WELCOME!

This workbook (and robot kit) is for everyone.

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!

Chapter 1

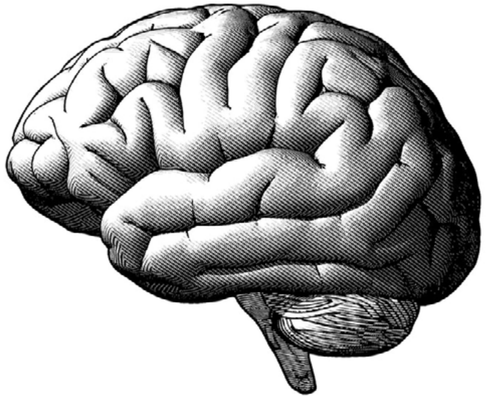
Getting familiar with your eBrain

ELECTRONIC BRAINS

Everything smart has a brain.

~~Electronic~~ “brains” aren’t just for ~~computers~~ and phones – they can be found in all sorts of places like airplanes, household appliances and ~~industrail~~ equipment. They’re all around us and they 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.



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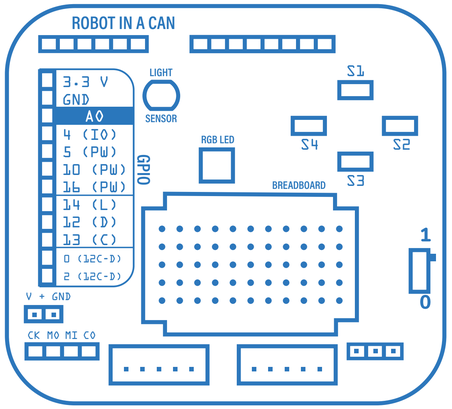
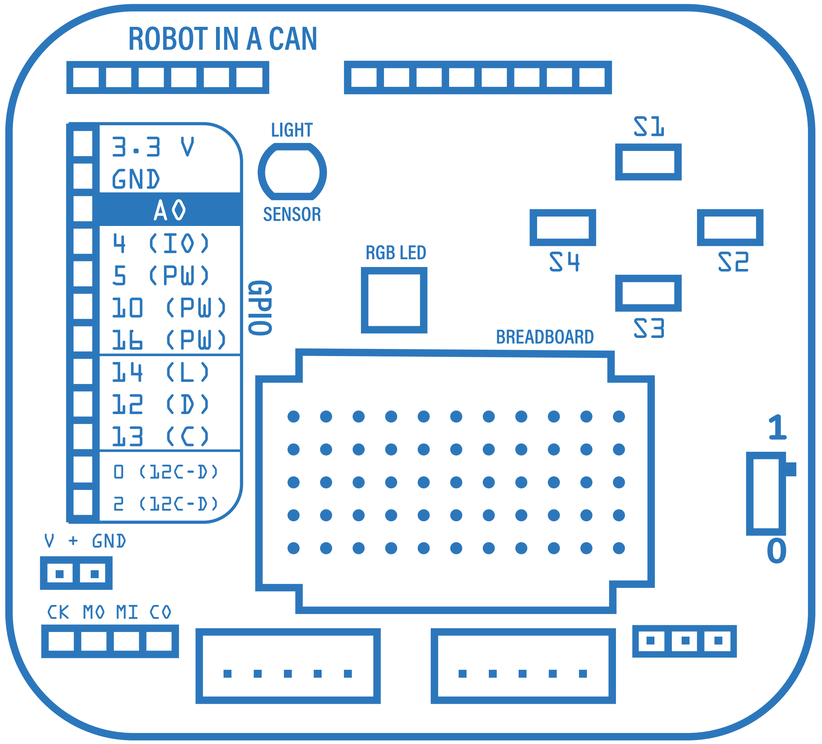




eBrain Superpowers

eBrain is a good teacher.

Your eBrain is a 'Development Board'. ~~This means~~ you don't need to solder to build your own circuits. Instead you can connect various areas by using the patch cables in the kit.

eBrain can speak and listen over wifi.

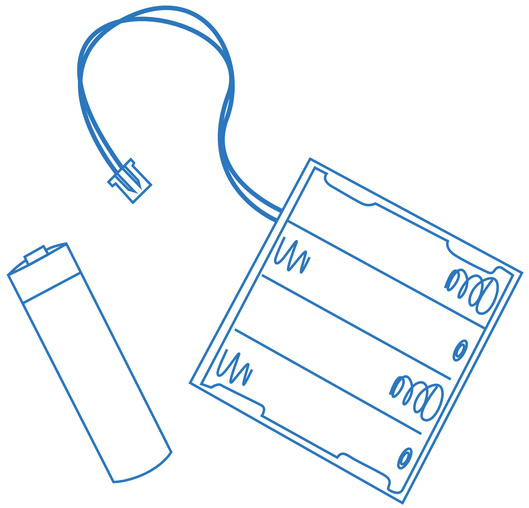
No wires to tether you! You can remote control into your eBrain from your computer or cellphone. Because you can tell it what to do wirelessly, your robot can be in one room while you're in another. You could even connect your robot to the internet and control it from another country!

eBrain can understand many programming languages.

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

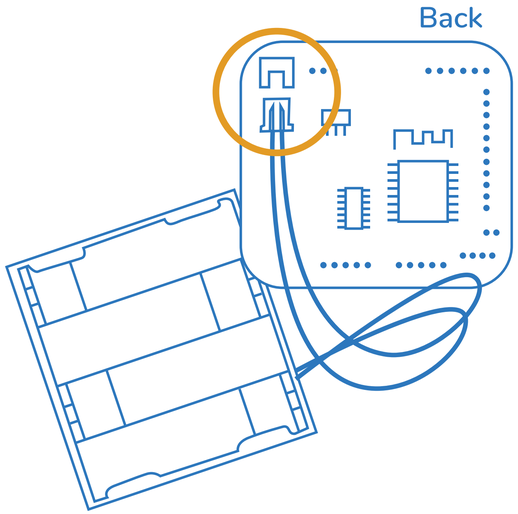
POWERING UP YOUR EBRAIN

xx mins



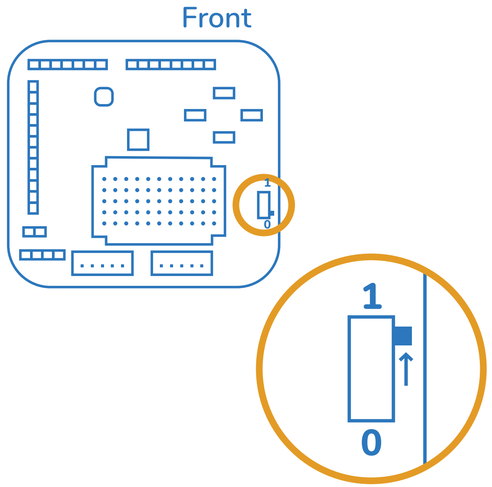
Insert 4x AA batteries

Place the flat side on the springs.



Connect the battery pack to the board

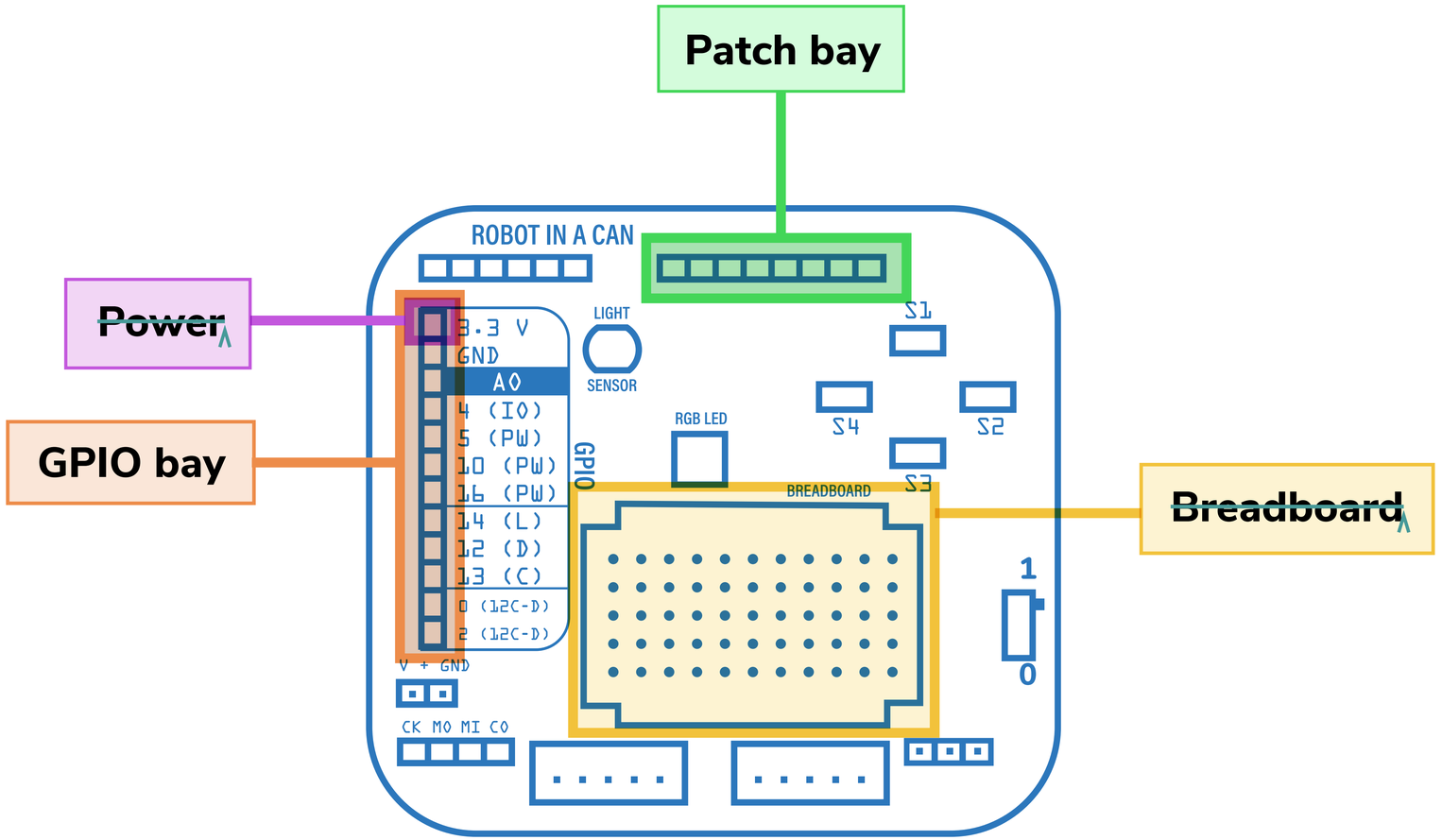
The connector is located on the back of the ~~board~~.



Turn it on

The tiny switch is on the front of the board. ~~Switch~~ it from 0 to 1.

EBRAIN ANATOMY



GPIO bay

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

Patch bay

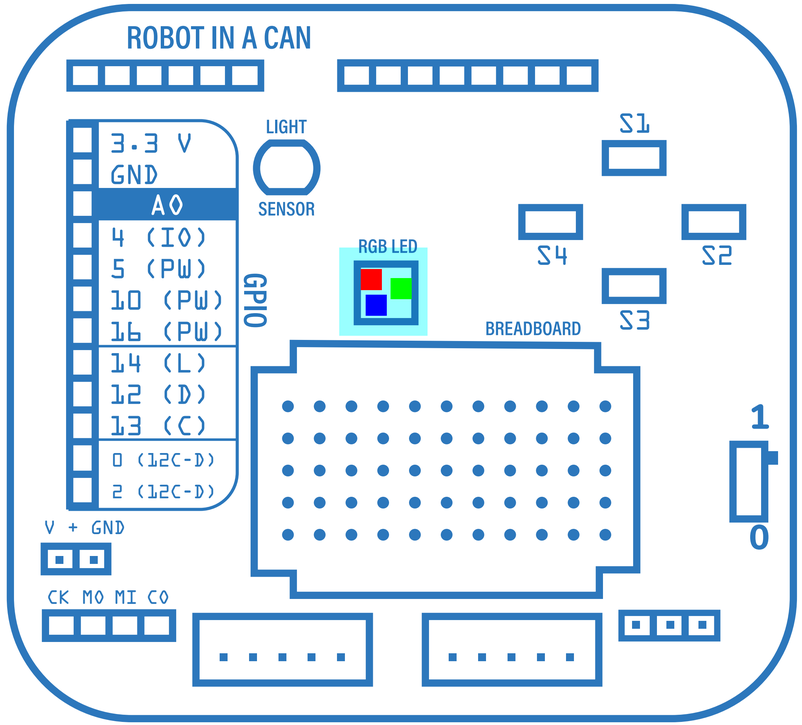
The patch bay has electrical connections to the light sensor, RGB LED and four buttons.

The breadboard

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.

ACTIVITY 1 - GETTING FAMILIAR WITH YOUR BOARD

xx mins



Meet the RGB LED

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

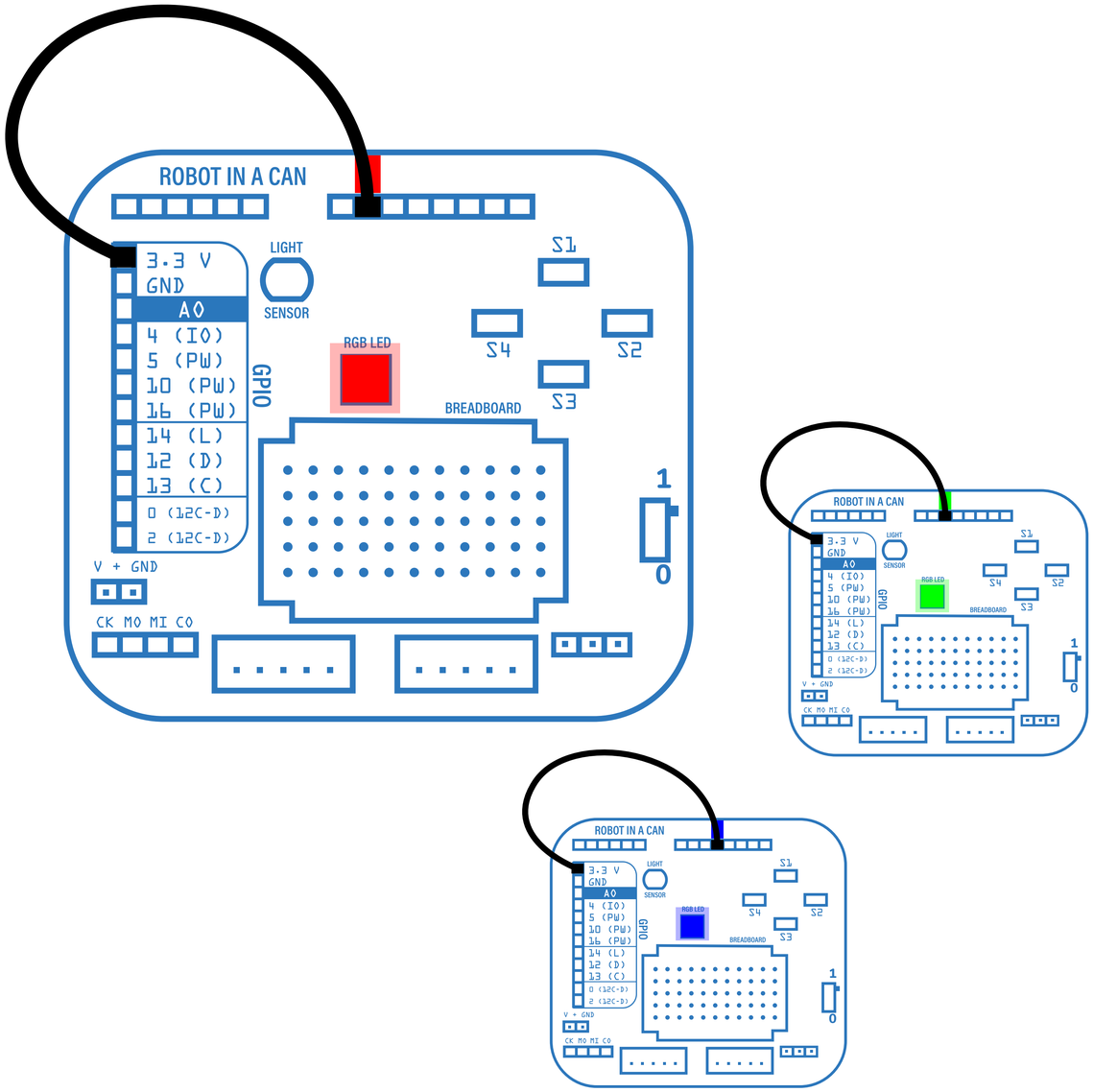
The tiny lights come in three colours: Red, Green and Blue, or RGB for short.

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 ~~millions of~~ different combintions!

M~~ore on c~~olour mixing later...

ACTIVITY 1.1

xx mins



Lighting up Red, Green and Blue

Take a wire out of your can and place one pin the the 3.3 V power source, located on the GPIO bay.

Plug the other pin 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!

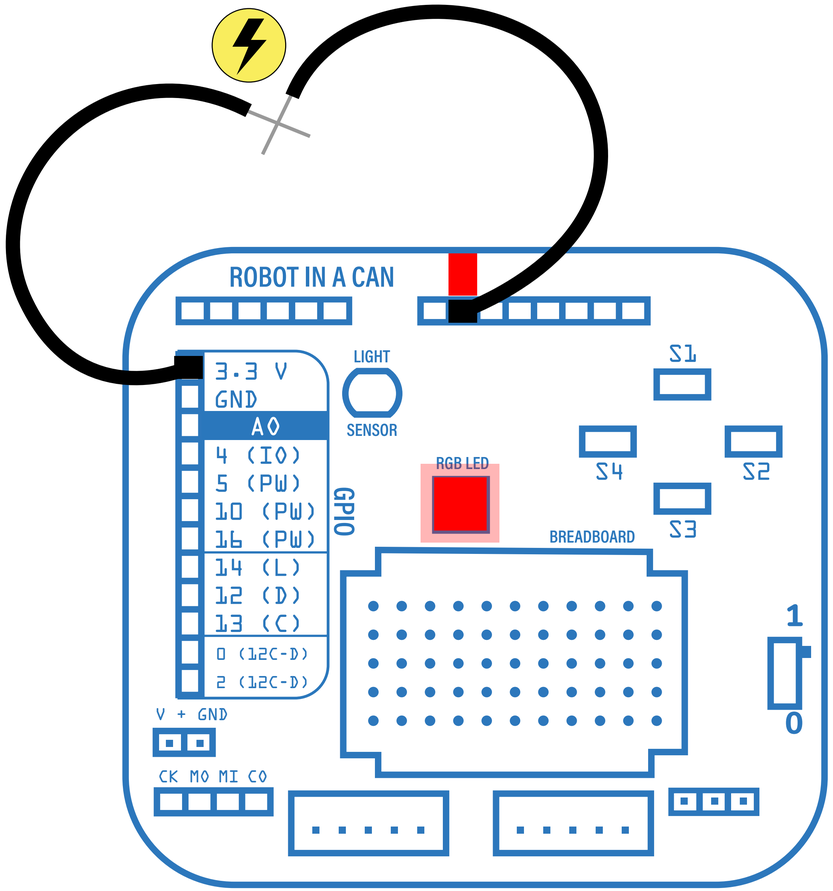
Next, remove the pin from the R plug and try G (Green) and then B (Blue).

Congrats, 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.

ACTIVITY 1.2

xx mins



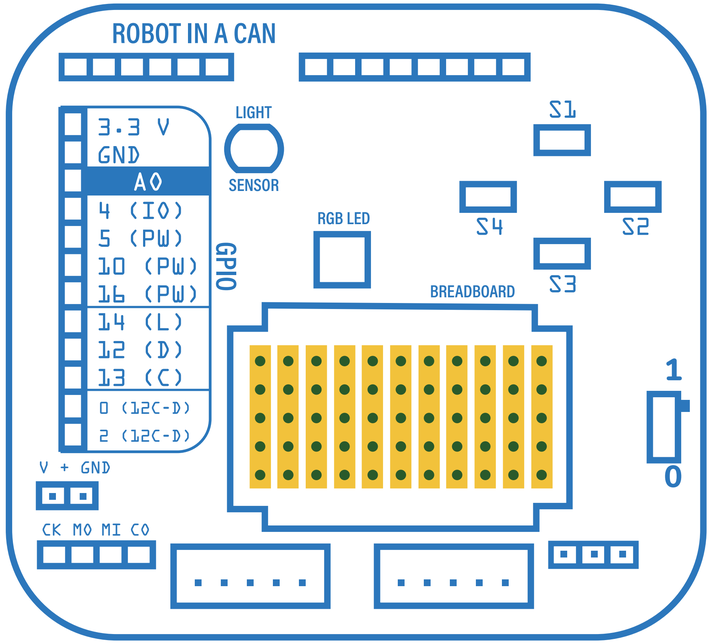
Connecting two wires

Your can connect different areas on your board by holding wires together. You try!

Take out another wire from your can. Place one wire in the 3.3 V plug on the GPIO bay, and the other one in the R plug on the instrument panel.

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

THE BREADBOARD



How to use the breadboard

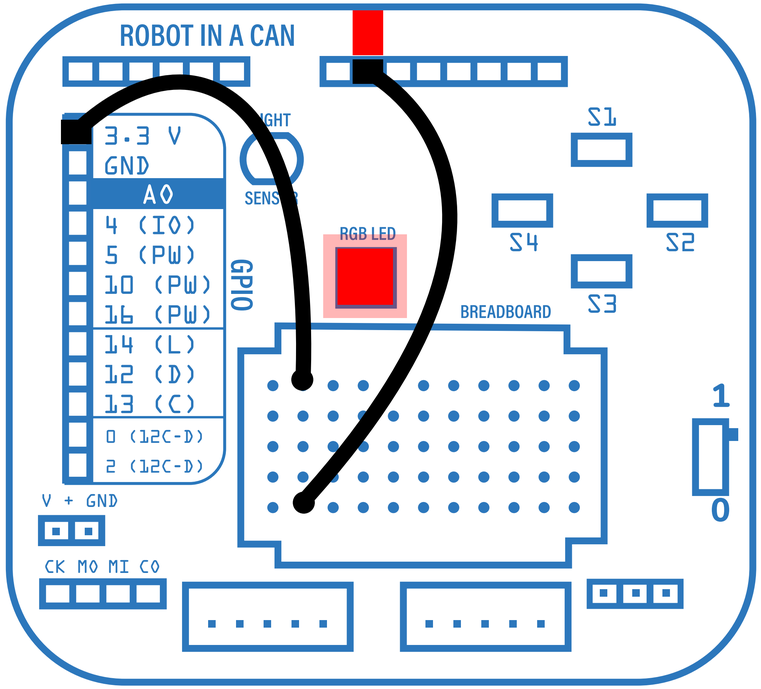
Sure, you can connect wires together with your fingers, but luckily there's much easier way, and that's to use the breadboard.

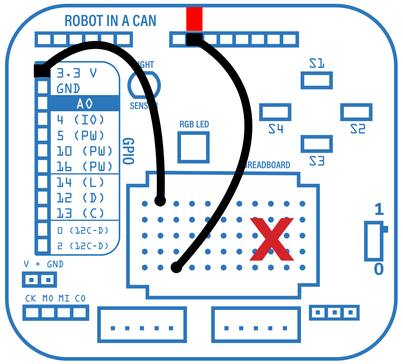
The breadboard let's you clip things together so you don't have to hold them. [link to video]

Your eBrain's breadboard as 11 rows. Each row contains one metal clip.

ACTIVITY 1.3

xx mins





Let’s try connecting wires using the breadboard

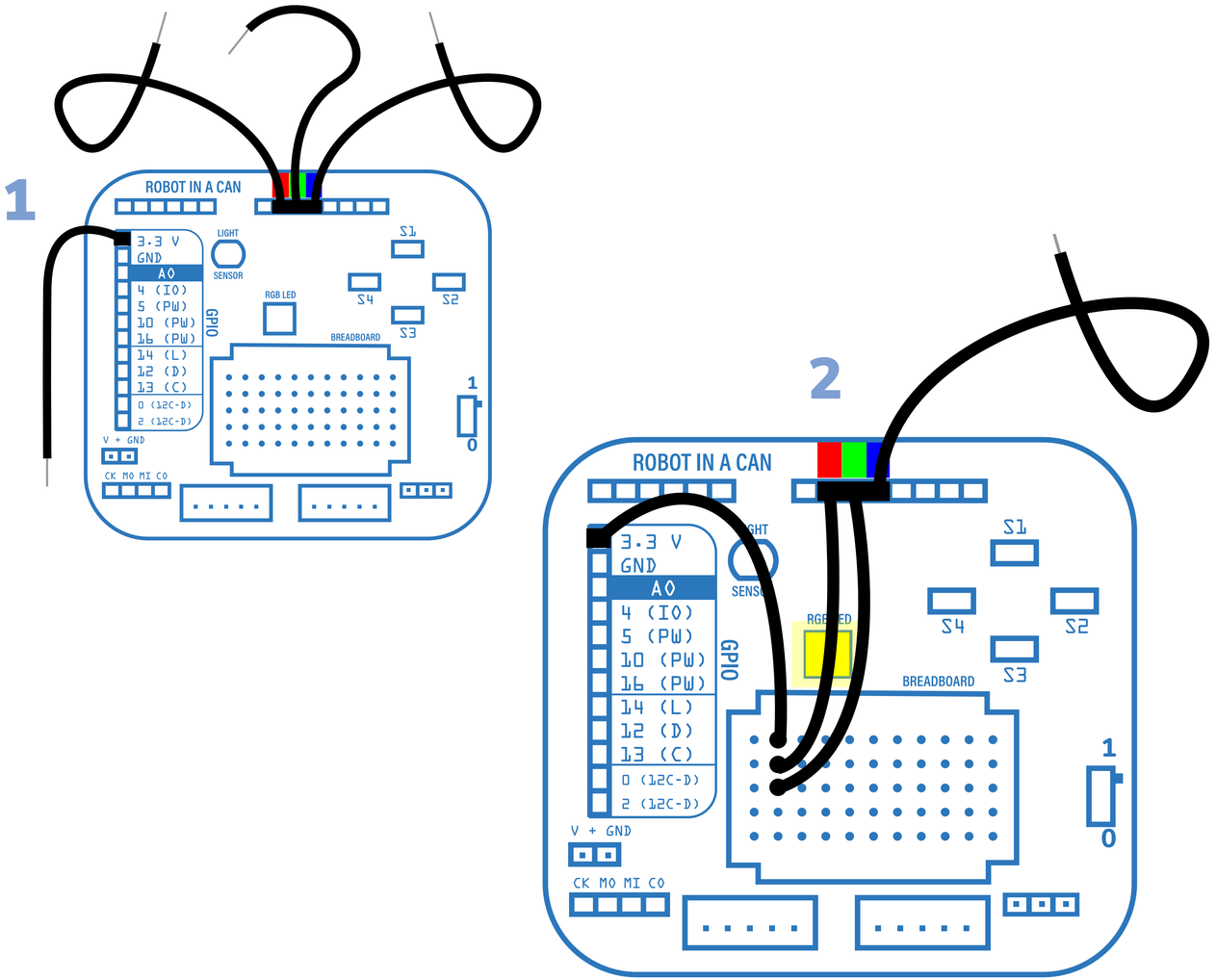
Start with the wiring diagram from Activity 1.2.

This time, instead of using your fingers to hold the two wires together, place them in any two plugs in a vertile row on the breadboard.

The red light should come on. Now try plugging the wires into different rows. See? They are no longer connected to the same clip, therefore the light won’t turn on.

ACTIVITY 1.4

xx mins



Using the breadboard to mix colours

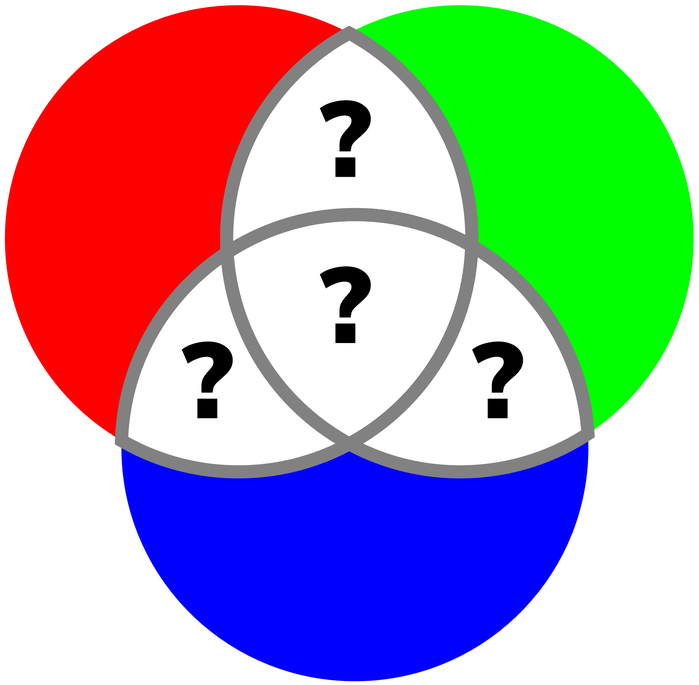
Let's find out what happens when you combine Red, Green and Blue in different ways!

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. (1)

We already know what happens when we connect the 3.3 V wire and Red on the breadboard.

What happens when we add Green to the mix? We create Yellow! (2)

ACTIVITY 1.4



Let’s try all the combinations.

What colour do you get when you mix:

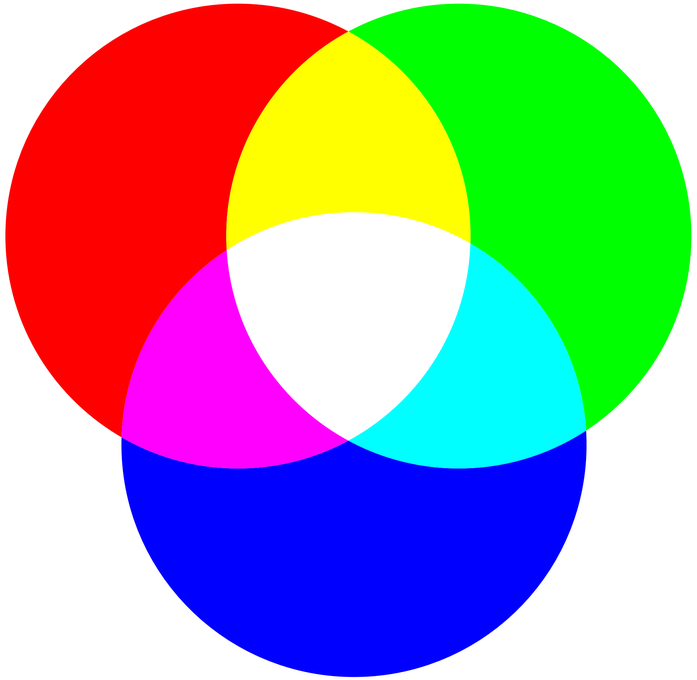
Red and green?

Red and blue?

Green and Blue?

Red, Green and Blue?

ACTIVITY 1.4



Here are the colour names.

Red and green make **Yellow**

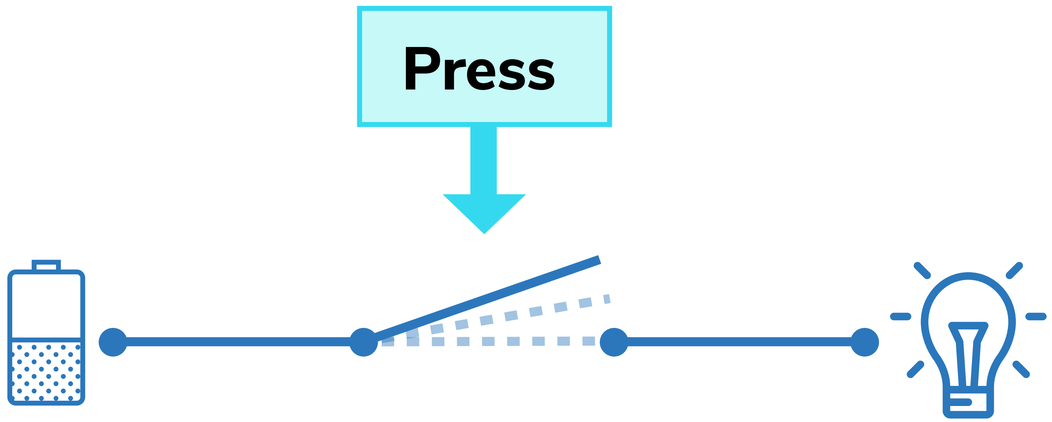
Red and blue make **Magenta**

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.



How to use buttons

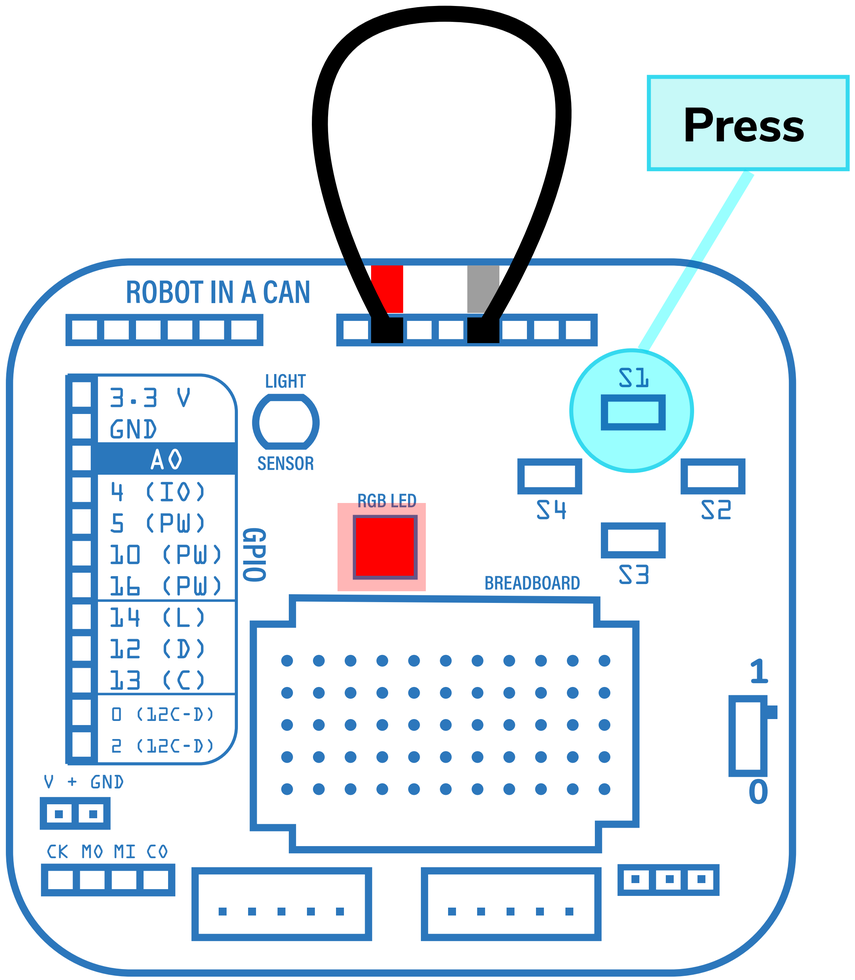
When you press a button you allow electricity to flow in a complete circuit, sending power to whatever is attached!

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~~!

ACTIVITY 1.5

xx mins



Using the buttons to turn on lights

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

Use a cable to connect R and 1 on the patch bay.

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

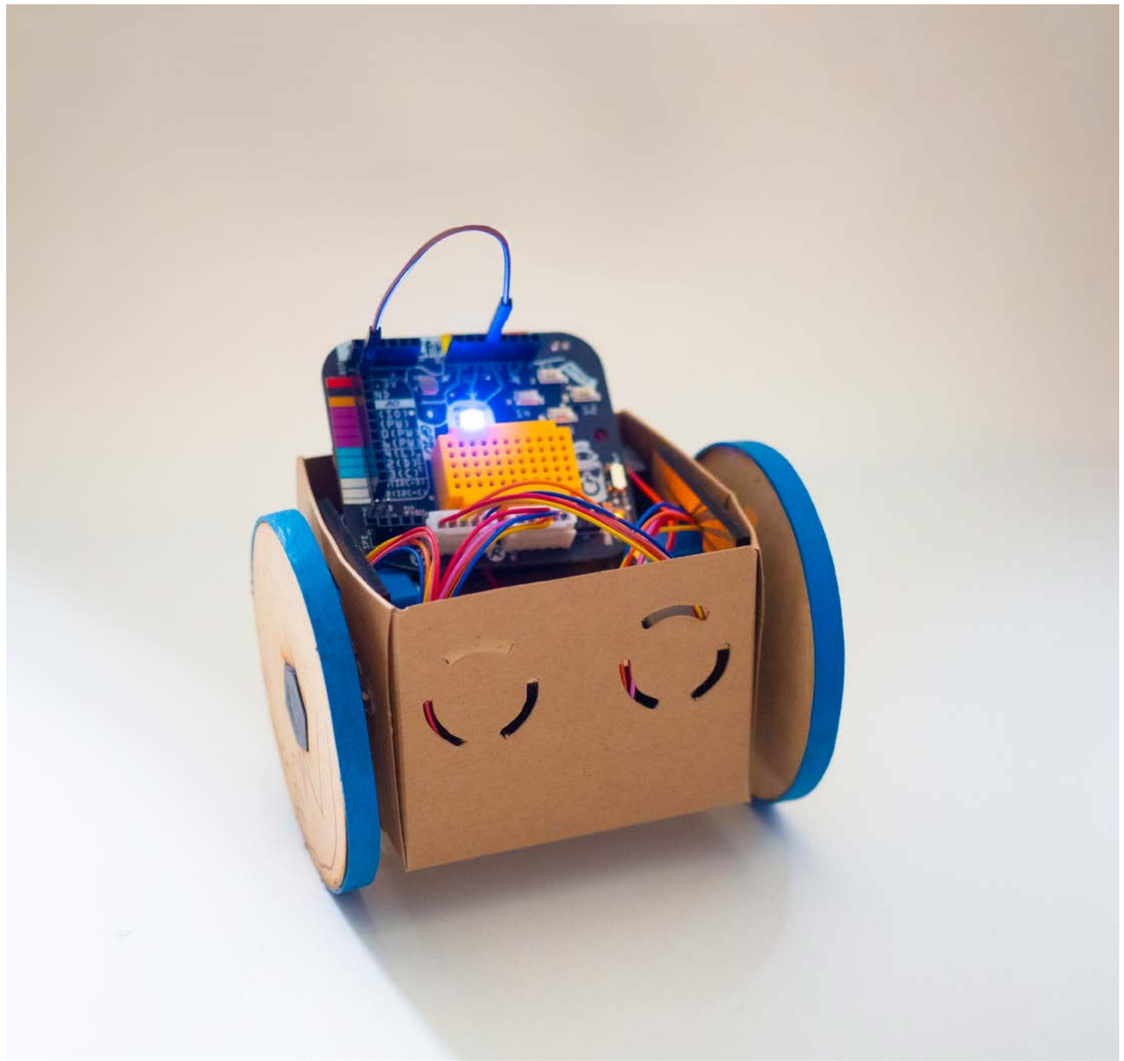
You explored the RGB LED and the buttons on the patch bay.

Breadboard

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

Chapter 2

Building your first robot



Your first robot

Robots are awesome!

Chances are, you like robots or you wouldn't have bought this kit.

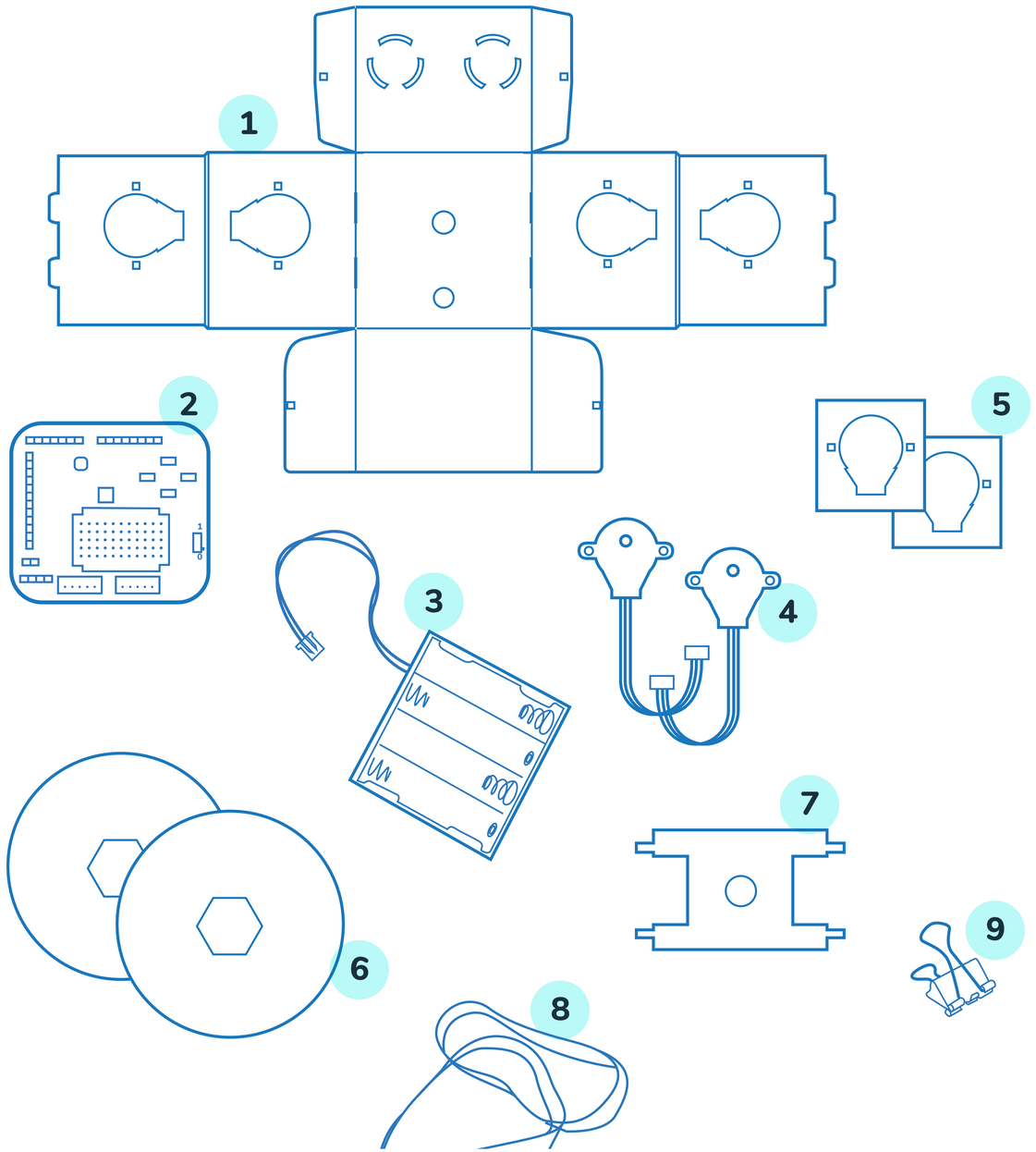
In this Chapter 2 you will build your first robot, and in the following chapter you will learn how to give it commands and make it move using Snap!

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...

ACTIVITY 2

xx mins

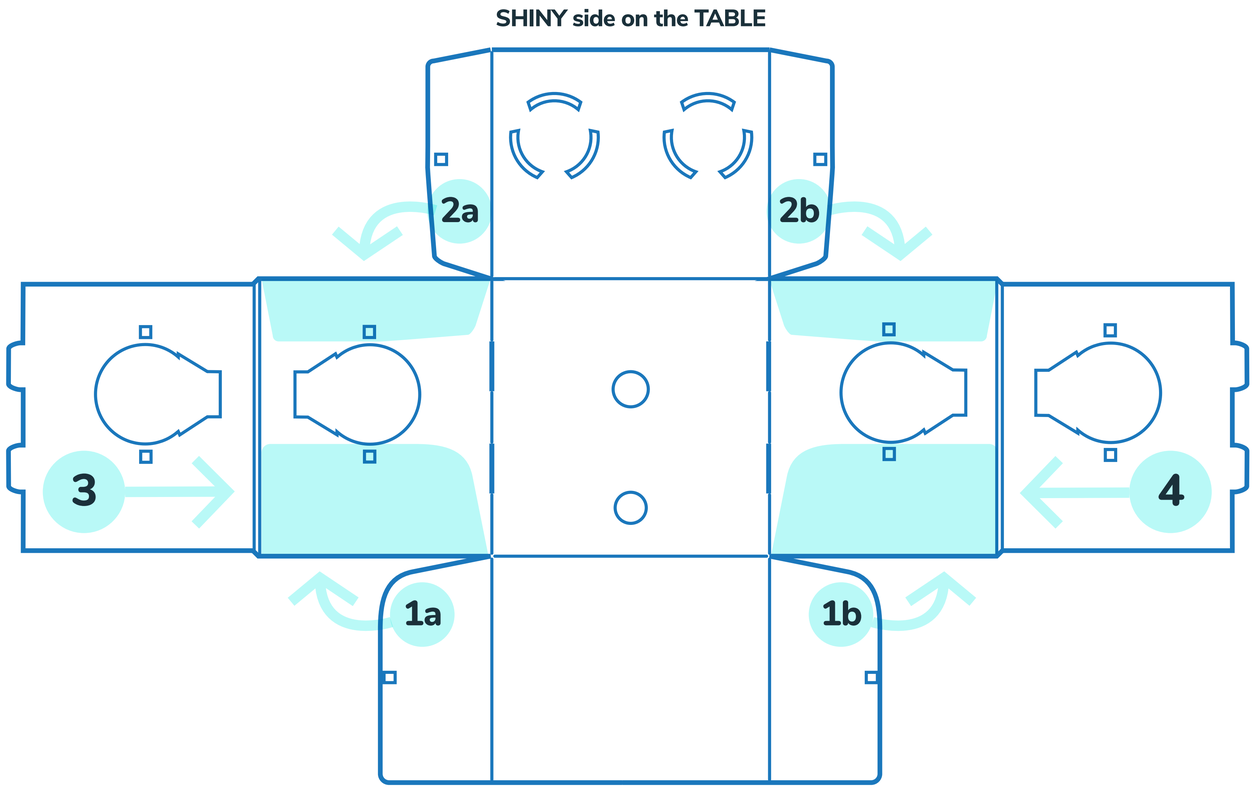


What you'll need

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

~~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

ACTIVITY 2.1



Folding your Robot Body

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

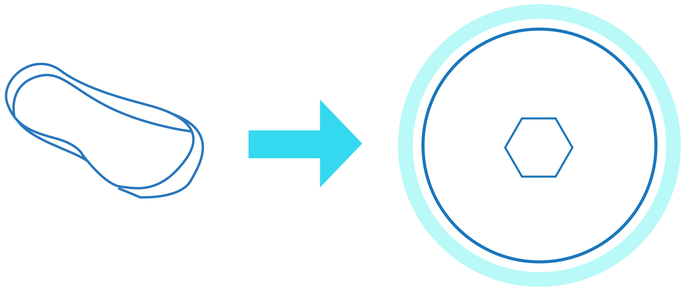
1 Place your cardboard robot body on your workspace ~~shiny side down~~. The shiny side will be the outside of the robot and the matte side will be the inside.

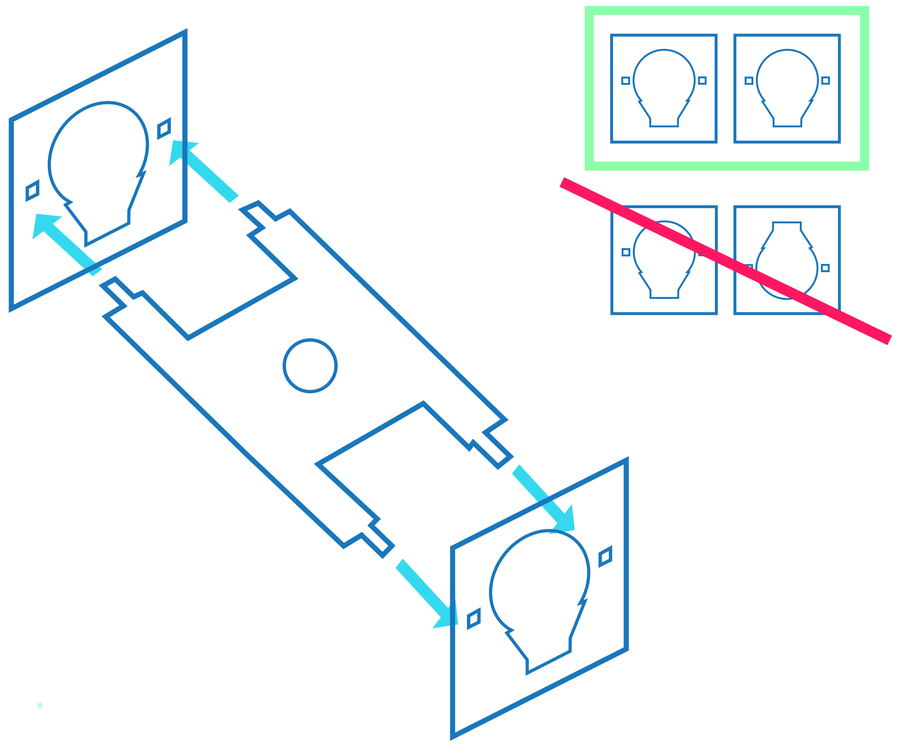
2 Following the image on this page, attach tabs 1a and 1b to the long horizontal panel. Then attach 2a and 2b. This should create 4 sides and a base.

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

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

ACTIVITY 2.2





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!

Note: 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!

ACTIVITY 2.3

Attach the wheels and motors to the robot body

1 Drop the skeleton into the robot body and line up the motor holder holes. Push the pegs through the cardboard.

2 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!

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

ACTIVITY 2.4

Hook up the eBrain

1. Attach the motors to the eBrain. Each motor connects to either the left or right side. 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!

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

Connecting to your eBrain

Turn your kit on. Connect to your kit's wi-fi network.

Click on the wifi icon on your computer and look for the robot in a can network.

Note: Check for the wifi id code that is written on your board to make sure you are connected to the right network

What is programming ?

A program is a process or set of instructions that is followed to solve a problem. These instructions are converted into a code that computers can read and execute.

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?

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

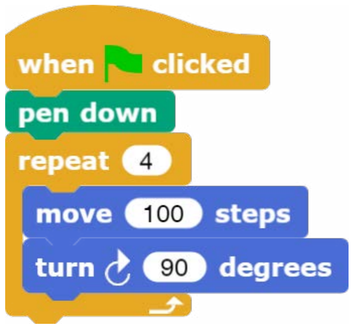
Launching snap

Open the robot in a can toolkit folder. Open the eBrain snap folder.

Using google chrome open Snap!.html

Snap is a visual programming tool that allows you to drag blocks of instructions snapping them together to create programs.

Take a look at the layout of the snap program in the image above.



Writing our first program

1 Do the control block section tag in orange. The control blocks control the order in which the computer steps through instructions.
Pick the wind green flag clicked block and the repeat block driving them into the scripting area.

2 next go to the motion blocks section tag in blue. These blocks move the arrow in the stage area. this arrow is called the sprite. think of it as an actor on the stage . you can customize the way sprites look and you can make multiple sprites. Pick the move 10 steps block and the turn 15° block and drag them into the scripting area

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