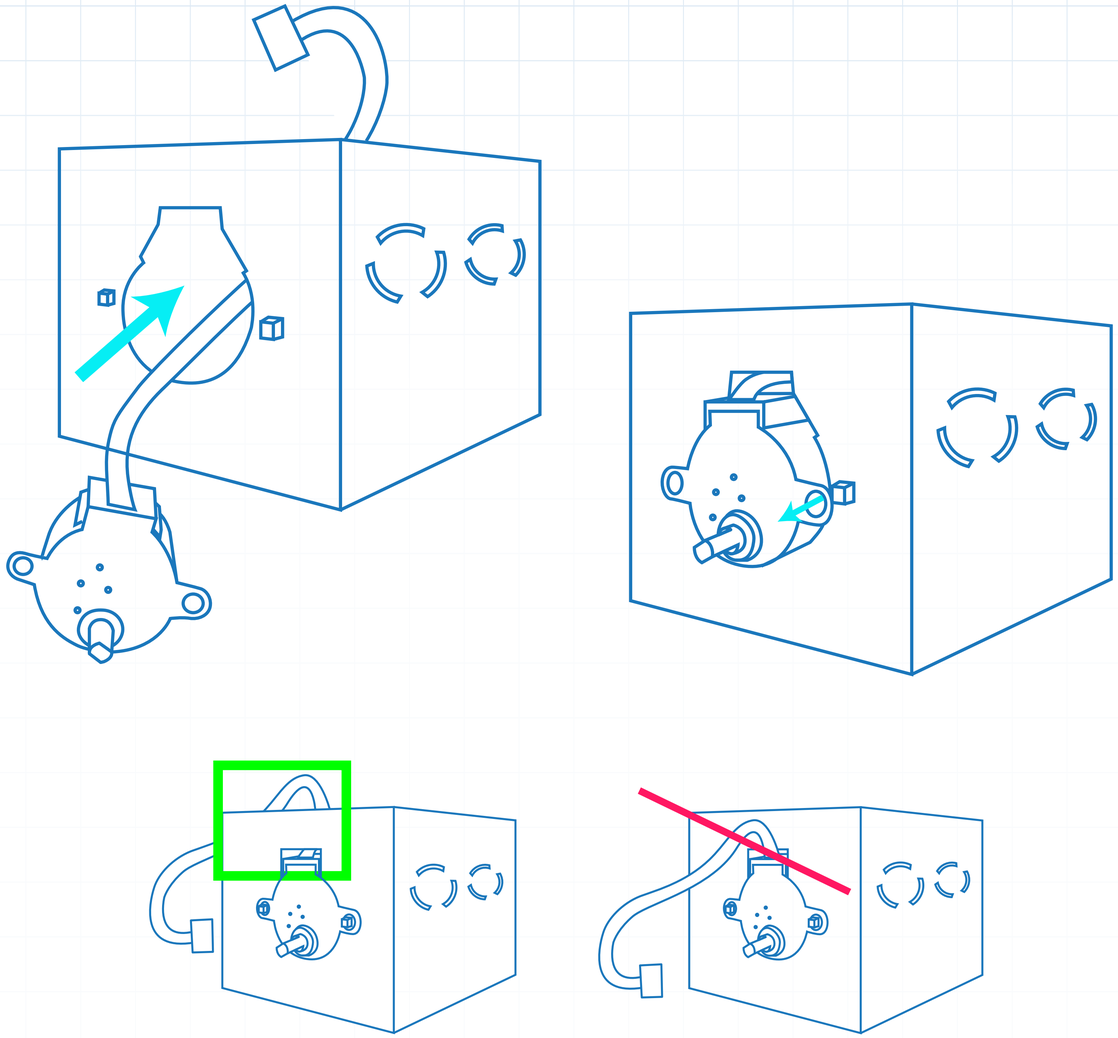


Drop-in the robot skeleton

1. Drop the skeleton into the robot body and lineup the motor holder holes.

2. Push the pegs through the cardboard.

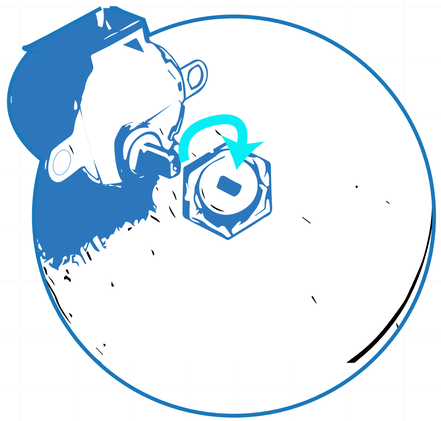


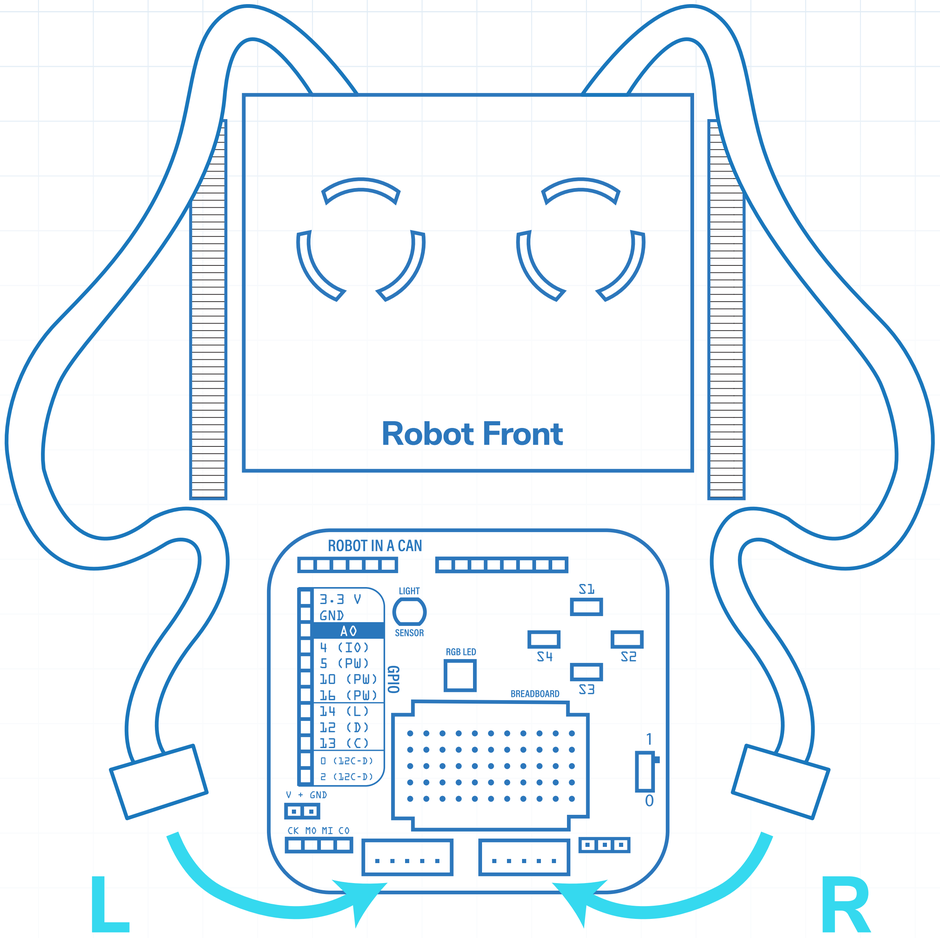


Attach the motors and wheels

1 Attach the motors by threading the wire **from the outside into the robot**. Align the motor mount holes with the pegs so it's flush with the side of the robot. Make sure that the motor axle faces out!

2 Insert the wheel hub into the motor axle. You may have to press hard!

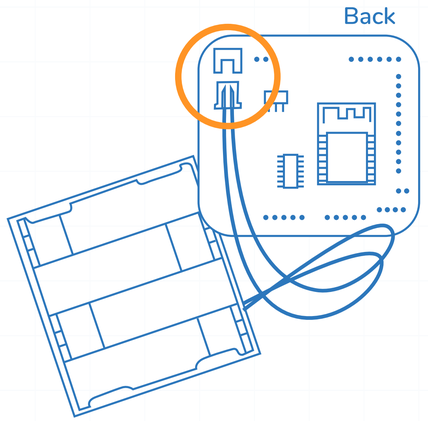


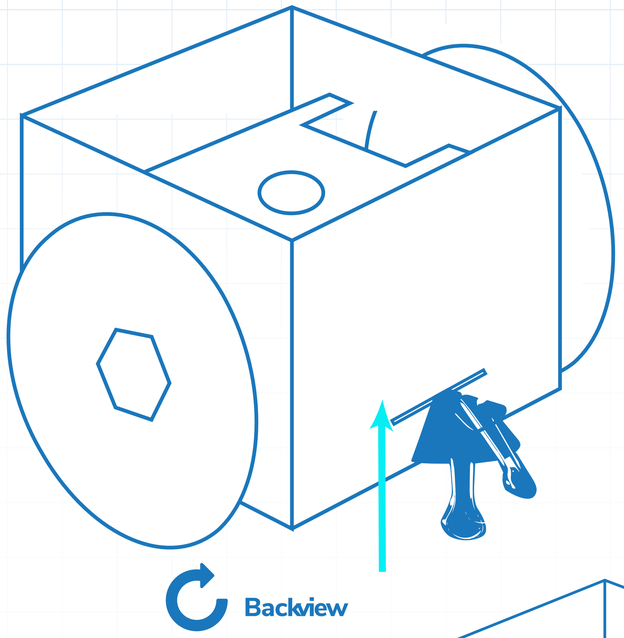


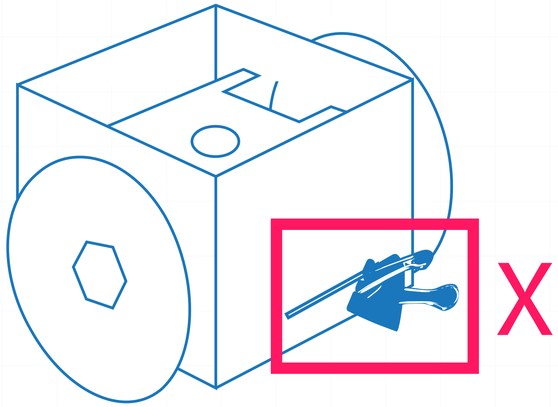
Hook up the eBrain

1. Attach the motors to the eBrain. Each motor connects to either the left or right side when viewed from the front. Check the diagram to ensure that you don't hook them up backwards.

2. Plug-in battery pack. The plug is on the back of the board.

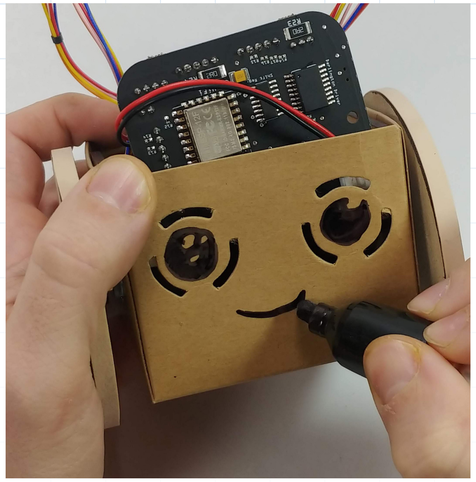


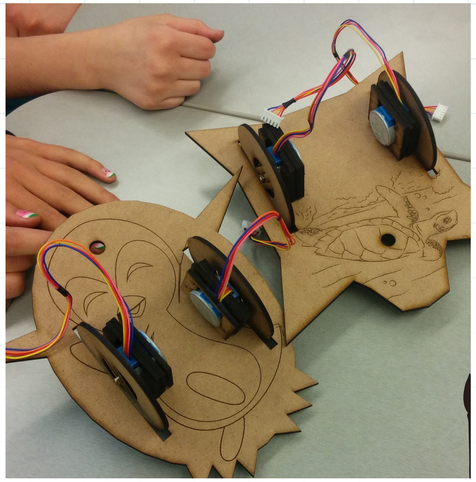




3 Place the battery pack inside the robot, behind the chassis towards the back. Placing the battery pack here balances the weight of the robot.

4 Attach the ‘secret clip’ a.k.a. the ‘bulldog clip’. Make sure to follow the diagram on this page to insert it correctly!



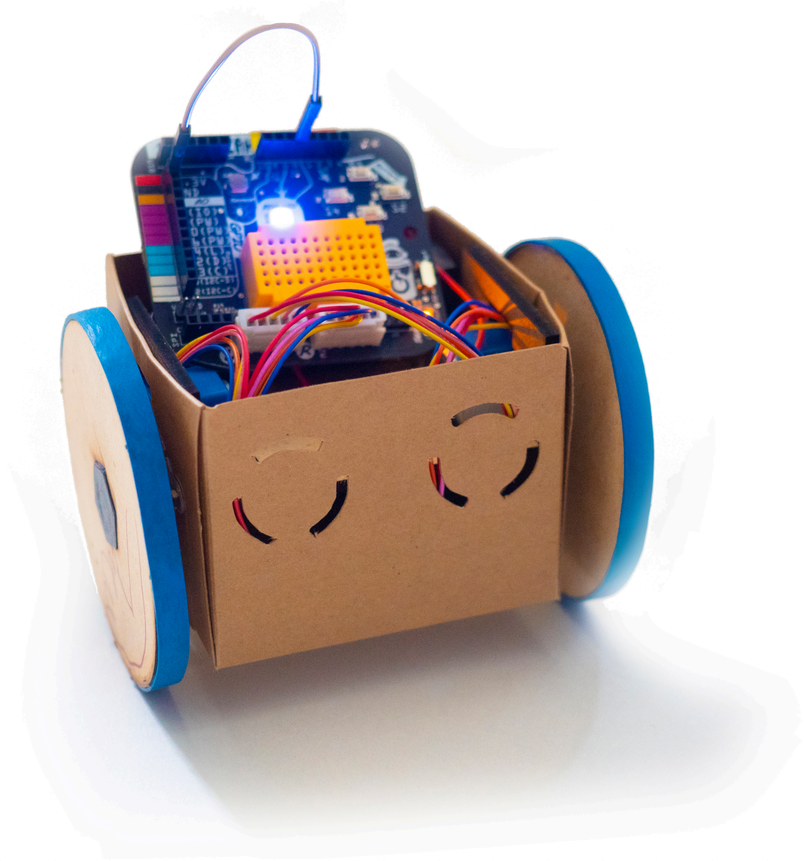


Decorate your robot body

There are so many different things you can do to decorate and customize your robot body!

You can build your robot special for things like: robot sumo competitions, playing soccer with ping pong balls, syncronized dancing, and more!

Build your robot the way you want it and remember you can build a robot out of almost any piece of cardboard you find!



Awesome!

You've just assembled your robot!

Next you'll some programming basic and move your robot around!

Chapter 3

Programming and moving your robot

How to brush your teeth

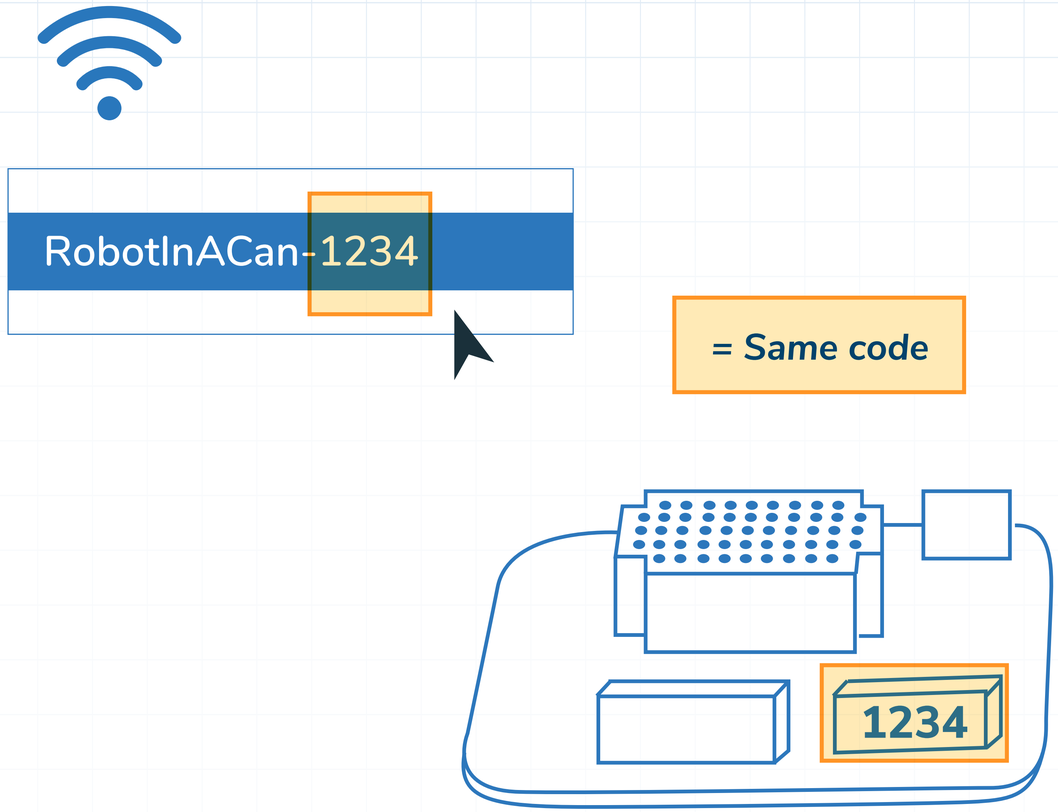
1. Pick up toothbrush
2. Pick up toothpaste. Unscrew cap and squeeze a small amount on your toothbrush.
3. Wet toothbrush.
4. Put toothbrush in mouth...

A program is a process or set of instructions that is followed to solve a problem.

Programs are like very specific instructions placed into a list. The computer steps through that list one item at a time executing each instruction. Could you make a list of instructions that explain how you brush your teeth?

These instructions are converted into a code that computers can read and execute.

You can control your robot's eBrain with blocks of code Let's learn how it works!



Connect to your eBrain

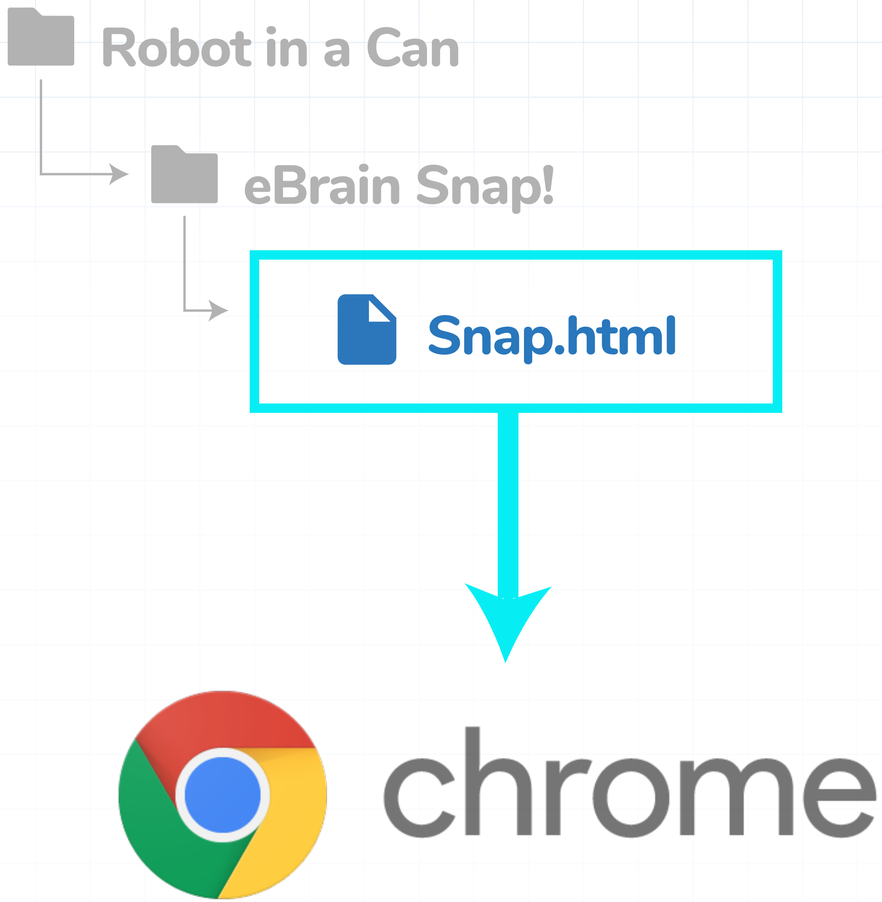
MATERIALS REQUIRED:
1x powered eBrain, 1x computer, tablet or phone

In order to control your robot, you'll need to connect to your eBrain.

1. Turn your kit on.

2. Click on the wifi icon on your computer and look for the robot in a can network. Select it to connect to your kit's wifi network.

Check for the wifi ID code that is written on your board to make sure you are connected to the right network.

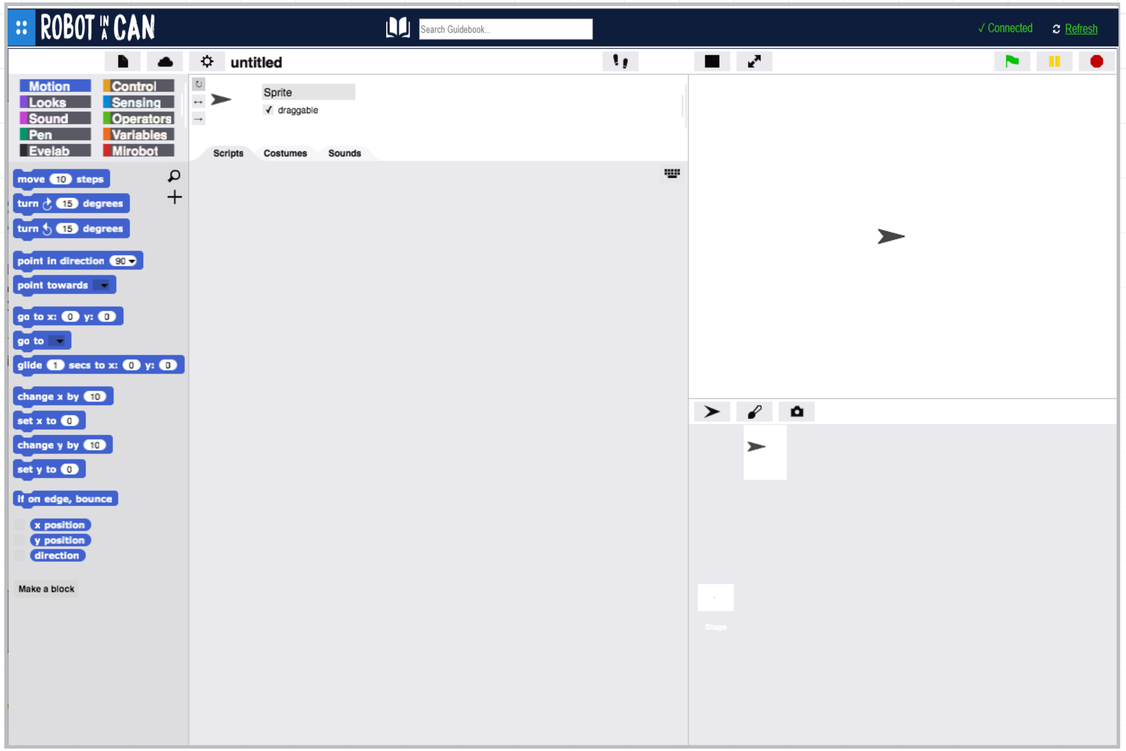


Launch Snap!, your programming tool

You should have already downloaded the ‘Robot in a Can Toolkit’ folder from Start.RobotinaCan.com. (This guide was in that folder.)

In that folder, locate a sub-folder titled ‘eBrain Snap’.

Locate and open Snap.html using Google Chrome.



Intro to Snap!

A visual programming tool

It allows you to create programs by dragging blocks of instructions and snapping them together on the scripting area. We're going to go over some important areas.

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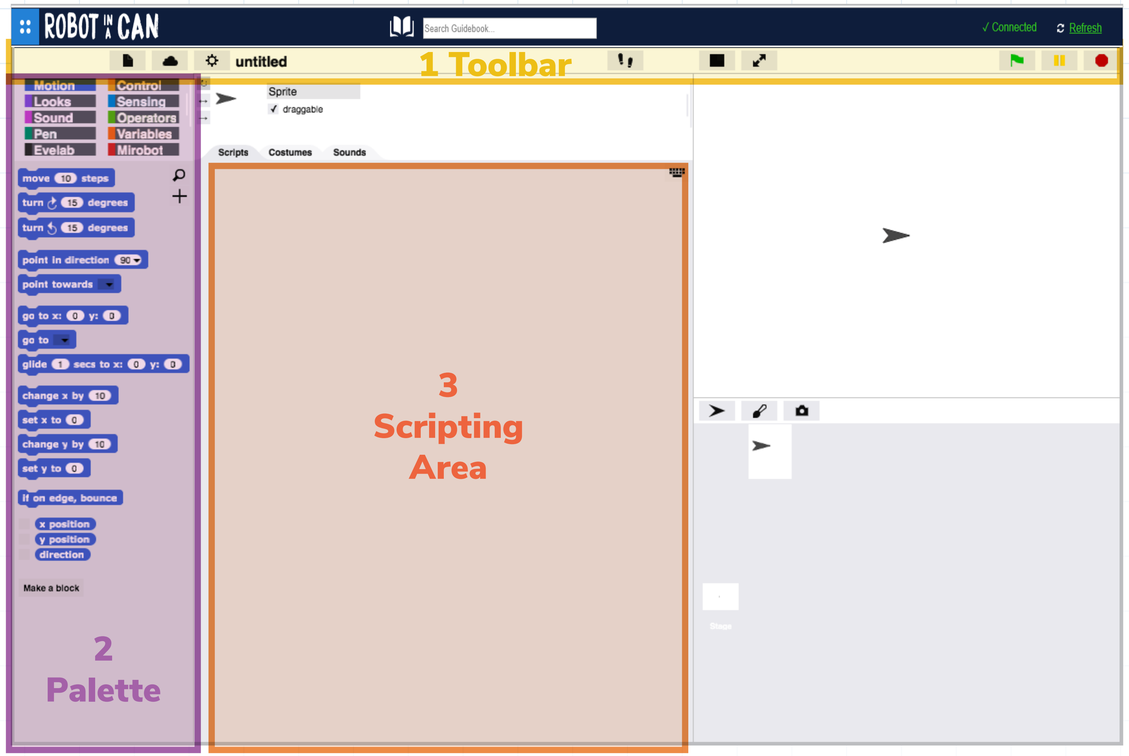

1 - Toolbar: Press the green flag to run your program and the red button to stop.

2 - Palette: This is where you can find your command blocks. They are organised by function and color.

3 - Scripting area: Drag blocks from the palette to the scripting area and snap them together to make a list of commands.

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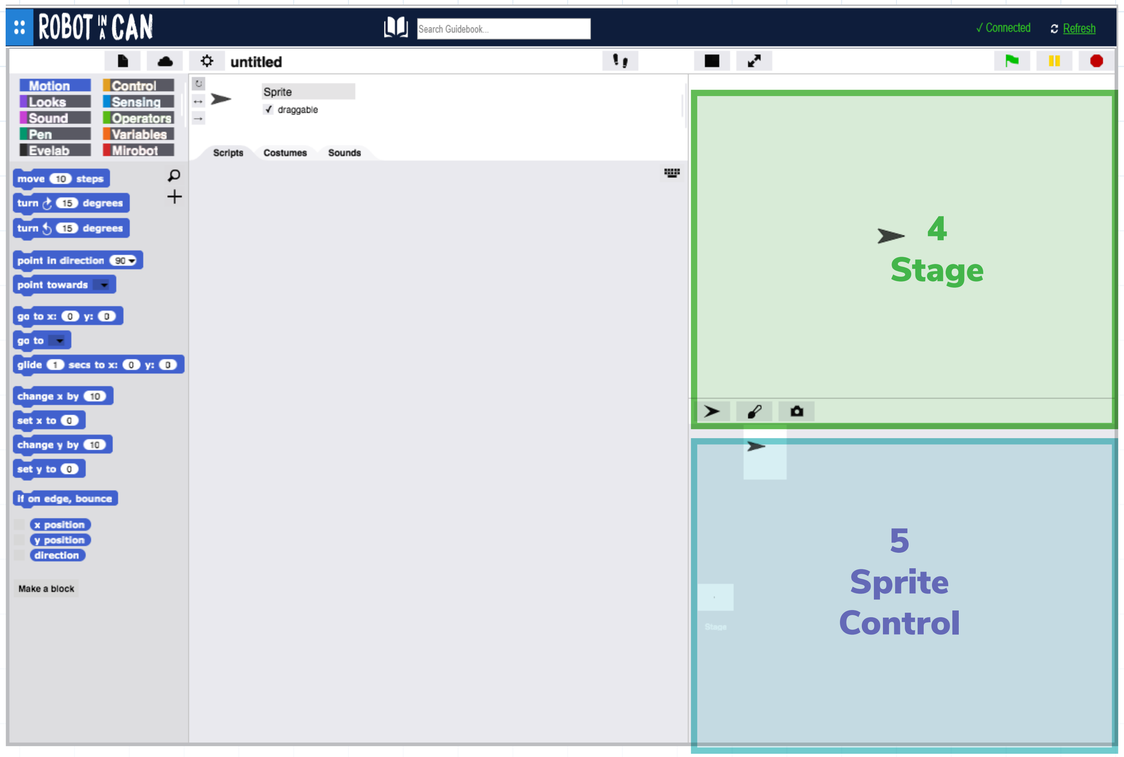


4 - Stage: The Stage is the area where you can add visual elements to your programs. For example if you were to make a game it would be here in the stage area where you would see and play the game.

5 - Sprite control: Sprites are visual objects on the stage. In this case that means the little triangular arrow on the stage. Imagine you were building a game, each charater would be a sprite. Every coin, enemy, or item would also be other sprites. In the sprite control you can make new sprites and control each sprite you have made. Remember all of the code in the scripting area, as well as the sounds and costumes only apply to the sprite that is currently selected!

Animate your robot

EXERCISES:

3.1.1 Draw with your sprite on screen

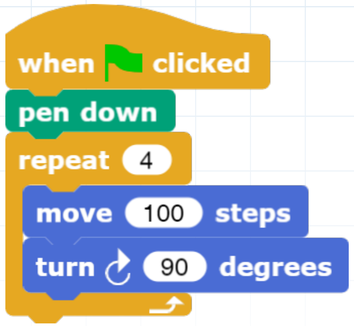
3.1.2 Move your robot

MATERIALS REQUIRED:

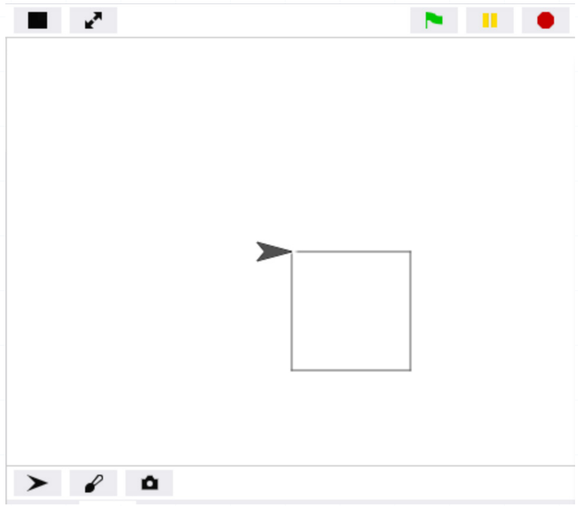
Assembled robot, turned ON and connected to Snap!

EST. TIME:

XX mins



Build the code shown here



Write your first program

1 Go to the **Control** block section on the palette (orange). The control blocks control the order in which the computer steps through instructions.

Pick the **when green flag clicked** block and the **repeat** block by dragging them one by one onto the scripting area.

Change the parameters on the repeat block to 4.

Continued on following page...

2 Next go to the **Motion** blocks section (blue). These blocks control the arrow in the stage area. This arrow is called the sprite. Think of it as an actor on the stage.

Pick the **move 10 steps** block and the **turn 15 degrees** block and drag them into the scripting area.

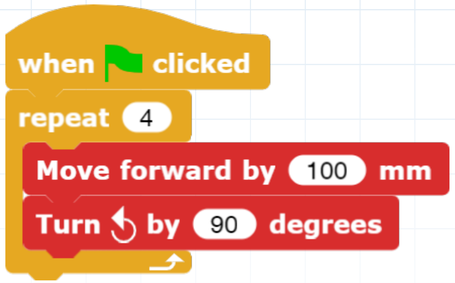
Change the parameters to 100 steps and 90 degrees.

3 Open the **Pen** blocks section tag in green. This section allows the sprite to draw.

Take the **pen down** block and drag it to the scripting area.

Arrange your blocks according to the code sample.

4 Click the green flag button to begin the program. Good Job! You should now see a square drawn on the stage.



Build the code shown here

Bonus! There are a few more red **eRobot** commands try out. See what they do can you make a square without the repeat? See what happens when you change the numbers around. Can you make other shapes?

Programming your robot

Let's write another program to draw a square. Instead of having your sprite draw it virtually, let's have your robot move!

Last time we used the blue **Motion** blocks control the sprite. This time, use the red **eRobot** blocks to control your robot.

Build the code sample on this page and when you're ready, click the green flag button to run the program.

Draw with your robot

EXERCISES:

3.2.1 Draw a square

3.2.2 Draw a triangle

3.2.3 Draw a hexagon

MATERIALS REQUIRED:

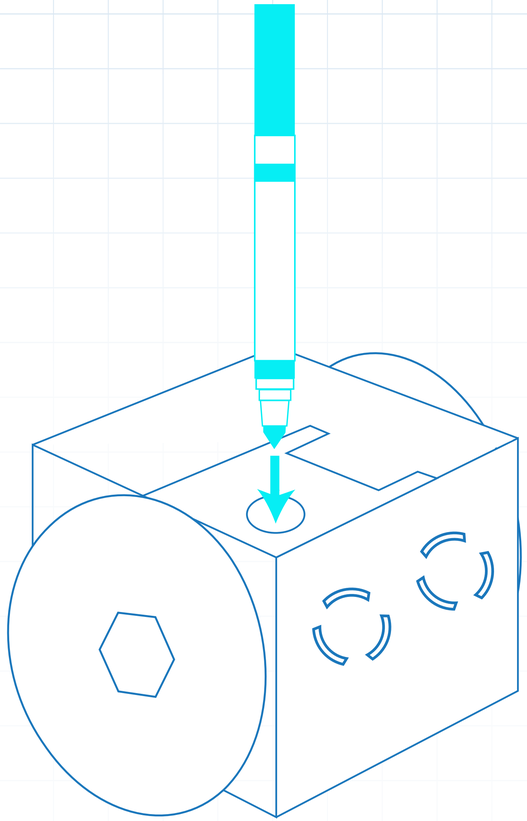
Assembled robot, turned ON and connected to Snap!

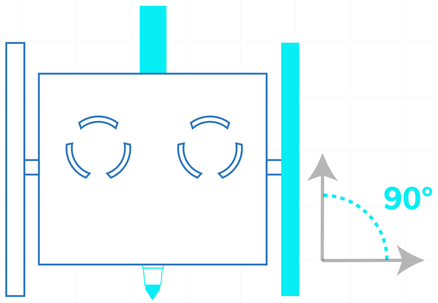
Washable marker or pen

Large paper to draw on

EST. TIME:

XX mins





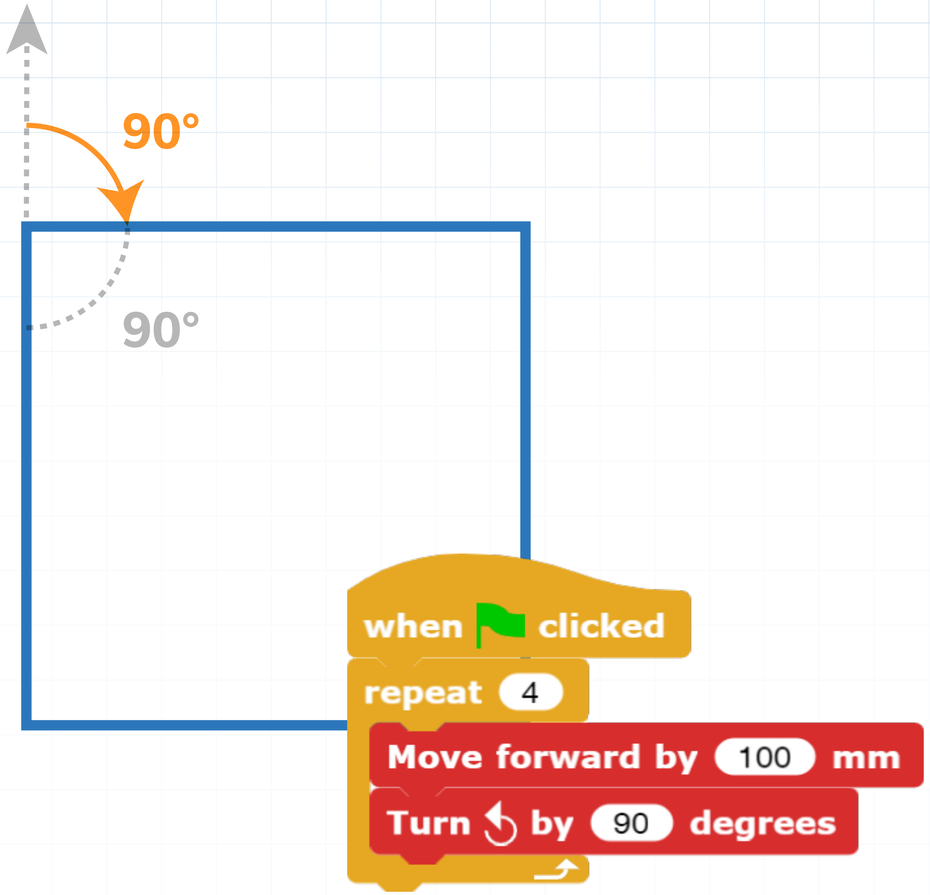
Draw with the Robot

Place a marker or pen through the hole in the center of your robot, making sure it goes through to touch the paper underneath.

The better constucted your robot, the more accurate the lines. When the pen or the robot is on an angle you might get squiggly corners on your shapes.

Here are some tips:

- Check that your robot bottom is parellel to the floor or table. You can adjust this using the bulldog clip at the back.
- Keep the wheels straight and parallel to the page so the the robot doesn't sag.
- Don't keep your marker in the same place too long or it will lose ink.

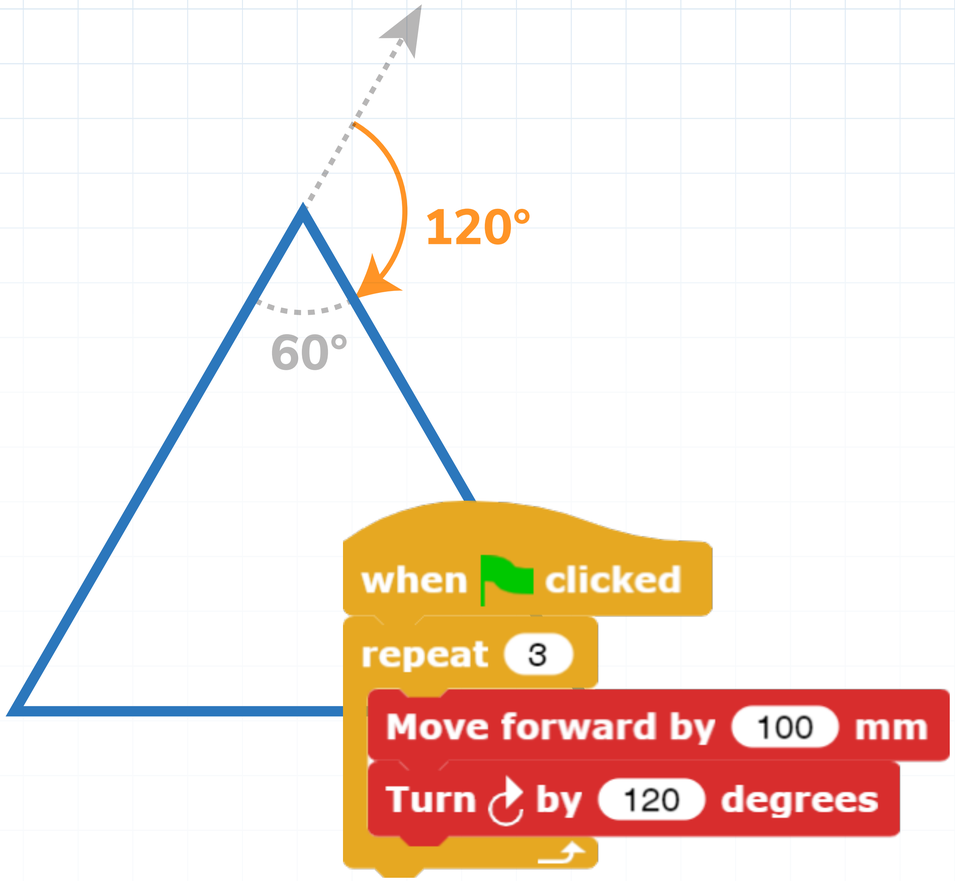


Build the code shown here

Draw a square

As you can see when you draw a square the outer angle of every corner is the same as the inner angle (90 degrees).

To draw the square we will move forward and turn 90 degrees 4 times. You can write out the code without using the repeat block.

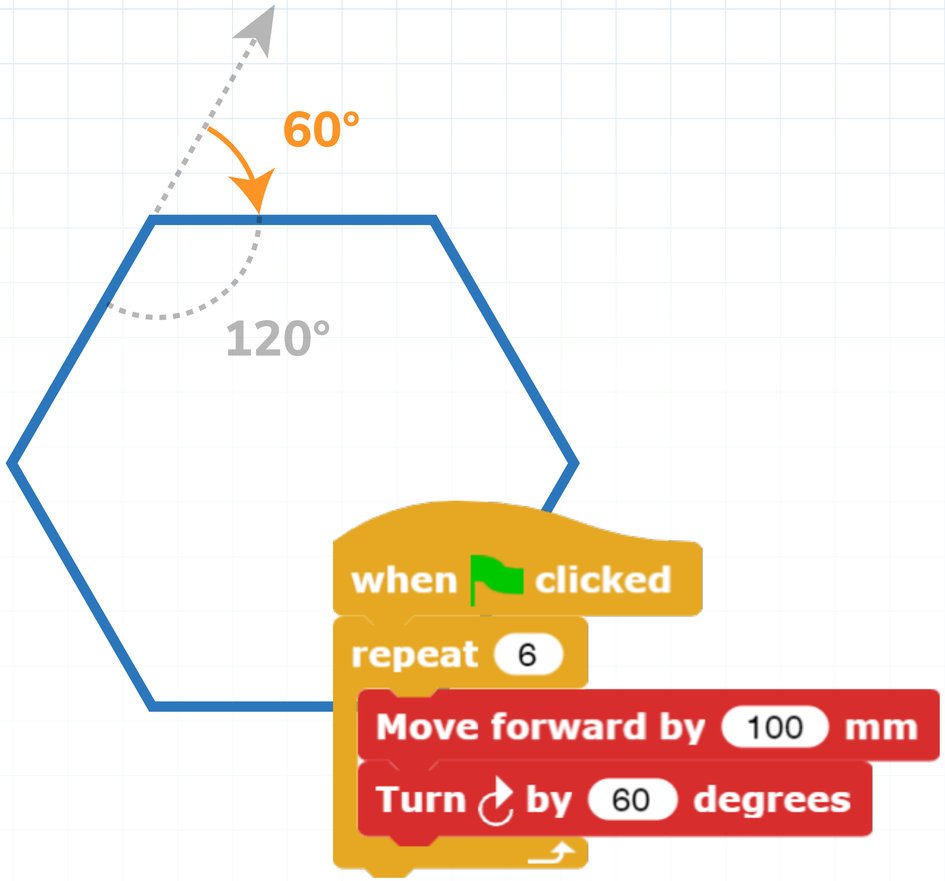


Build the code shown here

Draw a triangle

When drawing a triangle we are trying to draw a closed shape with 3 corners. The rule for calculating the anlges in triangles tells us that all the internal anlges must add up to equal 180 degrees.

So angle A + B + C = 180. If the triangle is symetrical on all sides then the angles all have to be equal to 60 degrees. So, angle A=60 - B=60 - C=60



Build the code shown here

Draw a hexagon

Now the tricky part.

If you move then turn the robot 60 degrees 3 times you end up with a shape like this.

The robot is moving forward in a straight line, if we turn from the axis the robot is moving we are tracing our shape from the outer angles or what is called **The Exterior Angle**

So as you can see then to draw a triangle we will actually have to turn 120 degrees.

Try it for yourself!

That’s it for now!

Thanks for now, and don’t forget to check back at learn.robotinacan.com for new materials!