SAM's STEAM Kit
teacher's guide

SAM LABS education

samlabs.com/education

Empower students with the endless
possibilities of SAM.

WELCOME TO SAM LABS EDUCATION

SAM Labs makes smart construction kits of clever little blocks and a fun app that give everyone the power of technology to build inventions.

SAM Labs believes that the journey is what counts. Hands-on activities and collaborative play in education leads to better learning.

Together with our award-winning software application, we've taken SAM into the classroom, empowering students with the endless possibilities of **SAM**.

learn through play

Serious inventions can be serious fun. With hands-on play, students learn STEAM intuitively whilst having fun.

built by curriculum experts

All lesson plans are built in collaboration with curriculum experts and are included in every kit.

trusted by educators

With an award-winning app, SAM is used and trusted in curricula across the globe.

limitless software

Dive into programming logic, data capture, and so much more using the SAM Space Education app, tailored for educators.

simple to use

Wireless SAM blocks easily connect to the SAM Space Education app with no setup time or fuss.

SAM + STEAM

SAM Labs Education offers students the ability to build and program their own inventions while learning key aspects of STEAM - science, technology, engineering, arts, and maths.

We've worked with educators and students to develop innovative, engaging lesson plans that align to the UK national curriculum standards, US national education standards and the international baccalaureate curriculum framework, across a variety of subjects.

The advantages of using **SAM** in STEAM subjects are countless. From building tangible motor skills whilst simultaneously gaining digital literacy, to exploring creative outlets whilst problem solving, **SAM** allows kids to delve into programming, logic, and analytical skills through play.

START BUILDING WITH SAM

In this section, we will outline how to get started with your kit. Getting started is as easy as 1-2-3-4!

step 1
Download the SAM Space Education app

step 2
Turn on the blocks

Turn on your wireless SAM blocks by pressing the button above the **SAM** logo. When the light turns on, you will know the block is full of power and ready to go.

BUTTON

HOLD
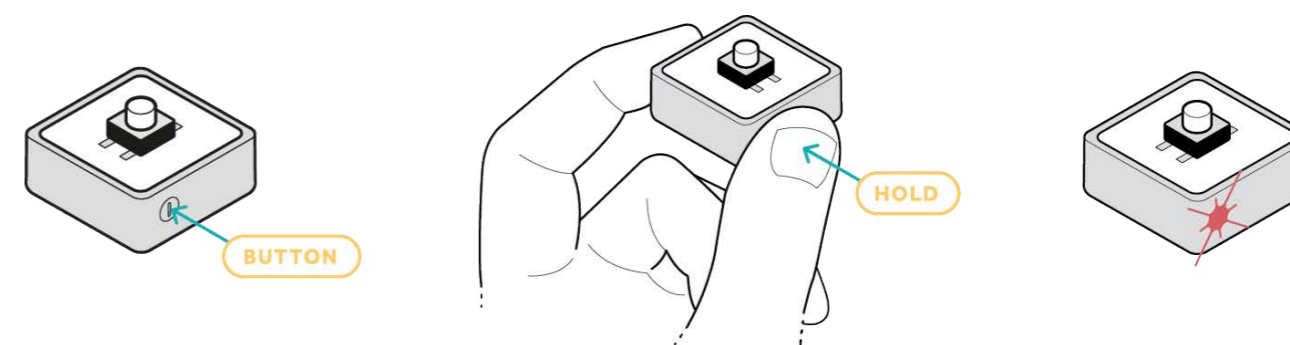
step 3
Pair the blocks

Now that your SAM blocks are turned on, you will need to pair them with the **SAM** Space Education app using Bluetooth.
Before you start pairing, make sure Bluetooth has been activated on your device. If it is not working on your device, try plugging in the Bluetooth dongle included in your kit.

First, turn on your SAM block and click on Connect **SAM**s' in the top left-hand-corner of **SAM** Space Education.

You'll see a screen with 3 columns. The column on the left is filled with the **SAM** blocks already paired to your device. The middle-column shows **SAMs** that are available to pair with. The right column shows SAMs paired with other devices.

To pair, simply click on 'Pair' on the block you want to pair with in the middle column. After clicking, a pop-up menu will appear. Tick this. The block on the screen and the physical block will both flash the same colour - indicating which block you are pairing. Click the checkmark on the screen to pair this specific block. The block will now jump into the 'My SAMs' column and will now beam a white light. To begin building, close this window and view paired blocks.
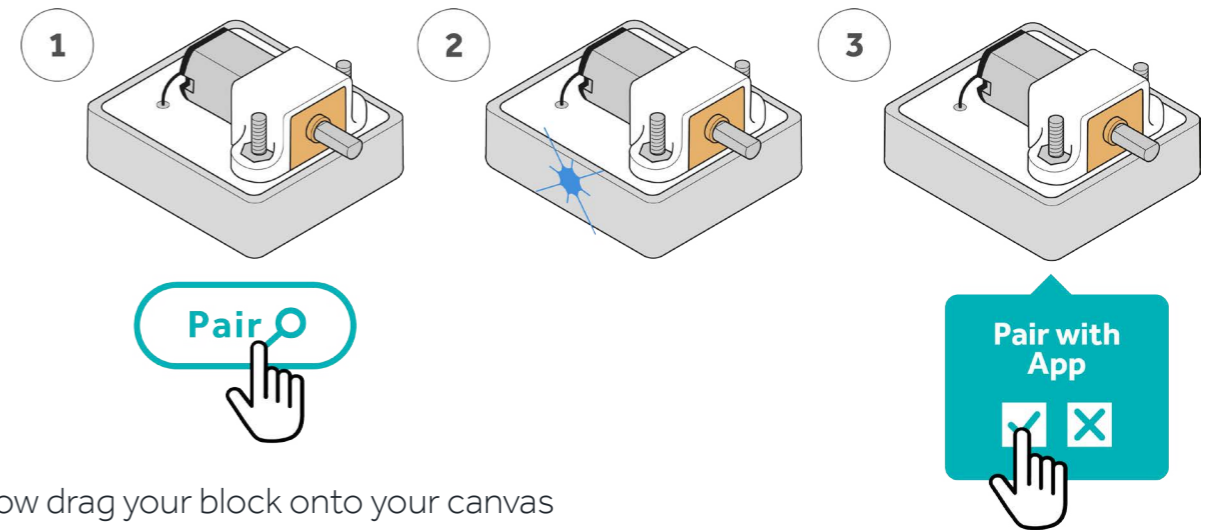
Now drag your block onto your canvas to start building with **SAM**!

step 4
Make Connections

SAM is all about making connections. Make the first connection between your blocks by connecting an input block to an output.
Simply drag and drop a line from one block to the next. It's that easy!

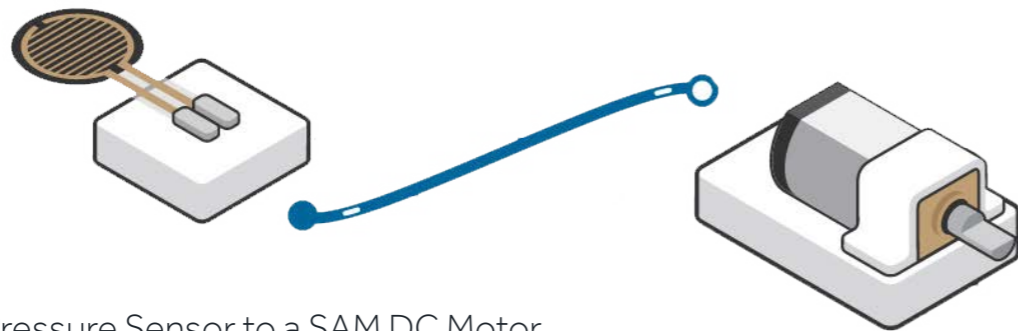**To help you get started, here are some easy connections you can make in seconds.**

TRY THIS!
Connect a SAM Button to a SAM Light.

TRY THIS!
Connect a SAM Proximity Sensor to a SAM Buzzer.

TRY THIS!
Connect a SAM Pressure Sensor to a SAM DC Motor.

Integrating software blocks

Take your inventions to the next level by adding in **SAM** software blocks. Drag and drop the behaviours and functions you want to use from the left-hand-side panel into your **SAM** Space Canvas. Then, make your blocks interact by creating connections from your hardware blocks to your software blocks.
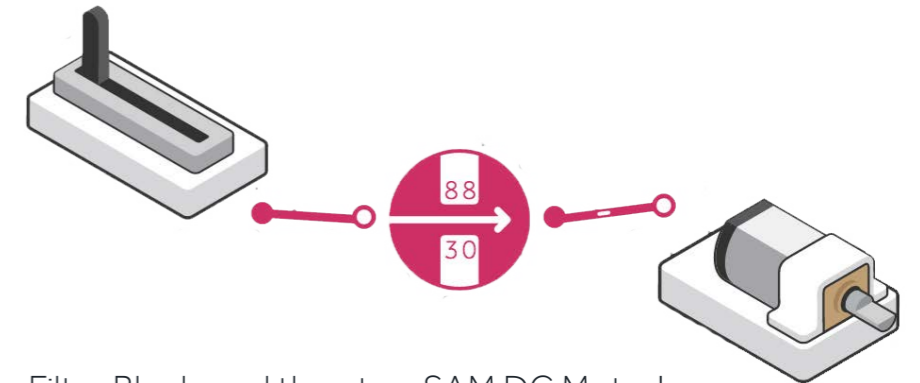

To help you get started, here are some easy connections you can make with your software and hardware blocks in seconds.
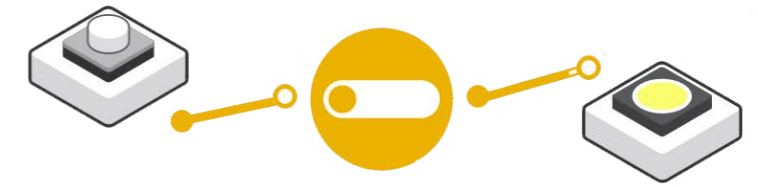
TRY THIS!
Connect a SAM Button to a Toggle Block, and then to a SAM Light!

TRY THIS!
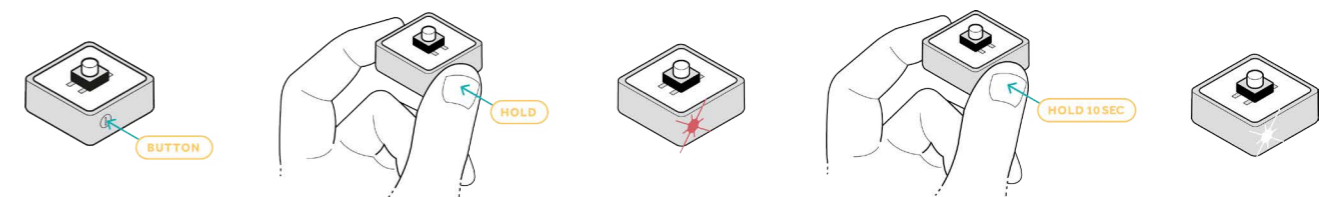Connect a SAM Slider to a Filter Block, and then to a SAM DC Motor!

TRY THIS!
Connect a SAM Button to an Inverse Block, and then to a SAM Light!
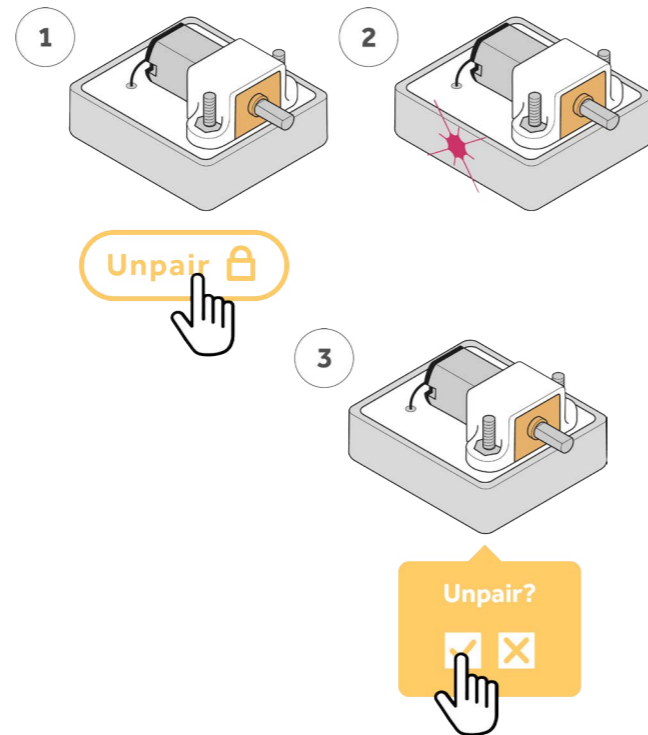
How to reset your SAM blocks

If your SAM block doesn't appear in the app menu, it may need to be reset.

To reset your SAM blocks, follow these simple steps:
• Make sure your block is turned on
• Hold the power button above the SAM logo for 10 seconds until it flashes white
• Turn the button back on and pair it to the app

Another way to reset your SAM blocks or to reclaim blocks in the room, is to click on "Connect SAMs", where you'll be greeted with three columns. The column on the right, "Claimed SAMs," shows SAMs that are paired to other devices (that could be in the room). Click on "Unpair" on the block you'd like to claim, click the checkmark, and the block will now appear in the "Available SAMs" column in the middle. Now, pair the block to your device.

How to charge your SAM blocks

If your SAM block won't turn on or is blinking red, it may need to be charged.

You can charge multiple blocks at a time with the STEAM Kit. Included in your kit, you will find a charging solution with 5 micro-USB cables. Charge your blocks in bulk to save time for the whole class. After 60 minutes, the red light will turn green, which means your blocks are charged and ready for more hours of fun!
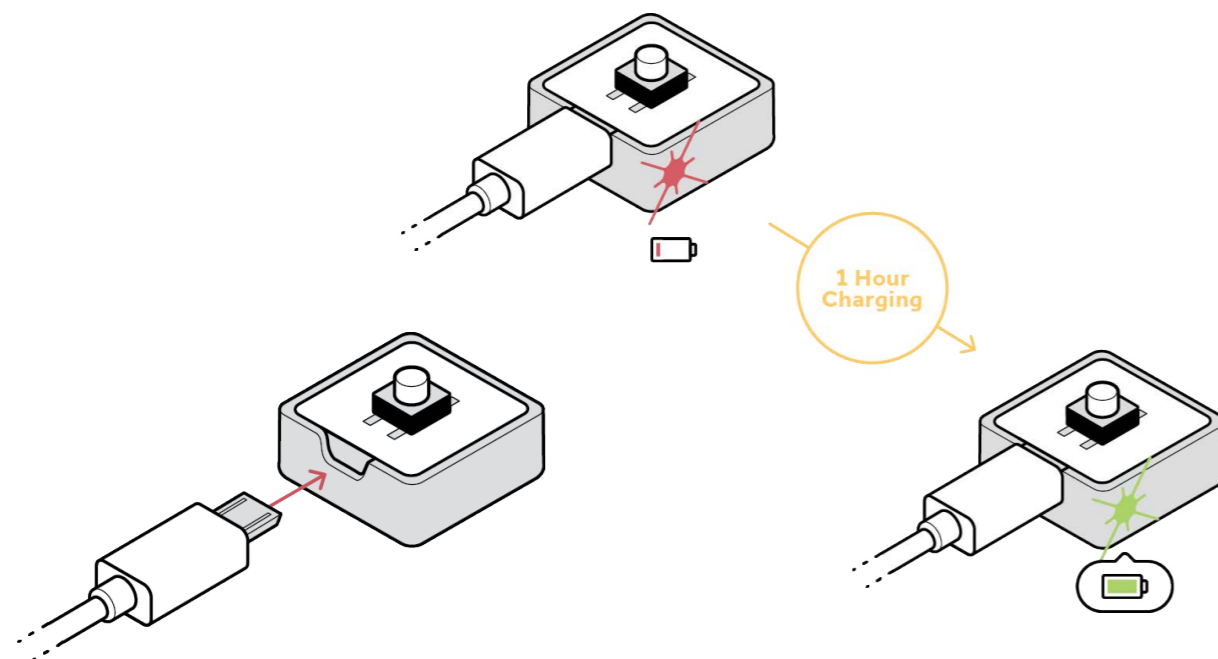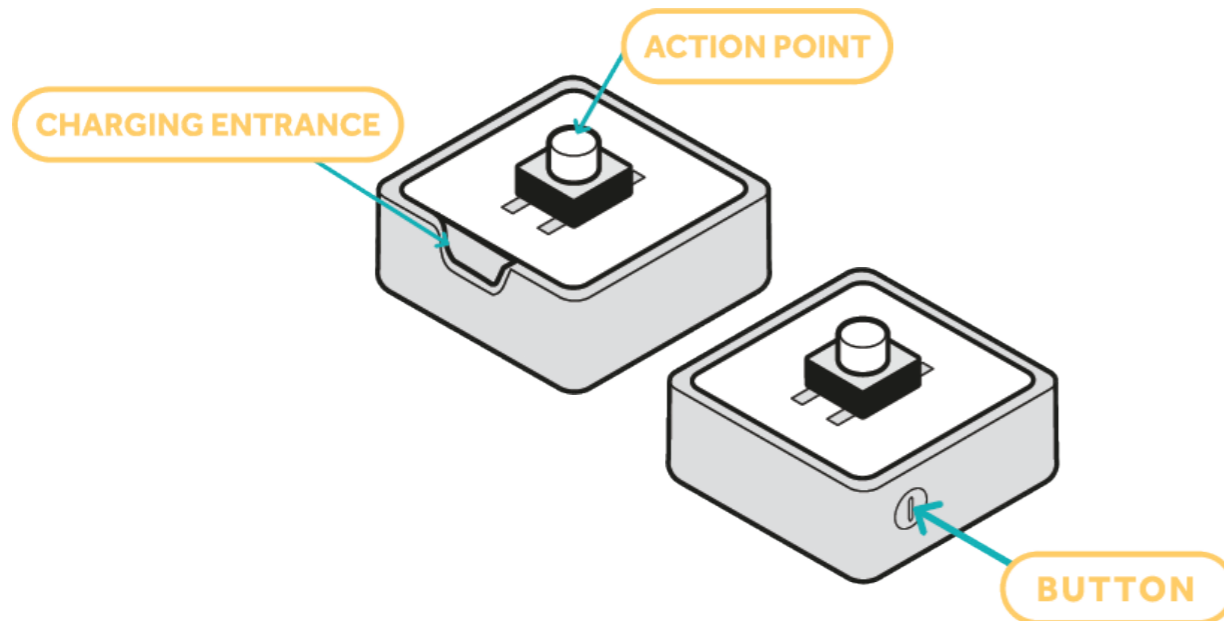

SAM'S STEAM KIT
what's inside the box?

SAM's STEAM Kit is the best way to help teach engineering, science and technology in the classroom. With endless STEAM projects built from 17 wireless blocks and a fun app to connect them all together, students can learn complex concepts without prior knowledge. Help empower your students with SAM's endless possibilities and unleash their inventive potential through play.

Read this section to learn more about the 17 wireless **SAM** blocks and the functions they provide. You will also learn more about the hardware accessories, and the limitless potential of the 40+ software blocks found in the **SAM** Space Education app.

HARDWARE BLOCKS

SAM BLOCK STRUCTURE

CHARGING ENTRANCE

ACTION POINT

BUTTON

What are hardware blocks?

SAM hardware blocks are the tangible part of **SAM's STEAM Kit**. They allow students to learn specific functionalities and behaviours. The hardware blocks consist of inputs and outputs.

What is an input block?

An input block takes in data and information, such as the pressure of a finger, the movement of a slider, or the level of heat, and then feeds instruction to an output block to perform its function.
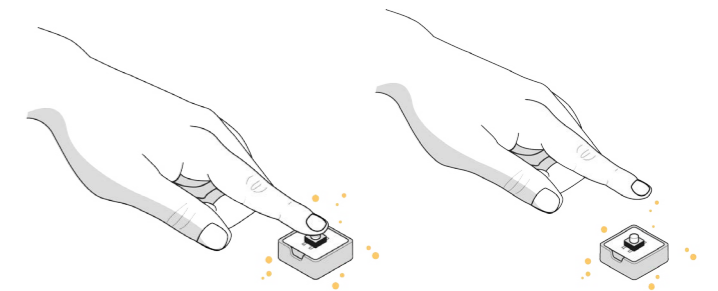
SAM Button

description

The **SAM** Button is a simple way for students to send functions to an output block -- as simple as the press of a button! Press the button to activate it, and release to deactivate.

how it works

When you press the button, it will send a 'true' signal to its corresponding output block, and when you release it, it will send a 'false' signal to stop the behaviour

TRY THIS! Try connecting the SAM Button to a SAM Light to see what happens!
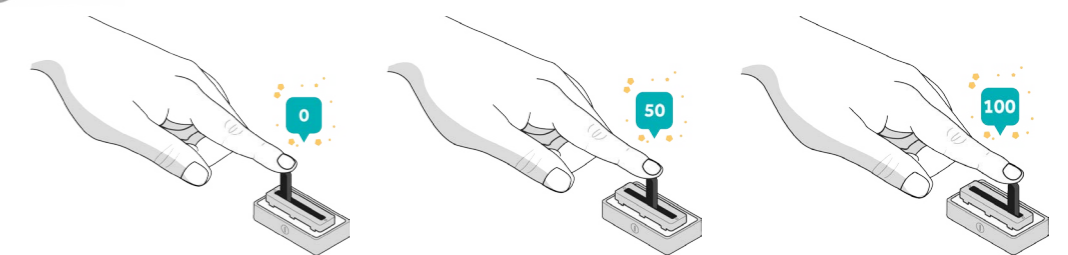
SAM Slider

description

The **SAM** Slider has a handle that you can move up and down, changing the input information from its minimum to its maximum value. A great block for students to control levels of speed, light, or intensity.

how it works

As the handle of the slider moves, it sends numerical values between 0 and 100 (with 0 being hard to the left and 100 being hard to the right). Every time the state of the handle changes, a new message is sent -- one message every 50ms.
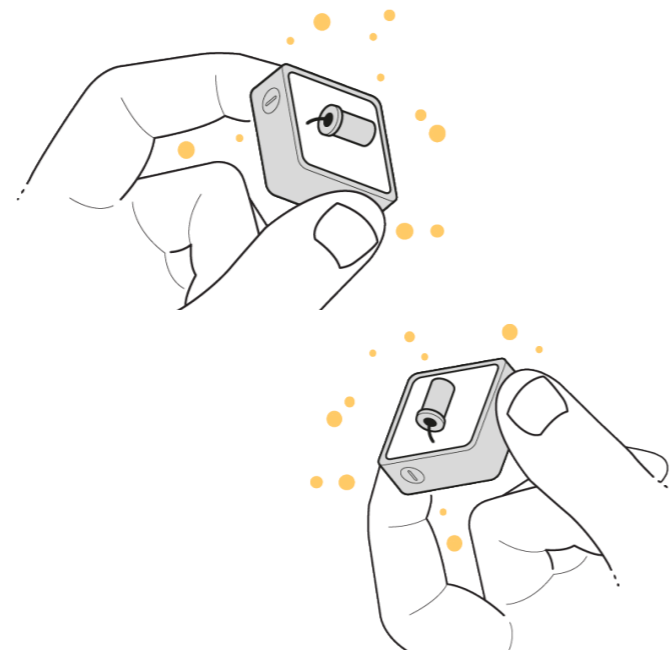
TRY THIS! Try connecting the SAM Slider to a SAM DC Motor to see what happens!

SAM Tilt

description

The **SAM** Tilt block uses movement to control its information sent to the output block - sending 'true' when it discovers movement.

how it works

The Tilt sensor sends a boolean value when it's tilted along the axis running through the length of the metal component. When the ball inside the sensor is on one side, it will send 'true', and when it is on the other, it will send 'false'.

TRY THIS! Try connecting the SAM Tilt to an RGB Light to see what happens!
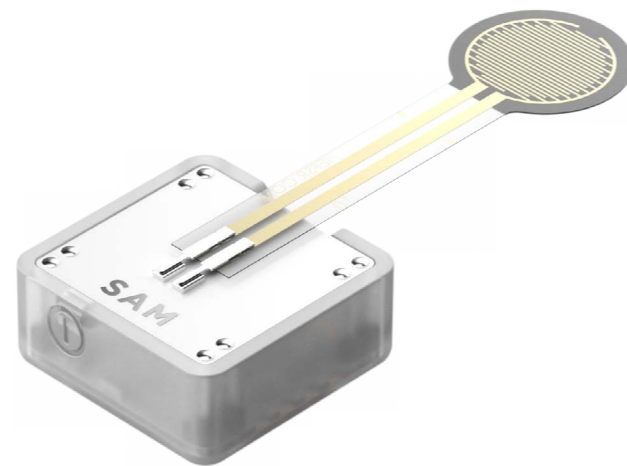
SAM Pressure

description

The **SAM** Pressure Sensor detects the amount of force applied to the block. The harder you push, the higher the value it will send to its corresponding output block.
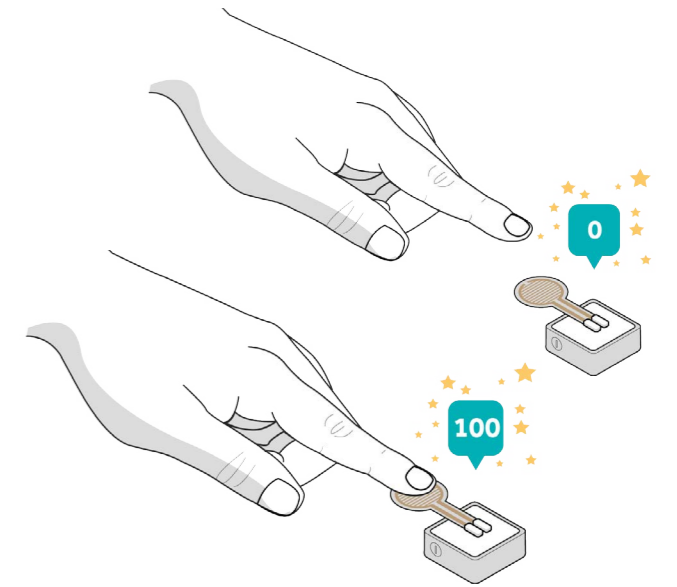
how it works

The block sends the pressure applied to the flat, circular part of the sensor. A new value is sent when the pressure applied changes.

The value is zero when no pressure is applied and the value is 100 when approximately 20N of force is applied.

Note that the sensor is technically measuring force (N), not pressure, and is optimised on the assumption that a human finger will be applying the force.

TRY THIS!
Try connecting the SAM Pressure Sensor to a SAM RGB Light to see what happens!

SAM Light Sensor

description

The **SAM** Light Sensor measures the amount of light coming into the block.

how it works

The light sensor provides light intensity readings to its output block. It will send a value of 0 when no light is detected (complete darkness), and a value of 100 when there is lots of light.

A new reading is displayed every time the light level of the surrounding environment changes.
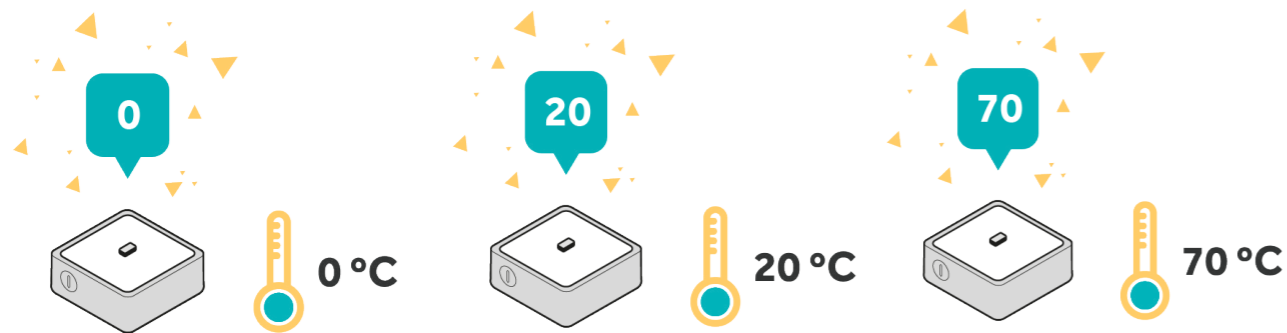
TRY THIS!
Try connecting the SAM Light Sensor to a SAM Buzzer to see what happens!

SAM Heat Sensor

The **SAM** Heat Sensor measures the current temperature in degrees Celsius, and send this information to its corresponding output block.

0 °C   20 °C   70 °C

how it works

The sensor measures the temperature in degrees Celsius and logs the data. A new reading is displayed every time the temperature of the surrounding environment changes. It is accurate to +/- 3 degrees and works in the range 0-70°C.

TRY THIS!
Try connecting the SAM Heat Sensor to a SAM Servo Motor to see what happens!

SAM Proximity Sensor

description

The **SAM** Proximity Sensor detects the distance of an object in respect to the block. The closer the object to the block, the higher the value it records.

how it works

The proximity sensor is composed of two components: one shines an Infra-Red (IR) beam and the other detects IR light. If an object is nearby, it will reflect the light from the beam, and therefore the sensor will know that there is a surface in its way.
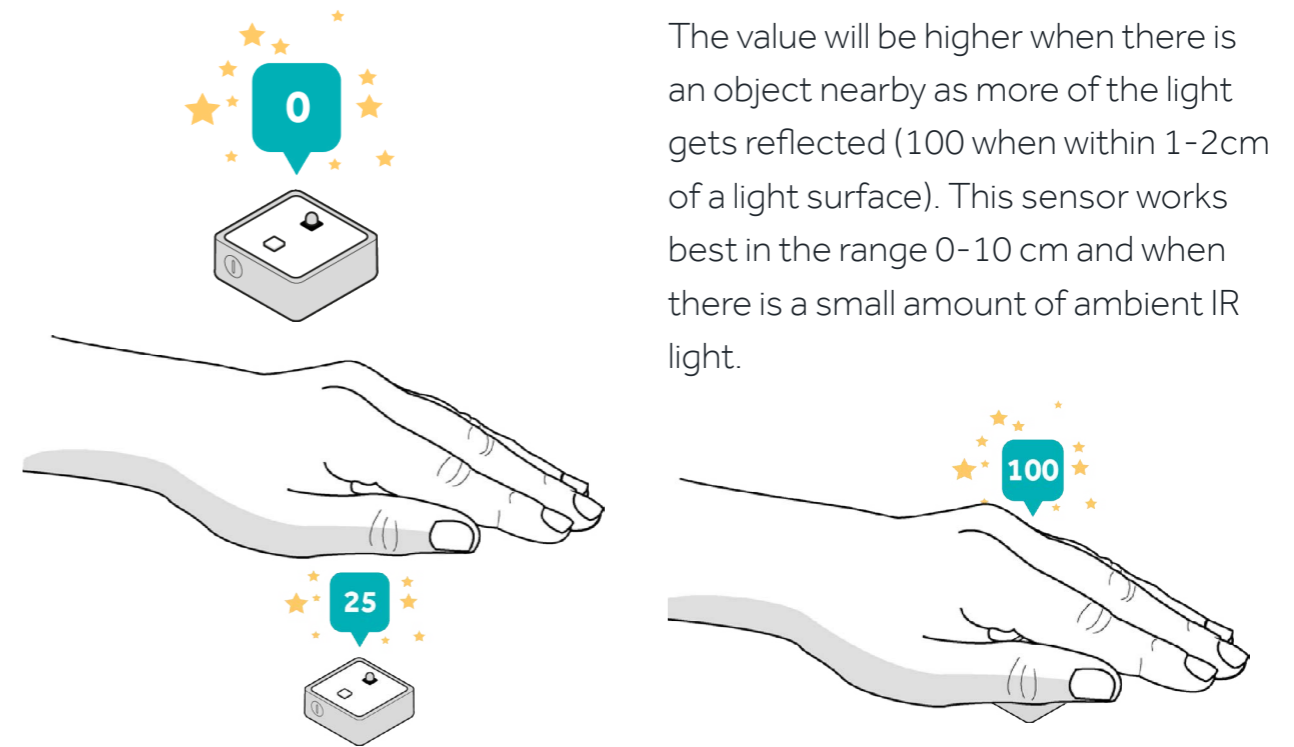
The value will be higher when there is an object nearby as more of the light gets reflected (100 when within 1-2cm of a light surface). This sensor works best in the range 0-10 cm and when there is a small amount of ambient IR light.

Note that a black surface will absorb all the IR light, instead of reflecting it, and therefore the block will not detect the surface.

TRY THIS!
Try connecting the SAM Proximity Sensor to a SAM Buzzer to see what happens!

What is an output block?

An output block receives a signal from the input block and then performs an action, such as making a sound, flashing a light, or spinning a motor.
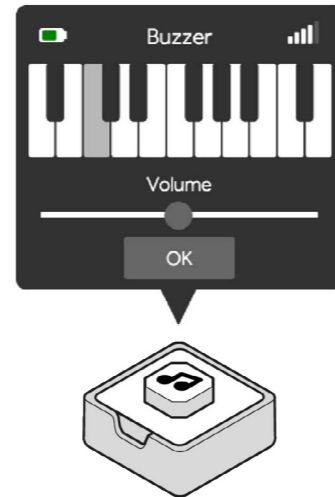
SAM Buzzer

description

The **SAM** Buzzer is a musical block that lets out sound. You can customise its note and volume using a software block.

how it works

This block expects to receive a '**SAM** Buzz' volume value - a measure between 0-100. When it does, it will play its specified note at the specified volume (between 0-100 sound level).

The range of notes supported are:

{ name: 'A3}, { name: 'A#3'}, { name: 'B3'}, { name: 'C4'}, { name: 'C#4'}, { name: 'D4'}, { name: 'D#4', midi: 75 }, { name: 'E4'}, { name: 'F4', midi: 77 }, { name: 'F#4', midi: 78 }, { name: 'G4', midi: 79 }, { name: 'G#4'}, { name: 'A4', midi: 81 }, { name: 'A#4', midi: 82 }, { name: 'B4', midi: 83 }, { name: 'C5'}, { name: 'C#5' }, { name: 'D5'}

["A4",0]:
By default

["A4",50]:
Note, Volume

["A4",100]:
Note, Volume
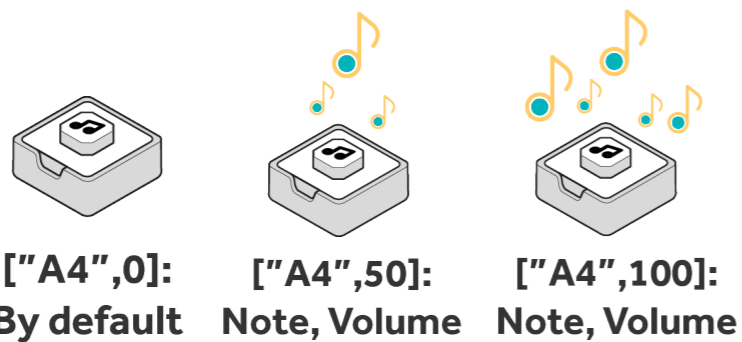
Turn the buzzer on or off using a 'true' or 'false' input (for example, from a SAM button).

Change the volume of the buzzer using a value between 0-100 (for example, from a SAM slider).

TRY THIS! Try connecting a Space Soft SAM to the SAM Buzzer to see what happens when you press the spacebar on your keyboard!
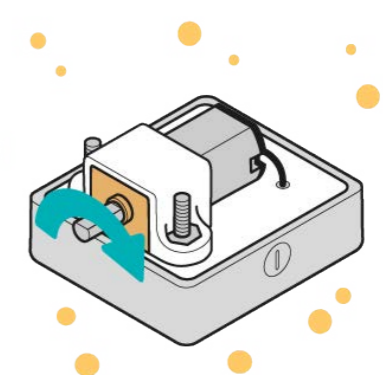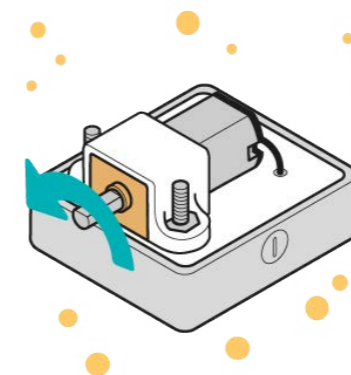
SAM DC Motor

description

The **SAM** DC Motor is a powerful block that adds motion to your inventions. The shaft of the motor spins around, and you can set its direction and speed using inputs.

how it works

The **SAM** DC Motor can turn in both directions and at varying speeds.

Turn the motor on by sending it a 'true' value - it will start spinning at the speed and direction specified in the block's settings.

Change the speed of the motor by sending a numeric value to the block between 0-100 - it will start spinning at that speed in the direction specified in the block's settings. Note that 100 is the maximum speed.
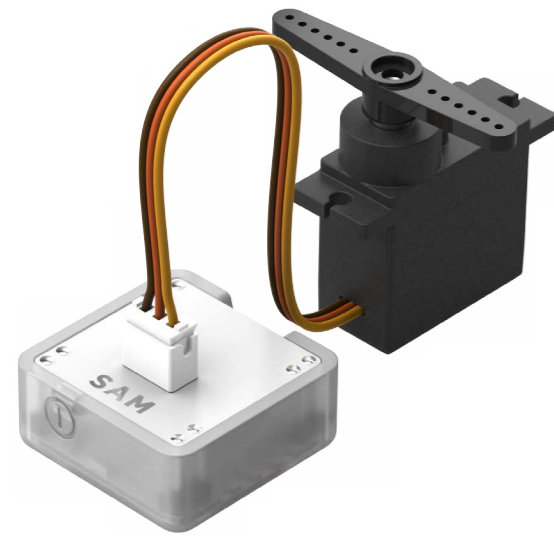
Note: If you send the block a value of 0 or 'false', it will stop working.

TRY THIS!
Try connecting a SAM Button to the SAM DC Motor to see what happens!

SAM Servo Motor

The **SAM** Servo Motor is another block that powers inventions with motion. The arm of the servo motor rotates back and forth around 180 degrees.

Servo0

180°
Angle

OK

how it works

The servo is a motor with an arm that rotates 180 degrees. The position of the arm is set according to the number that it receives - 0 being the arm's rest position, 50 being 90 degrees, and 100 being 180 degrees.

180 °

0   100

126 °

0   70
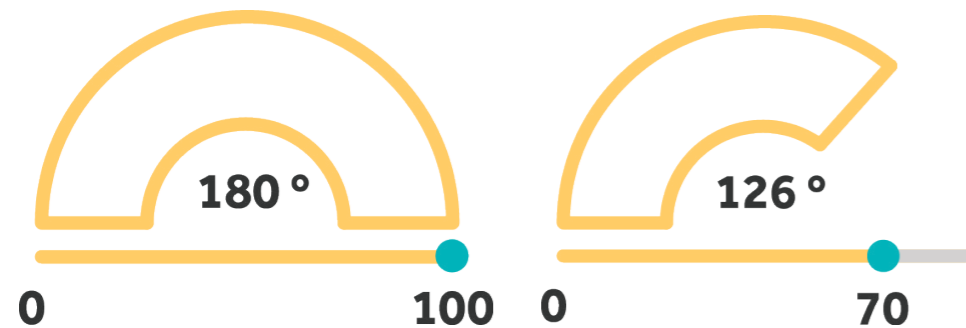
If you send a boolean 'true' to the servo, it will go to the position as specified in the settings menu. if you send a boolean 'false', it will go to its rest position.

TRY THIS! Try connecting a Keyboard Key Soft SAM to the SAM Servo motor to see what happens when you press a key on your keyboard!
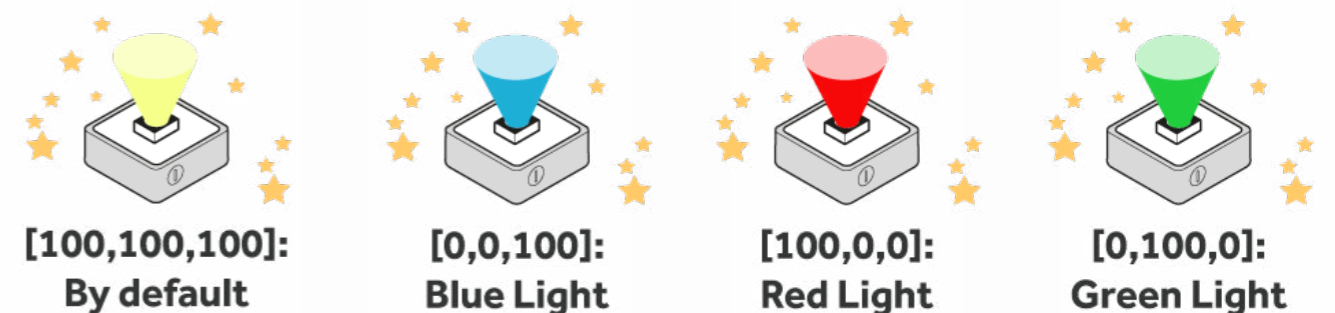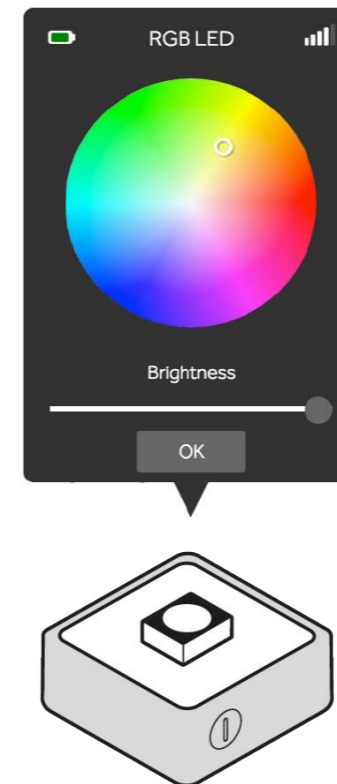
SAM RGB Light

description

The **SAM** RGB light adds a glowing effect to your inventions. The light has variable colours across the full spectrum, and you can also change the brightness.

how it works

RGB LED

Brightness

OK

To turn the light on, it must receive a boolean 'true' value. It will then turn on using the colour and brightness specified to the block. If it receives a boolean 'false', it will turn off.

You can change the colour of the **SAM** light using the settings menu of the block. The brightness of the light changes depending on the numeric value it receives between 0-100.

[100,100,100]:
By default

[0,0,100]:
Blue Light

[100,0,0]:
Red Light

[0,100,0]:
Green Light

TRY THIS!
Try connecting a SAM Button to the SAM RGB Light to see what happens!

SOFTWARE BLOCKS

What are software blocks?

Using software blocks found in the SAM Space Education app, you can easily customise the behaviour of your hardware blocks - for example, change the colour of the light, or create a melody for the buzzer.

There are over 40 software blocks included in the app. These are grouped into apps, behaviours, timing, and logic software blocks.

MY COMPUTER SOFTWARE BLOCKS

What is a My Computer Software Block?

A My Computer Software Block is something that is accessible through your device. For example, the Camera Soft SAM relies on the camera in your computer, as does the Keyboard Soft SAM.

SAM Camera Block

Description

Need to take a picture? This block is great for a quick snapshot.

How it works

When the camera block receives a boolean value 'true', it takes a picture using the computer's default camera, saves it in Documents > SAM > Camera, and makes it available to the next block in the circuit.

If the picture has been taken successfully, the camera will emit boolean 'true'. Note that it only saves the latest picture, and then continuously overwrites it. Remember that the settings menu in the app must be open or the picture will not take.
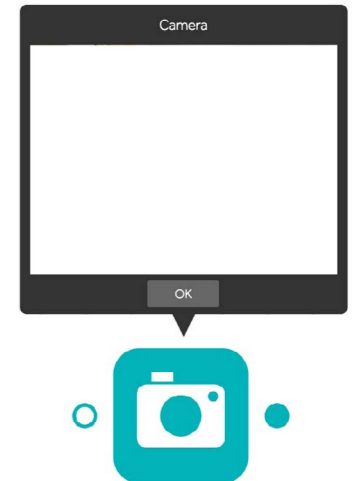
SAM Keyboard Block

Description

Turn any of your keyboard keys into buttons.

How it works

The keyboard key you select as your button turns into the 'trigger' key and appears in the app. If the trigger key on the icon is pressed, it sends a boolean 'true' when pressed and boolean 'false' when the key is released.

To change the trigger key, open up the settings and press a key. Trigger keys can only be letters or the space bar.
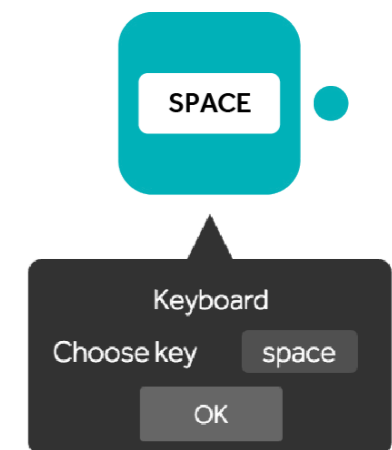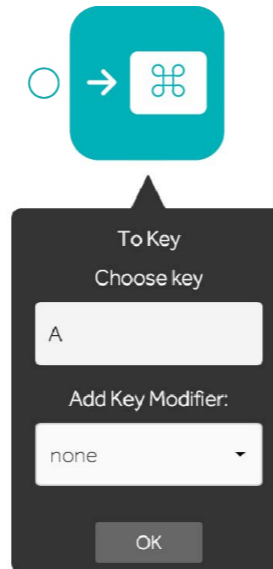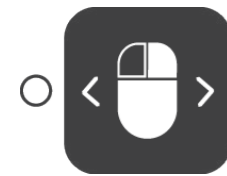
SAM To Key Block
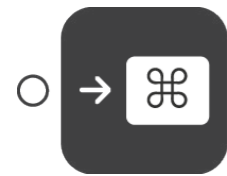
Description

Simulate a given key press every time it receives a boolean 'true'.

How it works

If this block receives the boolean value 'true', it will trigger the keyboard press specified in the settings menu.

To Key

Choose key

A

Add Key Modifier:

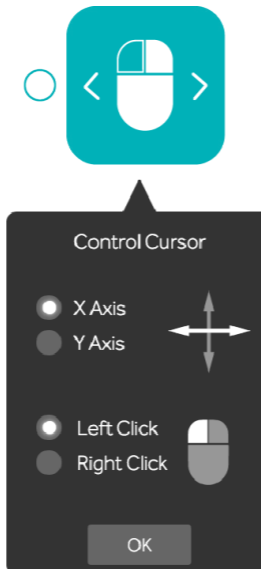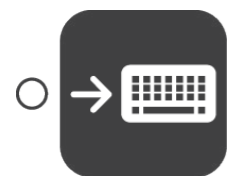none ▾

OK

SAM Control Cursor Block

Description

Control your mouse's movement and clicks.

How it works

A boolean value controls the click of the mouse button selected in the settings menu. A numeric value controls the axis of the mouse selected in the settings menu.

Control Cursor

● X Axis
● Y Axis

● Left Click
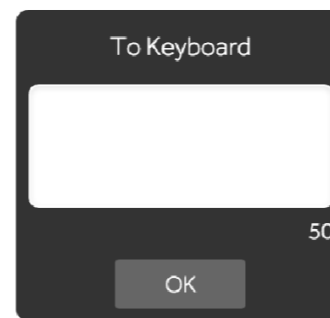● Right Click

OK

SAM To keyboard Block

Description

Control your keyboard and output with a series of key presses.

How it works

If this block receives the boolean value 'true', it will trigger the keyboard press specified in the settings menu.

To Keyboard

50

OK

Note that the maximum length of the text that you can specify in the settings menu is 20 characters.

SAM Block Sound Player
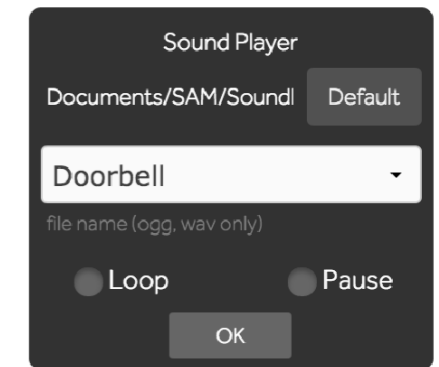
Description

Play .ogg and .wav sound files!

How it works

The **SAM** Block Sound Player plays a song when it receives a boolean value 'true' and stops playing when it receives a boolean value 'false'.

Select the song you want to play using the settings menu in the app. Add new audio to the list by saving your .wav or .ogg files in Documents > SAM > SoundPlayer. Or, click on the document path in the settings menu and select your music from a different folder. In this case, the tunes in the dropdown will correspond to the .ogg and .wav files found in the selected folder.

The pause tick box means that when you stop playing the recording and start playing again, it will pick back up again from the same point.

The loop tick box means that the sound will restart again when it reaches the end.

Sound Player

Documents/SAM/SoundI   Default

Doorbell ▾

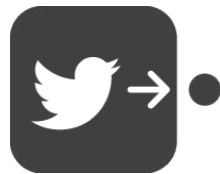file name (ogg, wav only)

● Loop   ● Pause

OK

INTERNET SOFTWARE BLOCKS

What is an Internet Software Block?

An Internet Software Block is a block that connects to the API of a website.

SAM Tweet In Block

Description

When it receives a tweet matching the criteria of the given search it will send out the tweet.

How it works

This block allows you to monitor Twitter for hashtags and mentions. Open the settings menu and enter the hashtags or names that you would like to search for (separate them with spaces).

Every time the selected words are mentioned on Twitter, the block sends a Twitter message that contains the selected words. 1 second later it sends a boolean 'false'.
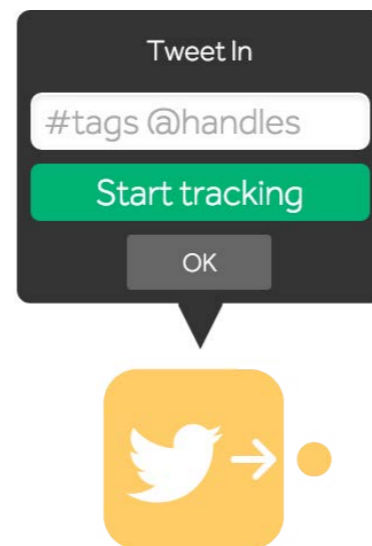
Note that you have to be authenticated to Twitter in order to use this app. You can do this by dragging the block onto the canvas and clicking 'connect' in the settings menu. You can always unlink your Twitter account from **SAM** by going to the right-hand pane, selecting 'Apps' and then 'Edit Apps' and then the X next to Twitter.

SAM Tweet Out Block

Description
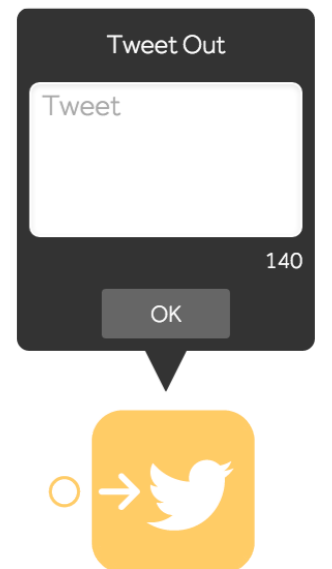
Post to a connected Twitter account.

How it works

The Tweet Out Block posts messages and pictures to your Twitter account.

To post to Twitter, your account needs to be linked to SAM Space Education. You can set this up by clicking on 'My Apps' on the right-hand-side pane, choose

Twitter 'connect' and log in to Twitter. It can also be done by double-clicking on the Twitter block when it is on the canvas.

If the block receives a text value, it will send the value it receives to Twitter. If it receives any other **SAM** Type, it will send the message in the settings menu to Twitter. If the Camera block is connected to the Twitter Out block, the last taken picture with the Camera will be posted to your Twitter feed along with the message.

Note that Twitter does not allow you to send the same Tweet twice. Additionally, you can send a maximum of 15 Tweets per 15-minute period.

SAM Facebook Out Block

Description

Post to the connected Facebook account.

How it works

The Facebook Out Block posts messages and pictures to your Facebook timeline.

To post on Facebook, your account needs to be linked to SAM Space Education. You can set this up by clicking on the 'My Apps' on the right-hand-side pane, choose Facebook 'connect' and log in to Facebook. It can also be done by double-clicking on the Facebook block when it is on the canvas.
If the block receives a text value, it will send the value it receives to Facebook. If it receives any other SAM Type, it will send the message in the settings menu to Facebook.

If the Camera Block is connected to the Facebook block, the last taken picture with the Camera will be posted to your Facebook timeline along with the message.
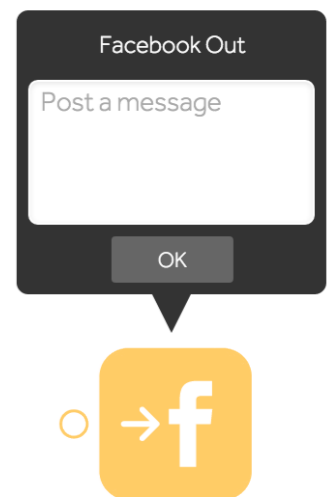
SAM IFTTT Out Block

Description

Trigger the IFTTT maker channel!

How it works

The IFTTT Out Block allows you to control your favourite applications with SAM through the IFTTT Maker Channel.

Every time the IFTTT Out Block receives a value, it will send a value to the IFTTT Maker Channel that you have configured in the settings menu. It's up to you to set up the necessary recipes in IFTTT to handle the received message, here's a bit more info about doing that:
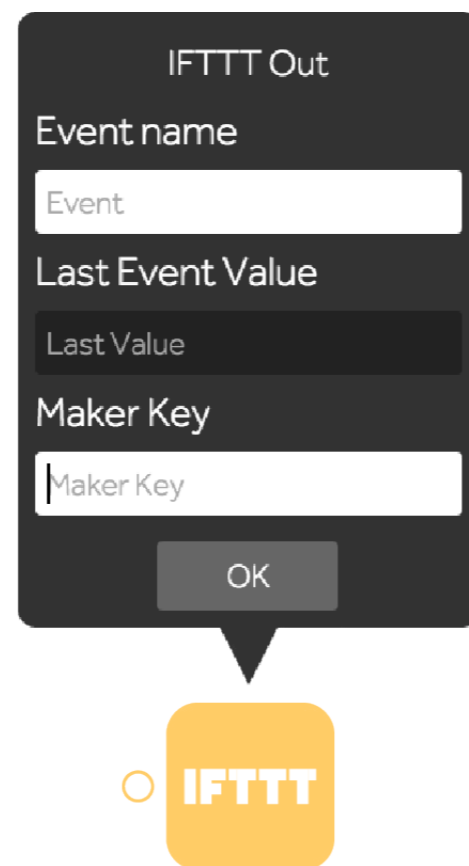
Firstly, it is necessary to have an account with IFTTT. If you don't have one, don't worry, you can create a free one here: ifttt.com/maker.

The second step is to connect your account to the Maker Channel. Once you have done this, you can get access to a Maker Key which needs to be entered in the IFTTT Out settings menu (in SAM Space Education).

In IFTTT you can now 'Create a Recipe'. First, you need to pick your input: choose 'Maker' as the channel and 'Receive a web request' as the Trigger.

Then, give a name to your Event. Type the same name into the 'Event name' field in the IFTTT Out block's settings menu.

Finally, all that is left to do is decide what you want to Trigger. See https://ifttt.com/channels for inspiration.

IFTTT Out

Event name

Event

Last Event Value

Last Value

Maker Key

Maker Key

OK

COMMANDS SOFTWARE BLOCKS

What is a Command Software Block?

A Command Software Block is something that sends or receives a command or language to/from another block.

SAM Text Block

Description

Output a line of text by controlling the Software Block with an input.

How it works

If you send this block any non-positive value, it will emit boolean value 'false'. If you send this block a positive value, it will behave differently depending on the type of input that you send it. If you send it text, it will append the text specified in the settings menu to the text received and emit the resulting message. If you send it any other positive value, it will simply emit the message specified in the setting menu.

You can embed the received value into the emitted message using the keyword %input% in the settings menu. For example, you can write: 'The received value is: %input%', and the emitted message will replace %input% with the actual value of the input (irrespective of its type).

Text

200

OK
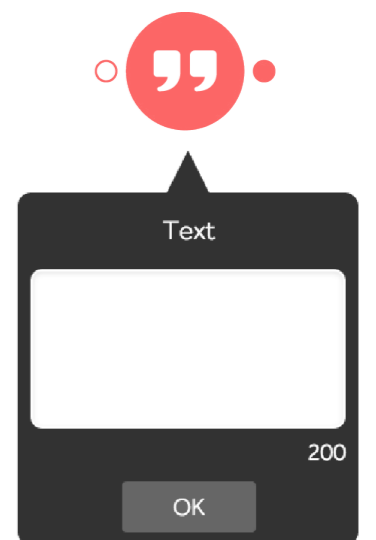
SAM Morse Code Block
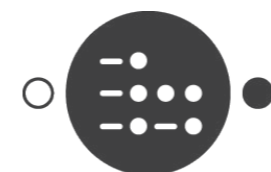
Description

Convert text to Morse code and send secret messages.

How it works

The Morse Code Block will convert any received value to text, and then convert that text to Morse code. You can set the speed of the Morse code in the settings menu.

For the best results, send text to the input of this block and connect a light or a buzzer to the output to see it in Morse!
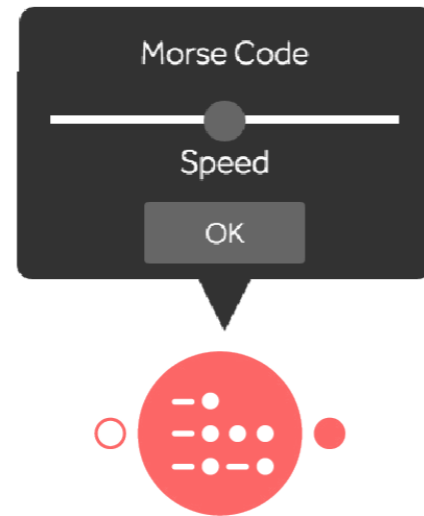
SAM Custom Code Block

Description

The **SAM** Custom Code Block lets you customise your own function and interact with the app using JavaScript.

How it works

The Custom Code block allows you to control the circuit with JavaScript. The JavaScript function that you write runs every time the block receives a message.

You can check the last sent value of any of the inputs by referring to it by its name which is passed as an argument to the function (check the settings menu of the block in question. Typically it will be 'blockName0').
The computational part of the function is done by writing any valid JavaScript.

Sending the result to the rest of the circuit can be done in one of two ways. Either you emit a value to all of the attached blocks using the standard JavaScript return statement or you can use a special method to send a value to specific blocks. This is the CM.sendTo (ModuleNameString, ValueToBeSent, DelayInMs) method. This function does not stop execution (like the return statement), so you can have more than one, allowing you to send different values to each block.
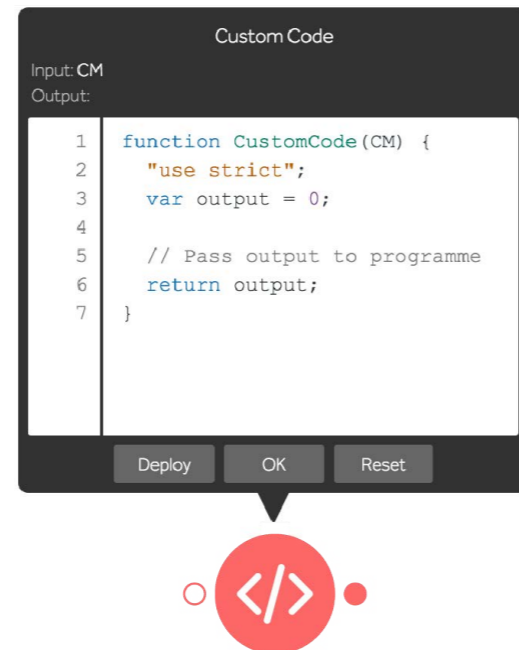
BEHAVIOURS SOFTWARE BLOCKS

What is a Behaviour Software Block?

A Behaviour Software Block allows you to switch or alter the traditional function of the SAM hardware blocks. For example, you may use a SAM Toggle Block to make a SAM Button into a switch, rather than simply a button. Alternatively, use the SAM Inverse Block with the SAM Light Sensor to trigger a reaction only when it's dark and the value is 0.

SAM Toggle Block
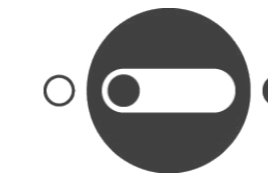
Description

When the **SAM** Toggle Block receives a positive value, it will toggle between sending out a 'true' and 'false' value.

How it works

Any input to this block gets converted to a SAM boolean value. This block changes state (toggles between 'true' and 'false') only when it receives boolean 'true' values (it ignores 'false' values).

SAM Inverse Block

Description

The **SAM** Inverse Block outputs the inverse of the input value it receives.

How it works

If 'true' is received, 'false' will be output, and vice versa. If a number 'X' is received, '100 - X' will be returned. If a SAM colour type ['X, Y, Z'] is received, then it will return ['100-X, 100- Y, 100-Z']. If a SAM buzz type is received with volume 'X', then it will return the same note with volume '100 - X'.

SAM Switch Block

Description

The **SAM** Switch Block allows values to pass through. If the hand is a positive value, then the other input values will be allowed to pass through.

How it works

This is a special block. It has two different types of input. One input is the hand that will control whether data from the other inputs will be allowed to flow through the block or not. You specify the block that will act as the hand in the settings menu. If the hand block sends a positive value, then the hand will push the switch down, closing the circuit, and allowing the values of the other input blocks to it to pass through the circuit.

SAM Log Block

Description

The **SAM** Log Block stores the values that it receives, so you are able to download the log as a .csv.

How it works

This block passes everything right through it without changing the value. If you leave the log interval to '0', it will make a copy of and log every single value that it receives.

If the interval is increased, for example to 1 minute, it will log at most 1 value every minute (it will log the first value that it receives at the beginning of each minute).

Once your experiment is complete, you can download the log file in the .csv format. Simply open the settings menu and click on 'Download File'.
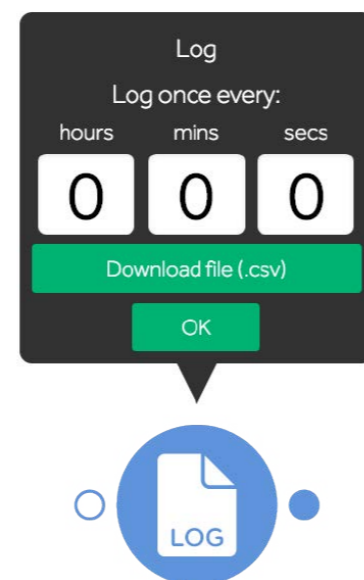
NUMBERS SOFTWARE BLOCKS

What is a Numbers Software Block?

A Numbers Software Block uses numbers to determine its behaviour. From filtering to mapping, these blocks use boolean, 'true'/'false', or binary logic to determine what will happen next.
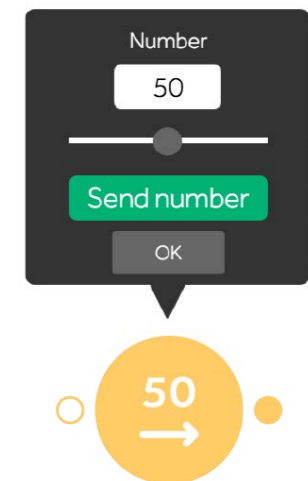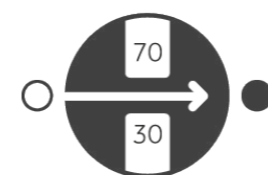
SAM Number Block

Description

The **SAM** Number Block outputs a specific number when it receives a boolean 'true' value.

How it works

When the block receives a boolean 'true' value, it will emit the numeric value stored in the block. If you send any other data type, it will convert it to a number and update the value stored in the block. The value in the block will not be emitted unless you send a boolean 'true' value.
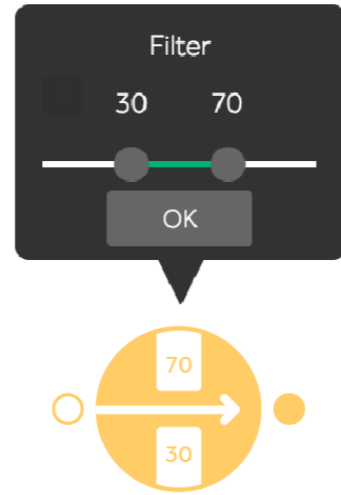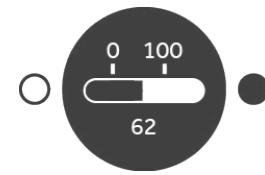
SAM Filter Block

Description

The SAM Filter Block will only let values through that are between two specified numbers.

How it works

The input to this block gets converted into a **SAM** number. If its value lies within the bounds controlled in the settings menu, the converted value will be allowed to pass through. Otherwise, the number '0' will be emitted.

SAM Map Block

Description

The **SAM** Map Block converts a number to a new value depending on the mapping specified in the settings menu.

How it works

In 'true'/'false' mode, you must set one threshold value in the settings menu. If the value received is below the threshold, the block will output false. If the value received is above the threshold, the block will output true.

In '0-100' mode, you must set two threshold values in the settings menu. All values received that are below the lower bound will be mapped to '0', and all values received above the upper bound will be mapped to '100'. Between the two bounds, the values are linearly mapped between 0 and 100.
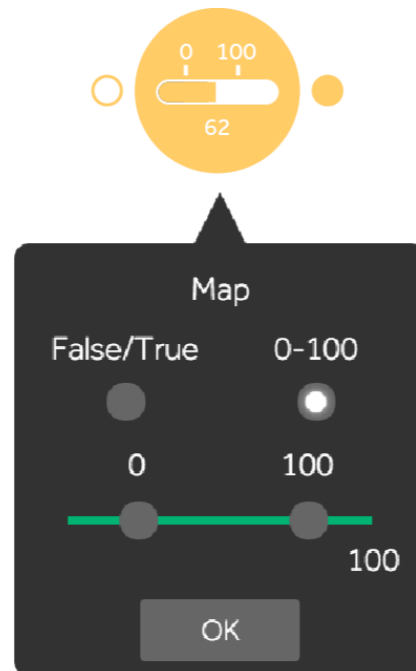
SAM Compare Block

Description

The SAM Compare Block allows you to compare incoming values to a pre-defined number.

How it works

This block will convert every input to a SAM Number and then compare that value with the one specified in the settings menu. If the comparison is 'true', the block will emit boolean 'true', otherwise, it will emit boolean 'false'.

SAM On/Off Block

Description

The **SAM** On/Off Block converts any input value to a boolean 'true'/'false'.

How it works

This block will convert any type of input to a boolean and emit the boolean value obtained.

SAM Counter Block

Description

The **SAM** Counter Block counts up (by increments of one) every time it receives a positive value.

How it works

Every time this block receives a positive value it will increment its internal counter value and send that value to the next block in the circuit.

The counter will 'max out' when the value reaches 100. In order to reset the counter, send it text with value 'reset'.

When it receives a non-positive value, it will ignore the value and not emit anything.
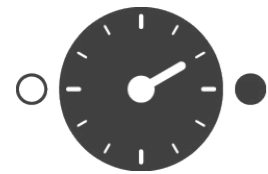
TIMING SOFTWARE BLOCKS

What is a Timing Software Block?

A Timing Software Block is an element of software that controls when a result is triggered. These blocks allow you to customise when you want the reaction to happen.

SAM Delay Block

Description

The **SAM** Delay Block holds onto values for the time specified before allowing the message to continue.

How it works

This block will store every value that it receives for the time indicated in the settings menu before emitting the value. The block only accepts boolean inputs and SAM number types, all other values sent will be converted to the boolean type.

| Delay		
hours	mins	secs
0	0	1
	OK	
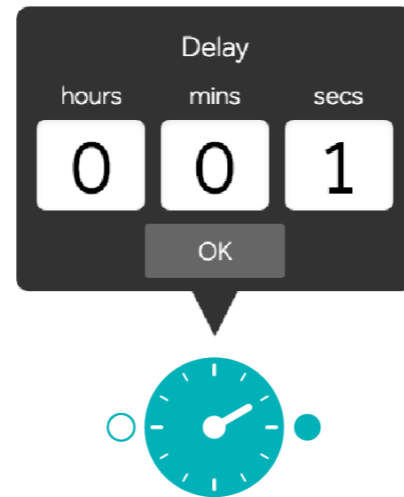
SAM Hold Block

Description

The **SAM** Hold Block holds a value for a specified period of time.

How it works

This block will immediately trigger the value received, hold the value for the time indicated in the settings menu, then trigger a cancel value afterwards. The cancel value is a boolean 'false', if the trigger value is a boolean. Otherwise, the cancel value is a number of '0'.

| Hold		
hours	mins	secs
0	0	2
	OK	
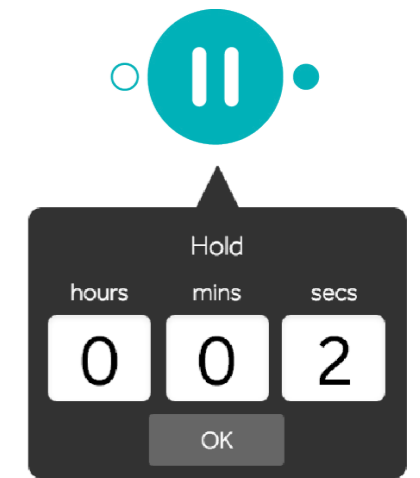
SAM Interval Block

Description

The **SAM** Interval Block alternates 'true' and 'false' values at specified time intervals.

How it works

When the block receives a positive value, it starts alternatively sending 'true' and 'false' at the interval specified in the settings menu. When it receives a non-positive value it stops the interval and emits a boolean 'false' value.

| Interval		
hours	mins	secs
0	0	0
	OK	
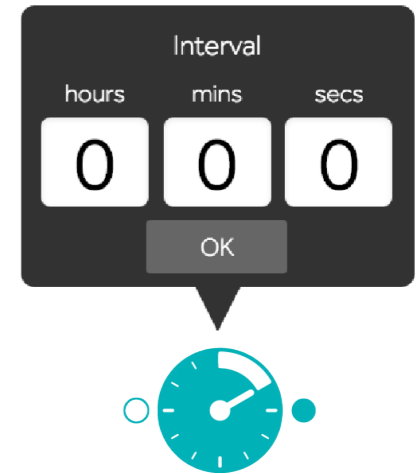
SAM Time Trigger Block

Description

The **SAM** Time Trigger Block sends out a 'true' value at a specified date and time.

How it works

This block allows you to set a system in motion at a specific pre-defined time. When the time specified in the settings menu is reached, a boolean 'true' value is emitted. One second later, it is followed by a boolean 'false', so it only acts on the given time.
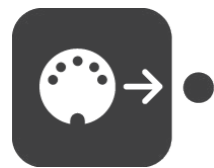
Time Trigger	
07	December ▾
15 : 28	Set
	OK
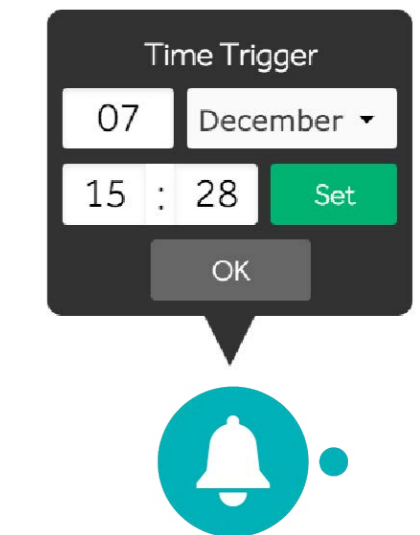
MUSIC SOFTWARE BLOCKS

What is a Music Software Block?

A Music Software Block deals with MIDI music-editing software, allowing you to pair **SAM** blocks with elements of song composition. Edit, trigger, or warp music using MIDI signals.
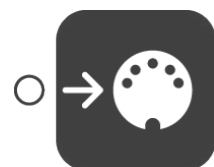
SAM MIDI in Block

Description

Use an external MIDI device to send MIDI messages.

How it works

Connect your MIDI device to your computer and select it from the settings dropdown in the app. SAM uses MIDI Channel 1, so make sure that you send and receive on that Channel in your Music software and MIDI devices.
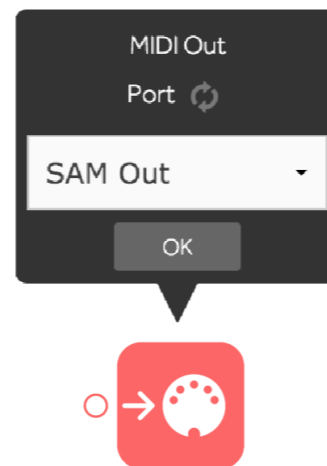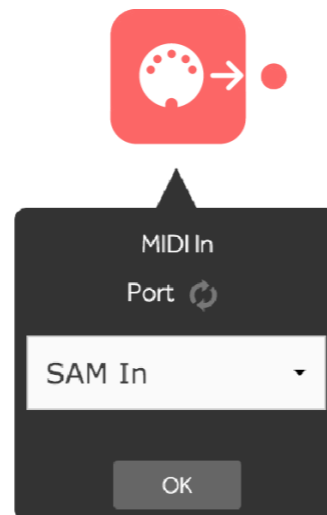
You can also use virtual ports as MIDI devices to send MIDI messages. To set up virtual ports (mainly Windows), you have to use a driver.

SAM MIDI Out Block

Description

Send MIDI messages to a connected MIDI device.

How it works

Connect your MIDI device to your computer and select it from the settings dropdown. The default port used is **SAM** Out.
If you connect a MIDI message or a Note Block to this, it sends the MIDI message and note respectively.

SAM MIDI Message Block

Description

The **SAM** MIDI Message Block sends out a MIDI message when it receives a boolean 'true'.

How it works

If the block receives a boolean 'true' value, it will emit the MIDI message stored in the block. If it receives a number value, it updates the data of the MIDI message. If it receives a buzz value, it updates the MIDI message stored in the block. The value in the block will not be emitted unless you send a boolean 'true' value.
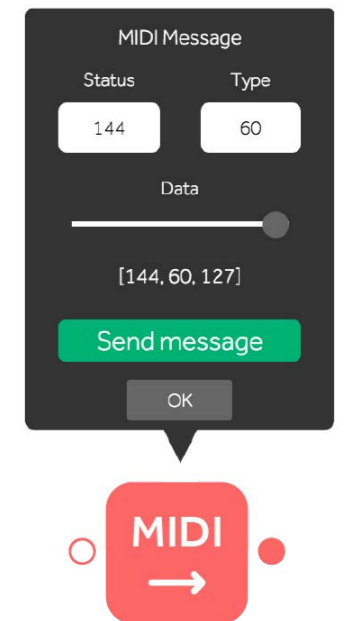
LOGIC SOFTWARE BLOCKS

What is a Logic Software Block?

A Logic Software Block is a block that filters values from various inputs. If you connect two buttons to an AND Logic Block and press them at the same time, a 'true' value will be emitted as the gate says both inputs need to be pressed to emit a signal on the other end, though if you only pressed one of the two buttons, the value would not be 'true'.

SAM NOR Block

Description
This block outputs 'true' when all inputs are 'false'.

How it works
When all inputs are 'false' it will send out a 'true' value.

SAM XOR Block

Description
This block behaves similarly to an OR Logic Gate with only one positive input.

How it works
When only one of the values is positive, it will send out a 'true' value.

SAM OR Block

Description
This block behaves like an OR Logic Gate, meaning that when either of the inputs is true, the gate will send a true signal.

How it works
This block will emit a boolean 'true' when at least one of the inputs is a positive value.

SAM NAND Block

Description
This block outputs 'false' when all inputs are 'true'.

How it works
Will send a 'false' value only when all its inputs are 'true'.

SAM AND Block

Description
The block behaves like an AND Logic Gate.

How it works
The output will be a boolean 'true' if all the inputs are positive values.

DC MOTOR SOFTWARE BLOCKS

What is a DC Motor Software Block?

A DC Motor Software Block sends a signal to your SAM DC Motor Block regarding direction.

SAM Switch Direction Block

Description
The **SAM** Switch Direction Block toggles the direction of the DC Motor.

How it works

This block flips the direction of a DC Motor. When the value is a boolean, 'true' will trigger. When the value is a number, a non-zero number will trigger.

If a connected DC Motor is going clockwise, and this block is triggered, the DC Motor will change to anticlockwise. If the connected DC Motor is going anticlockwise, and this block is triggered, the DC Motor will change to clockwise.

SAM Direction Block

Description
The **SAM** Direction Block outputs a direction string when it receives a positive input value.

How it works

This block will send the direction specified in the settings menu when a positive value is sent. When the value is a boolean, 'true' will trigger. When the value is a number, a non-zero number will trigger.
A clockwise direction will send the string clockwise, and an anticlockwise direction will send the string anticlockwise.
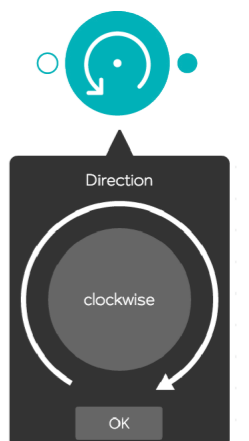
RGB LED SOFTWARE BLOCKS

What is an RGB LED Software Block?

An RGB LED Software Block manages the behaviour of the **SAM** RGB LED Block in real life, controlling elements of colour percentage in the light emitted.
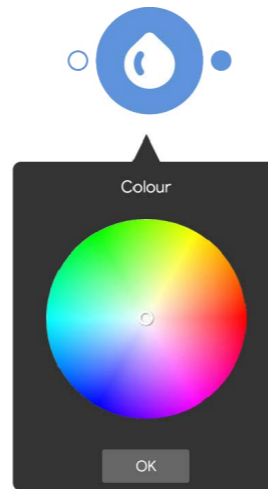
SAM Colour Block

Description

The **SAM** Colour Block outputs a colour value when it receives a positive input.

How it works

This block will output the colour specified in the settings menu, when it receives an input boolean 'true' value.

Colour

OK

SAM Cycle Colours Block

Description

The **SAM** Cycle Colours Block sends out a red, green and blue colour value.

How it works

This block behaves differently depending on the type of input it receives. If the input is text, a buzz or a colour, the value will be converted to a boolean and behave as follows:

• Every time this block receives a positive value it will cycle between 3 colours: red, green and blue. When it receives a false value, it will emit a boolean 'false'.

• If the input is a number, it will not follow the same pattern. If the input number is 0-33 then red [100,0,0] will be emitted, if the input number is 34-67 then green [0,100,0] will be emitted, otherwise blue [0,0,100] will be emitted.

SAM Cycle Brightness Block

Description

The **SAM** Cycle Brightness Block changes the brightness of a light and behaves differently depending on the type of input it receives.

How it works

If the input is text, a buzz or a colour, the value will be converted to a boolean and behave as follows:

• Every time this block receives a 'true' value it will cycle between 3 numbers: 0 (off), 33 (medium brightness) and 100 (maximum brightness). When connected to a light, the numbers get converted to the colour type according to the SAM conversion rules. When it receives a false value, it will emit a boolean 'false'.

• If the input is a number, it will not follow the same pattern. If the input number is 0-33 then 0 light will be emitted, if the input number is 34-67 then 33 will be emitted. Otherwise, 100 will be emitted - full brightness.

BUZZER SOFTWARE BLOCKS

What is a Buzzer Software Block?

A Buzzer Software Block adjusts the speed or the note(s) from the playback of the **SAM** Buzzer.

SAM Note Block

Description

The **SAM** Note Block sends out a musical note when it receives a positive value.

How it works

Connecting in

If a MIDI Message Block is connected, a MIDI note is stored using the type value (2nd value) as the note, and the data (3rd value) as the volume.

If a number is sent, the number is mapped to the keyboard of notes and stored.
The MIDI Message Block does not send the value until a boolean 'true' is sent to it. If a boolean 'false' is sent, then a 'MIDI off' message (status of 128) is sent. 'MIDI off' messages are also sent when notes change to turn off previous notes.
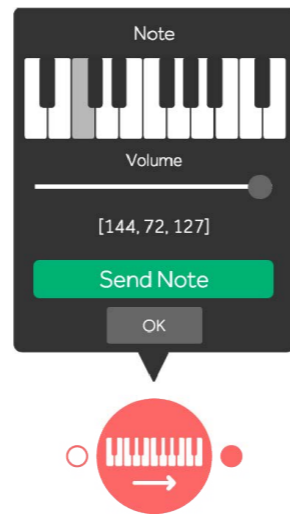
Connecting out

If connected to a Buzzer, it will play the note sent.
If connected to MIDI Out, it will send a MIDI Note. The SAM Note Block is limited to 17 notes. All MIDI notes are sent on MIDI Channel 1.

SAM Cycle Volume Block

Description

The **SAM** Cycle Volume Block will send out a pre-defined note at low, medium and then high volume.

How it works

This block behaves differently depending on the type of input it receives. If the input is text, a buzz or a colour, the value will be converted to a boolean and behave as follows:

• Every time this block receives a positive value it will cycle between 3 preset buzz values: note A4 at 10% volume, note A4 at 30% volume and note A4 at 50% volume. When it receives a false value, it will emit a boolean 'false'.

• If the input is a number, it will not follow the same pattern. If the input number is 0-33 then note A4 at 10% volume will be emitted, if the input number is 34-67 then note A4 at 30% volume will be emitted, otherwise note A4 at 50% volume will be emitted.

SAM Cycle Frequency Block

Description

The **SAM** Cycle Frequency Block sends one of three pre-defined music notes.

How it works

This block behaves differently depending on the type of input it receives. If the input is text, a buzz or a colour, the value will be converted to a boolean and behave as follows:

Every time this block receives a positive value it will cycle between 3 preset buzz values: note A3 at 30% volume, note D4 at 30% volume and note G4 at 30% volume.

• When it receives a false value, it will emit a boolean false. If the input is a number, it will not follow the same pattern. If the input number is 0-33 then note A3 at 30% volume will be emitted, if the input number is 34-67 then note D4 at 30% volume will be emitted, otherwise note G4 at 30% volume will be emitted.

SAM Sequencer Block

Description

This block allows you to programme a tune to play on your buzzer.

How it works

Connect this block to your buzzer and programme a tune to play. Open the settings menu to create the tune by choosing the sequence of notes, volume and tempo.

Sending a boolean value 'true' will initiate the sequencer to start sending the notes to the output block. Sending a boolean value 'false' will cause the sequence to stop.
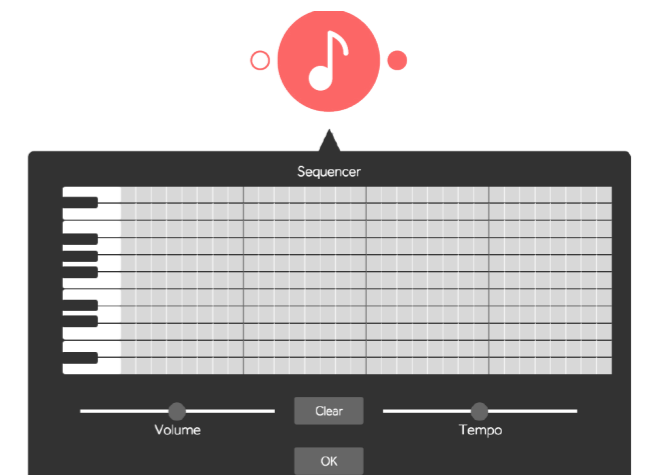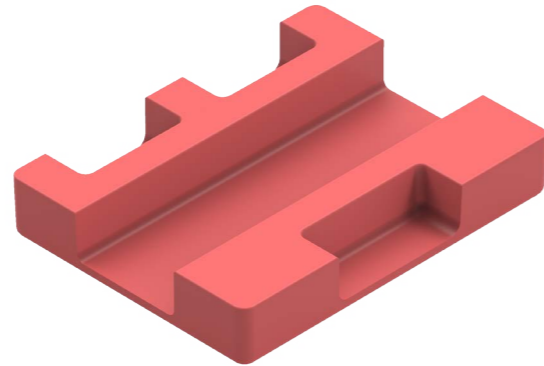
HARDWARE ACCESSORIES

CHARGING AND CONNECTION ACCESSORIES

car chassis
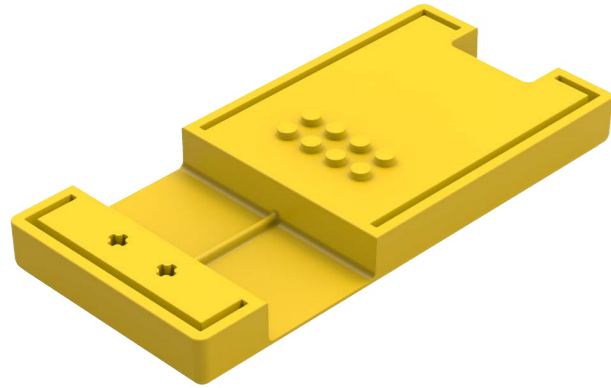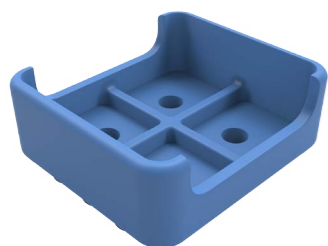
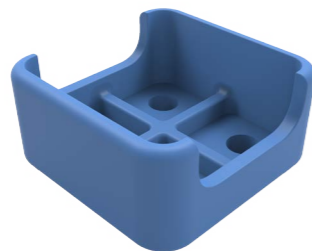car controller

wheels

roller balls

TRY THIS! Introducing our new range of accessories, specially developed to help you integrate with Lego®!
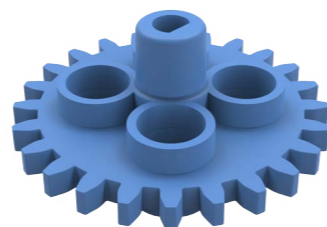
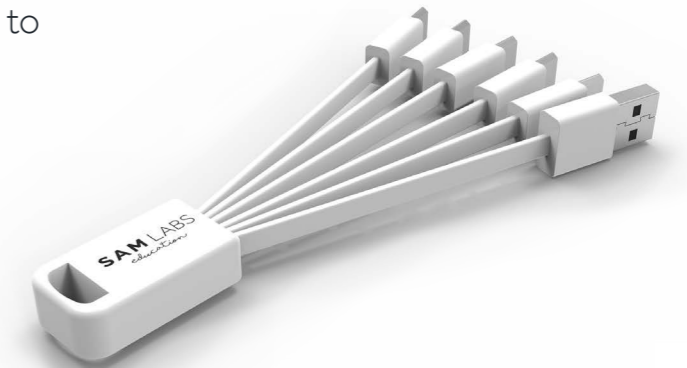large block connector

small block connector

gear wheel

charging solution

Included in your kit, you will find a charging solution which allows you to charge up to five blocks at a time.

usb cables

Use the USB cables to charge your blocks individually by connecting them to your laptop or tablet.

bluetooth dongle

If your device doesn't support Bluetooth and your connection isn't working, simply plug in the Bluetooth dongle to your computer to generate a Bluetooth connection.
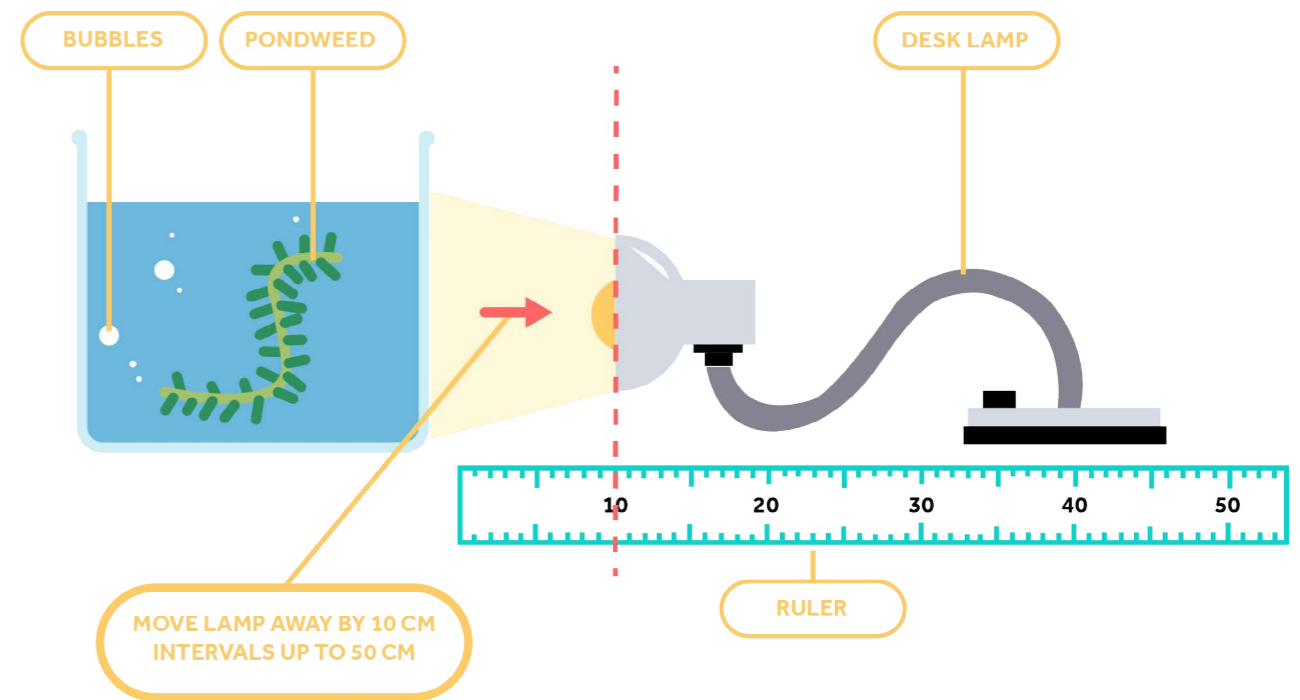
LESSON PLANS

SAM makes learning chug full-STEAM ahead! With lesson plans that involve weather, light, Morse Code and more, you can be sure that whilst the students are having fun building, they are learning. These lessons are aligned to a multitude of different subjects across the UK national curriculum, the international baccalaureate curriculum framework as well as the US national educational standards.

You can find them all at:

www.samlabs.com/education/resources

photosynthesis

Photosynthesis is the process whereby plants use sunlight to generate oxygen as a by-product. In this lesson, the students will experiment with the intensity of light to determine the amount of oxygen generated.

BUBBLES   PONDWEED   DESK LAMP

MOVE LAMP AWAY BY 10 CM INTERVALS UP TO 50 CM

RULER
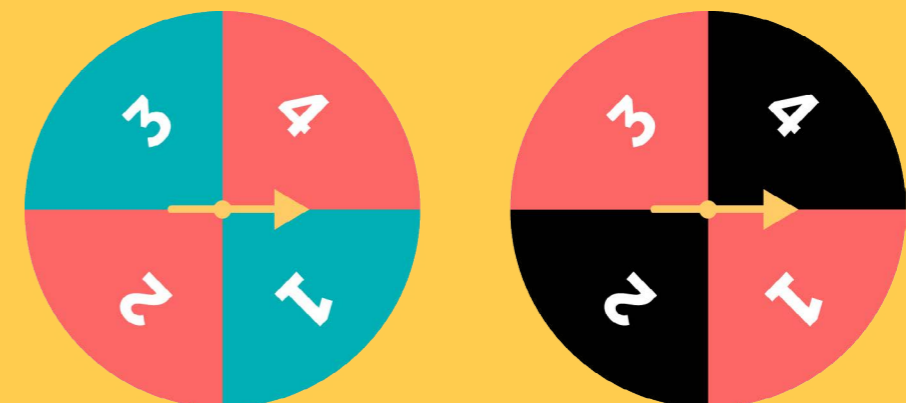
10   20   30   40   50

sam's curious car

Inspire students by creating SAM's Curious Car. This project will get them thinking about the basics of design, engineering and the importance of accurate measuring.
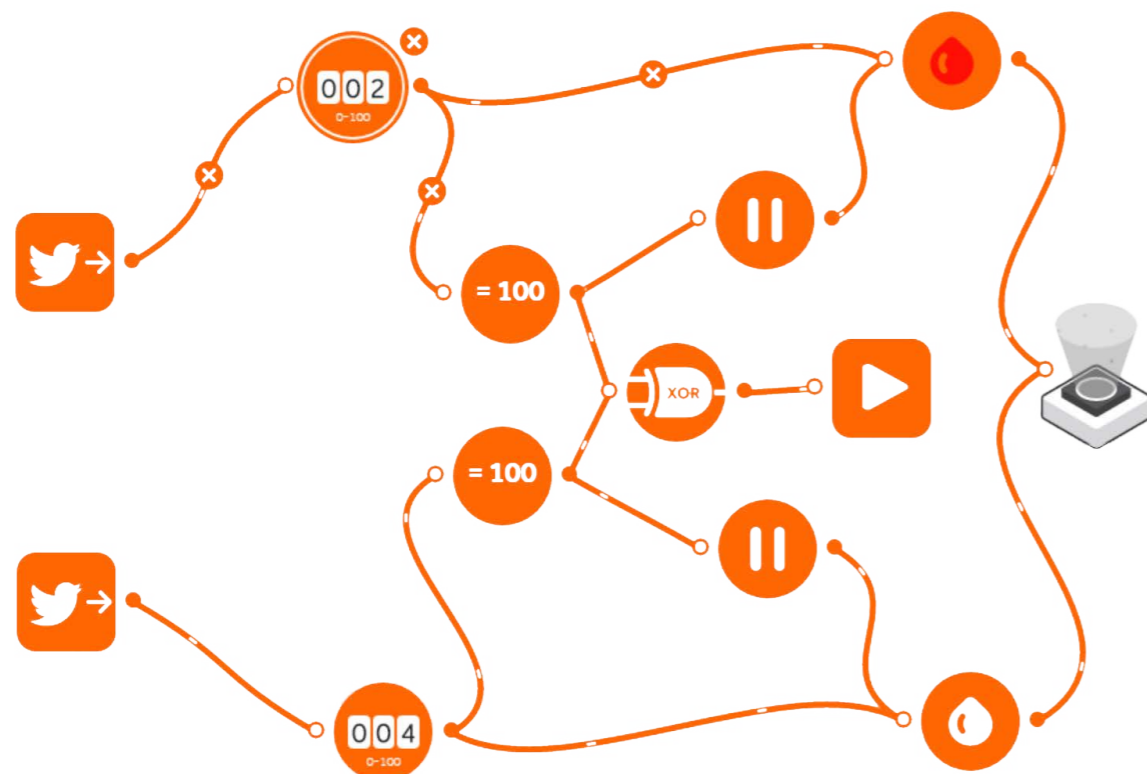
probability

Probability is the measurement of how likely it is for an event to occur. This lesson determines the logic behind comparing, judging and recording this.

twitter battle

This activity will get students thinking 'outside the classroom' and will give them an insight into how things 'trend' on social media. It will allow them to work with multiple topics from sports and celebrities to news and current affairs.

ASPIRATIONAL INVENTIONS FROM STUDENTS (AND TEACHERS)

You've now mastered the basics. You've gone through the lesson plans. Time to take your kit to the next level and see the full potential of how **SAM** can empower your students to go beyond. Why not see how SAM works with other awesome products like Makey Makey, IFTTT, Minecraft and many many more!

inspire

morse code

Morse code revolutionised long-distance communication prior to the invention of the telephone and email.
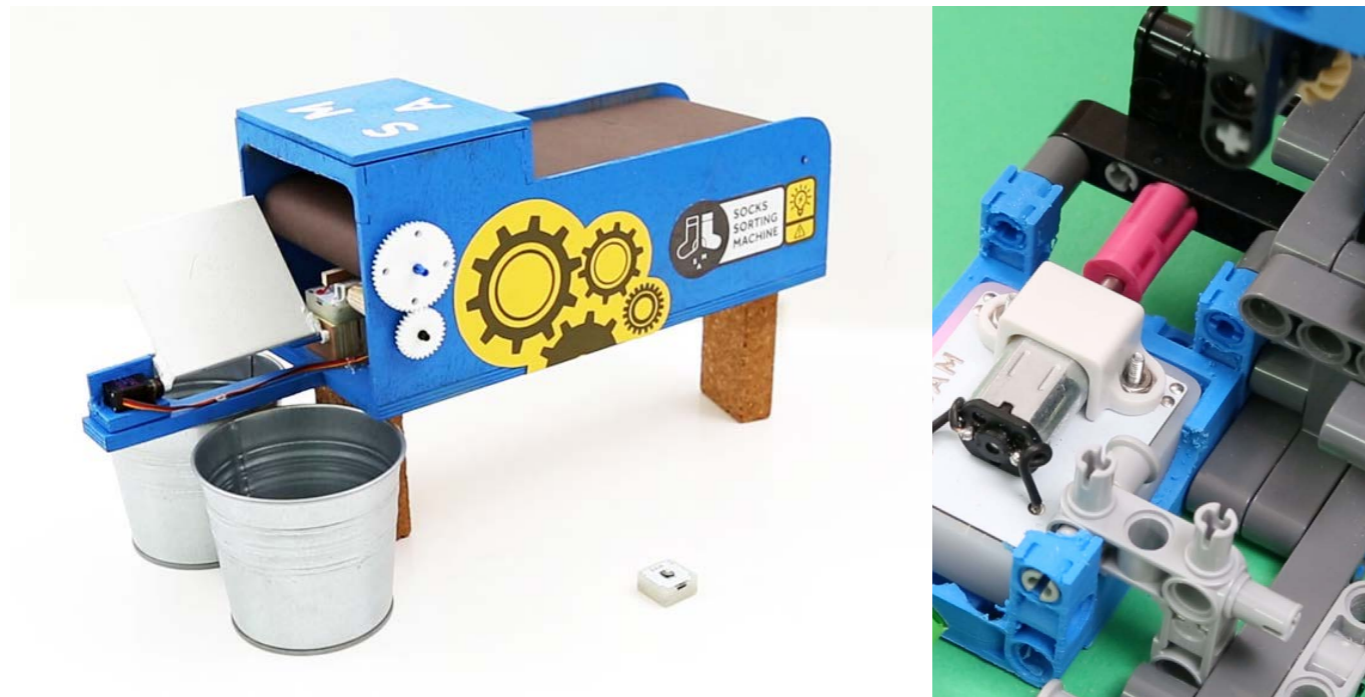
This project on Morse code gets pupils thinking about how technology can be used to develop solutions and create codes.

share

Have you come up with a new lesson plan using your STEAM Kit? If so, please email it to us at education@samlabs.com for your chance to be featured on our website.

HELP & SUPPORT

We're here to help. Dig into our support network for any unanswered questions.

faqs

Our FAQ section houses in-depth explanations of many frequently asked questions about **SAM**. You can find the link here: samlabs.com/support

app support

By clicking the ? in the bottom right-hand-corner of the **SAM** Space Education App, you may reach a member of the **SAM** Labs team directly. Ask us anything between the hours of 9:30 am - 6:30 pm GMT. Otherwise, we'll get back to you within 24 hours.

email link

Prefer to email? Feel free to send any queries to education@samlabs.com and our dedicated team will get back to you within 24 hours.

live chat

If you're visiting samlabs.com, you'll see a pop-up in the corner. That's us! You can chat to us between the hours of 9:30 am - 6:30 pm GMT, and we'll get back to you at lightning speed. If you've asked a question and want to leave the page, you can leave your email in the chat and we'll get back you.

forum

The forum is where your questions are posted and answered, either by SAMsters or members of the **SAM** Labs Education community. You can access the forum at: http://forum.samlabs.com/

SAM LABS education

education@samlabs.com

samlabs.com/education