Introductory Guide
for PICAXE Igloo and Blockly

STUDENT MANUAL

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Introduction:

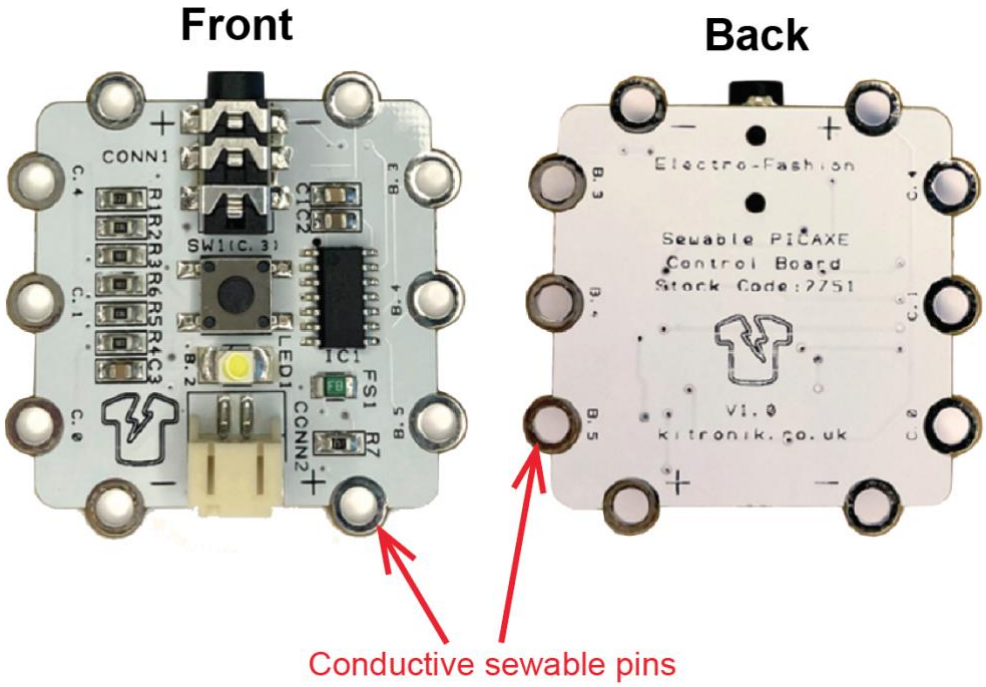
What is the PICAXE Igloo?

PICAXE refers to a product range of microcontrollers. When built into a circuit, a microcontroller acts as a small computer, telling the rest of the circuit what to do in a particular order (known as a sequence).

PICAXE microcontrollers include pre-programmed firmware, meaning it can be linked to a computer to create a own custom program and send this to the device. Because of its accessibility and endless possibilities, it is a common resource for creative projects of all skill levels.

The **PICAXE Igloo** is a microcontroller that has been specifically developed as a wearable module, meaning it can be sewn or attached to soft materials or clothing. The combination of electronics and textiles is often referred to **e-textiles** (electronic textiles), or **smart clothing** when worn on the body.

PICAXE's Electro-Fashion range includes the Igloo, along with various sewable components. These can be linked to the Igloo through a circuit and programmed to react in a sequence, depending on the project it is for.



What makes wearable modules different?

Wearable modules are designed with special **sewable pins**, which are conductive metal-coated rings placed around the board.

A specially designed **conductive thread** carries an electrical current the same way wires do. In order to make a circuit, this thread is wound around the pins and sewn through fabric.

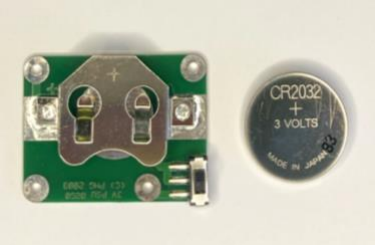
This technique was designed as an alternative to the typical method of soldering wires. Because the components have been sewn to the fabric, it becomes a **flexible circuit** which moves with the material instead of against it.

Additional Wearable Modules/Components:

As the Igloo works as the controller for the circuit, there needs to be additional components to be controlled, and to power the circuit.

Wearable modules each serve a specific purpose and can function in many different ways.

Power Supply

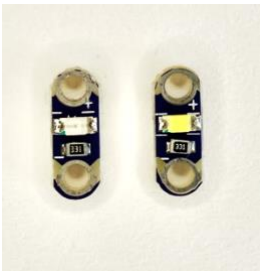


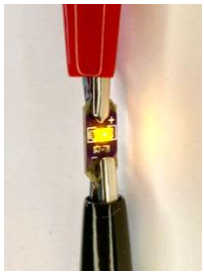
DAISY PIC 3V Coin Battery

This device supplies electric power to the Igloo and through the circuit. This is a requirement for all projects, as the Igloo does not have a power supply of its own. You will need to connect (or sew) the Igloo to the power supply first before creating the rest of the circuit.

The Igloo and components require a minimum of around 3 volts to function correctly. As the voltage is too low to create a shock, it is safe to touch and hold your project while it is turned on.

LED (Light-Emitting-Diode)



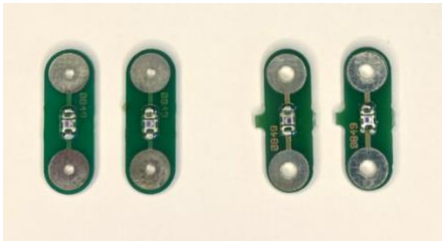


Arduino LilyPad PCB LED

An LED functions as a light source. When an electric current runs through it, the LED with light up in various colours.

As LED's require only a small amount of power to turn on, multiple LED's can be used as once and can be programmed to turn on and off in various sequences using the Igloo.

Light Sensor

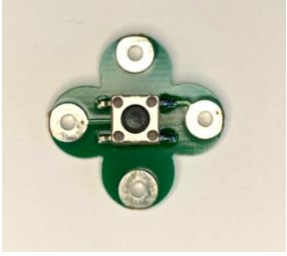


DAISY PIC Light Sensor

This device can recognise light and will react based on how bright or dim the surrounding environment appears.

When enough light is exposed, it sends an electric signal dictating how the rest of the circuit will react. For the DAISY PIC sensors, If an LED is attached it will glow brightly in light, or will turn off if it is dim.

Push Button



DAISY PIC Push Button

A push button has a small hidden mechanism inside which acts like a spring. When it is not pushed, it stops the circuit from completing itself, making it appear to be turned off. When the button is pushed down, it completes the circuit by letting electrical current pass through.

It can be connected to LED's to turn them on and off, or the sound generator to play sound only when the button is pushed.

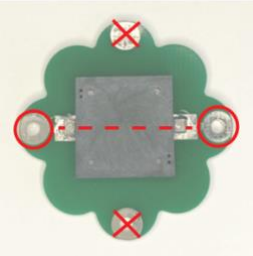
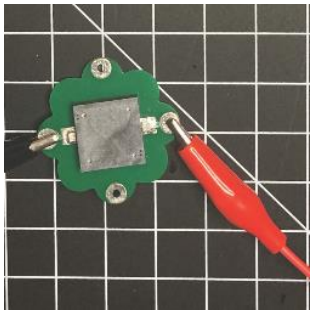
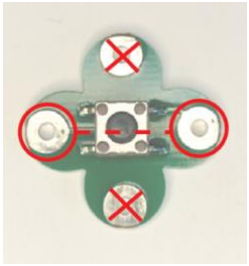
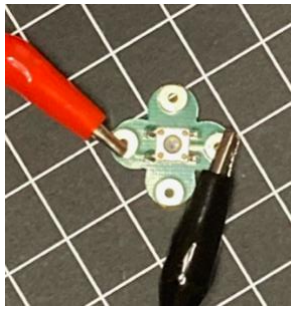
Trialling Circuits:

Prior to using the Igloo, it is important to be familiar with the other components that will be used for your project. Only a basic circuit is needed to see how they function when connected to a power supply.

To save conductive thread, these components can be connected to one another using **alligator clips**. The following examples demonstrate some basic circuits to trial, which will help build an understanding for what these components do and how they can be applied to the Igloo.

Note for DAISY PIC components:

Look closely at DAISY PIC components in particular when making your circuit, the alligator clips need to be connected to the pins that have a connection/line running through the centre as these will carry the electrical current. Pins that are disconnected will not work.

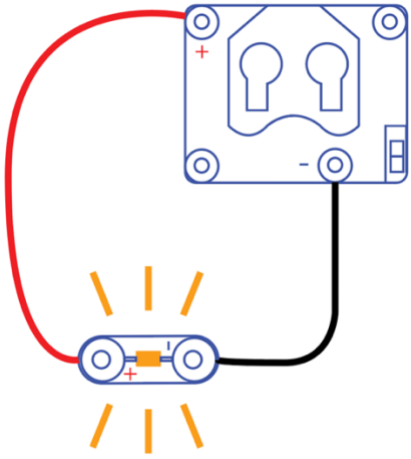
Some DAISY PIC components do not have the positive (+) and negative (-) symbols visible on the board. If the circuit is not working, try swapping the clips around during testing to see if there is a difference.

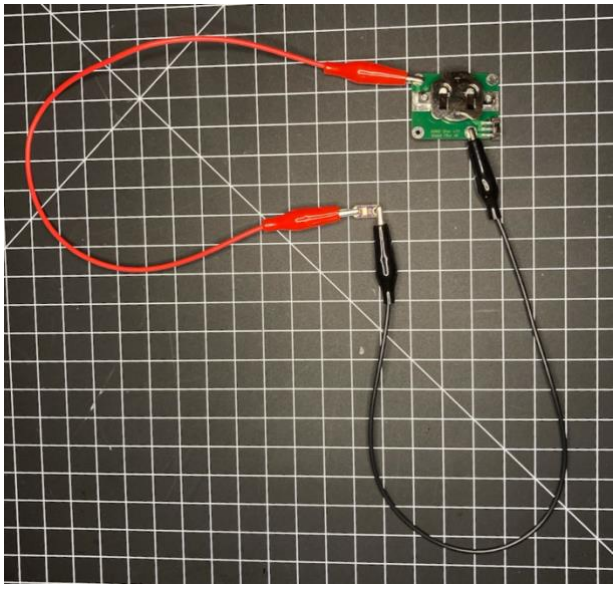
LED Circuits:

Basic LED Circuit:

Match the positive (+) and negative (-) symbols on the LED and the battery pack.

The LED will remain on as soon as the switch is turned on.

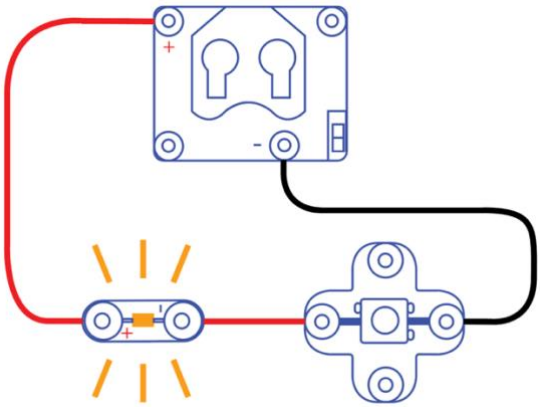


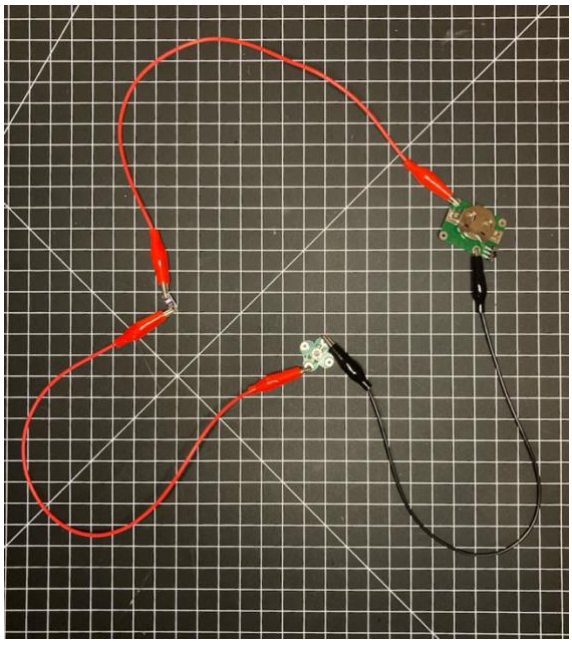


LED Button Circuit:

This circuit is the same as the basic LED circuit, with the addition of the push button, placed before (or after) the LED.

The LED will only turn on when the button is pushed.

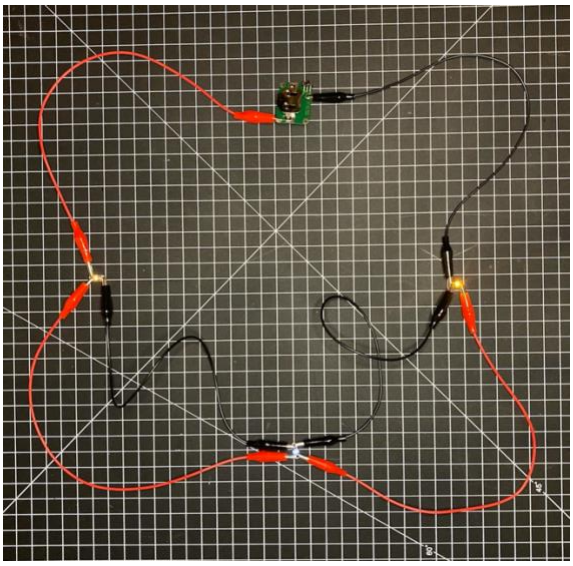


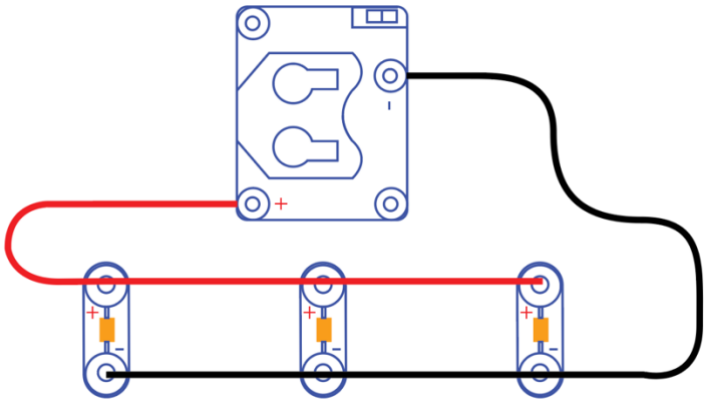


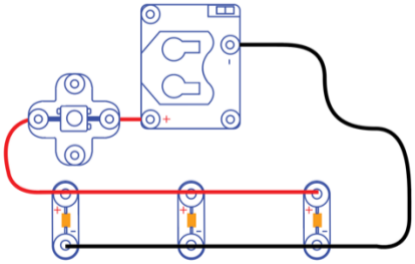
Using Multiple LED's

Multiple LED's can be strung onto a **parallel circuit**. Align the positive (+) pins on the same string, connecting to one another. Repeat the same for the negative (-) pins, leading back to the battery.

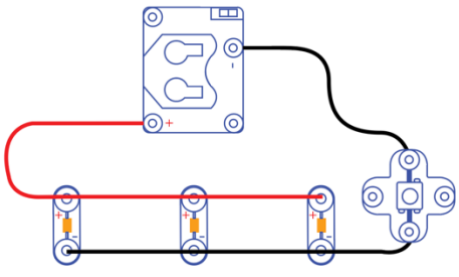
As these LED's are strung on the same circuit, they will turn on and off together.







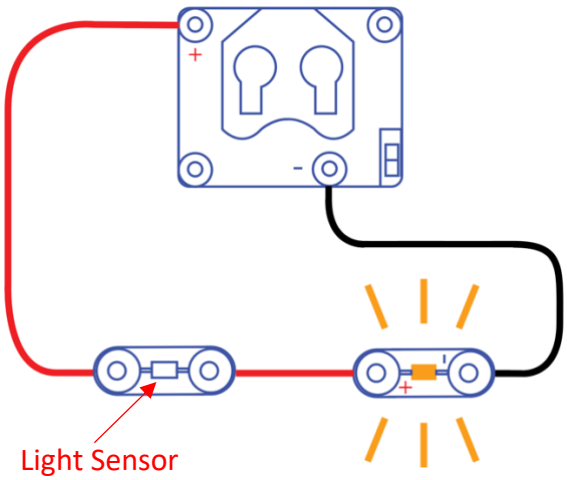
A button can also be added to turn the string of LED's on and off instead of using the power switch.

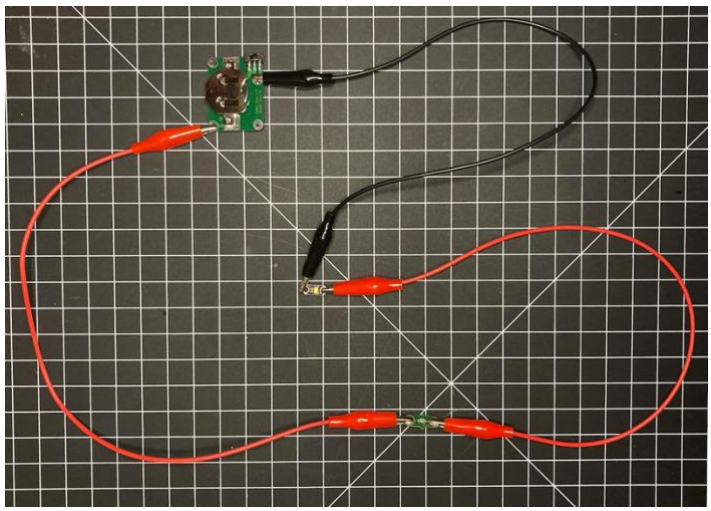


Light-Sensor LED Circuit:

The light sensor must be connected first to the battery pack (before the LED) for this circuit to work correctly.

If the LED is not reacting to the light (it is permanently on), it means the sensor is backwards and needs to be turned around. When working correctly, the sensor will react to the light. The brighter the light, the brighter the LED will glow.

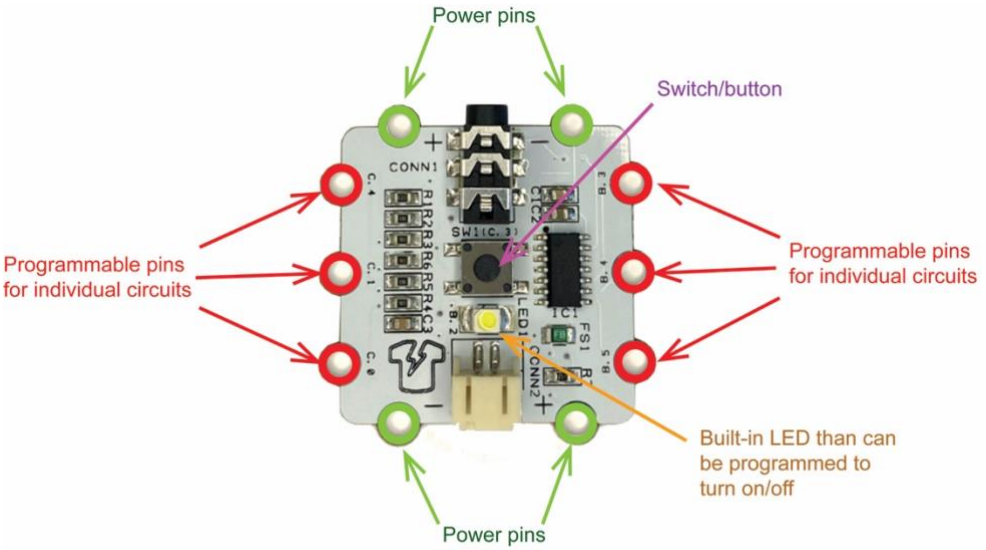


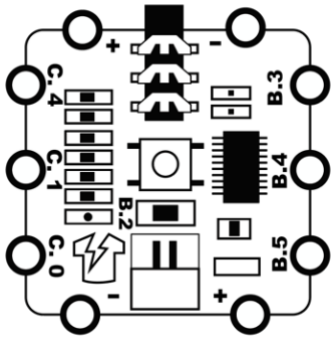


Testing the PICAXE Igloo:

All of the pins on the Igloo each serve a different purpose. The power pins are indicated with the positive (+) and negative (-) symbols. Numbered pins can be programmed and are separate from each other, which means you can string on multiple circuits and program each of them to act differently.

There is also an additional numbered LED on the igloo that can be programmed to turn on/off.





The Picaxe Igloo and similar microcontrollers can be programmed through **Blockly.**

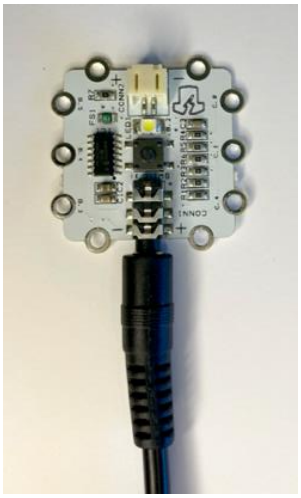
Blockly is a free visual programming software designed around the concept of building blocks. By clicking and dragging various commands from a menu, you can create countless sequences to upload to the Igloo.

NOTE: The PICAXE Igloo can be programmed and re-programmed as many times as you like. Whenever a new program is uploaded to the Igloo, it overwrites the previous program and cannot be reversed, so it is recommended to save each of your Blockly projects before uploading if you would like to go back and use them later.

PICAXE uses a special cable for connecting the Igloo to the computer and access the Blockly software.

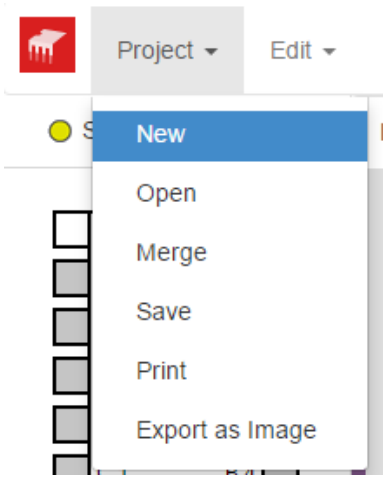
Before opening up Blockly on the computer, plug in the AXE027 USB cable to the computer through the designated USB port.

Connect the Igloo to the cable with the jack plug end. Now you can open Blockly to begin your project.



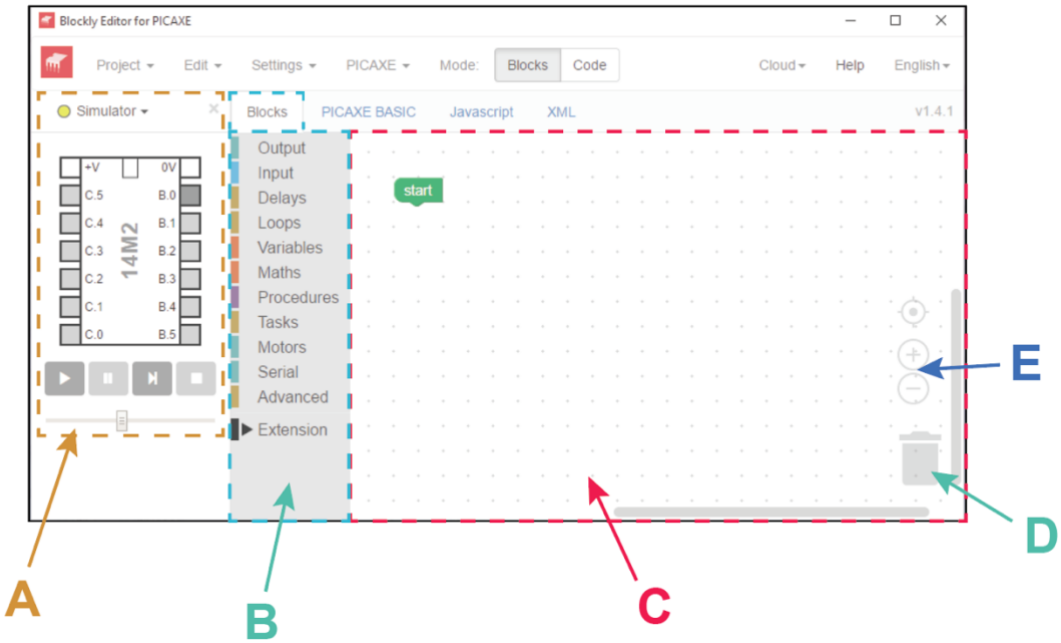
Your Blockly Workspace

To begin a new project, select the following:



Go to Project > New
(App users)

Select the 'New Blockly' button
(PE6 Users)



Your screen should appear similar to this.

A: The simulator. Once your program is finished, click on the play button to see which pins are activated in the sequence. Click on the stop button afterwards to return to editing.

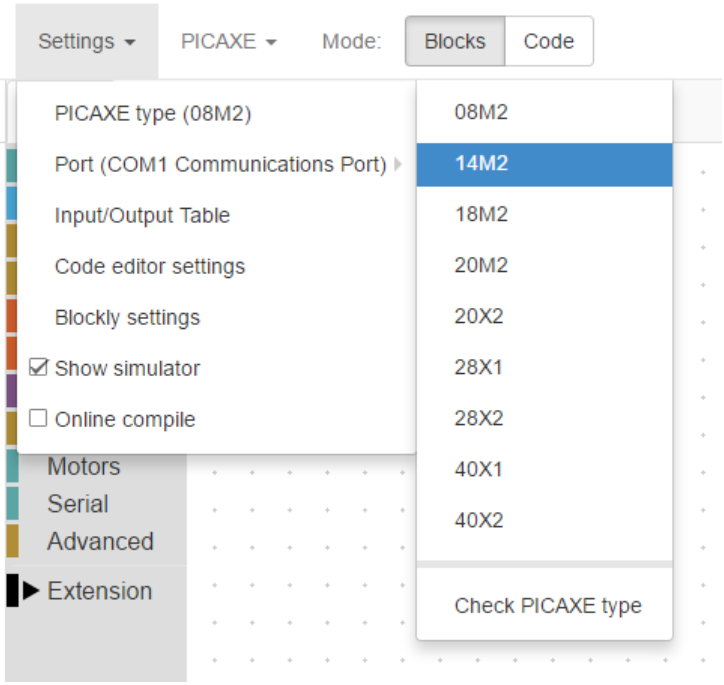
B: The toolbox, where you can choose from a range of blocks to build your project

C: The workspace, where you build your blockly program.

D: Trash can, to delete blocks.

E: Zoom buttons, to zoom in and out of your blockly project

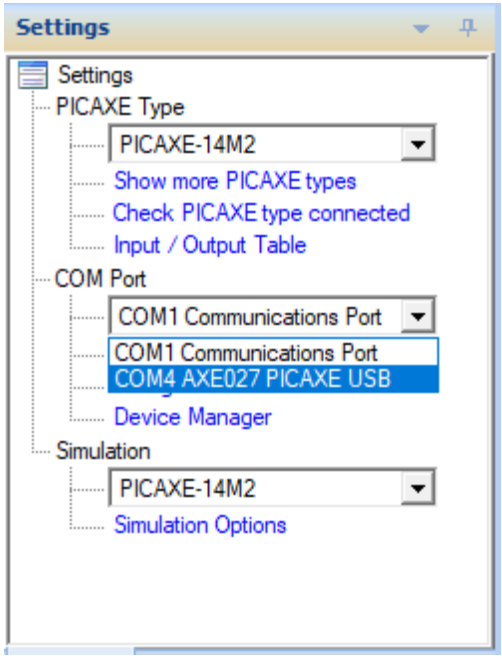
Ensure you have the correct PICAXE type selected for the Igloo (14M2), and the designated COM port for the USB cable. The microcontroller simulator will not look the same as the Igloo, but it has the same numbered pins that we need.



The PICAXE type can be selected from Settings>PICAXE type>14M2

Select your COMM port under Settings>Port

(App users)



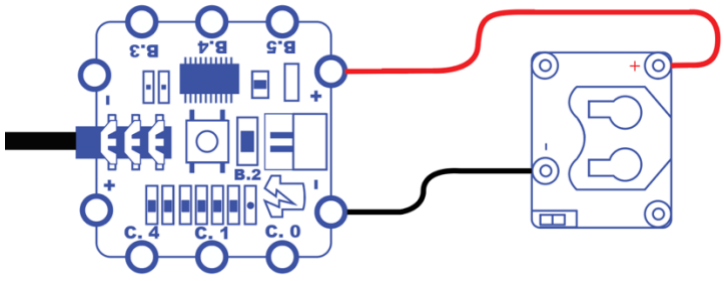
Select from the workspace explorer on the left side of the screen.

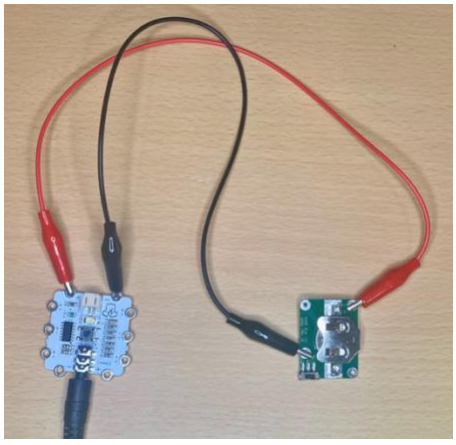
(PE6 Users)

Preparing the Igloo for your Program

The Igloo does not have its own power source and will need to be connected to the battery holder in order to work when your program is sent from Blockly.

If your project is not sewn yet, the Igloo will need to be connected with alligator clips to the positive and negative symbols.

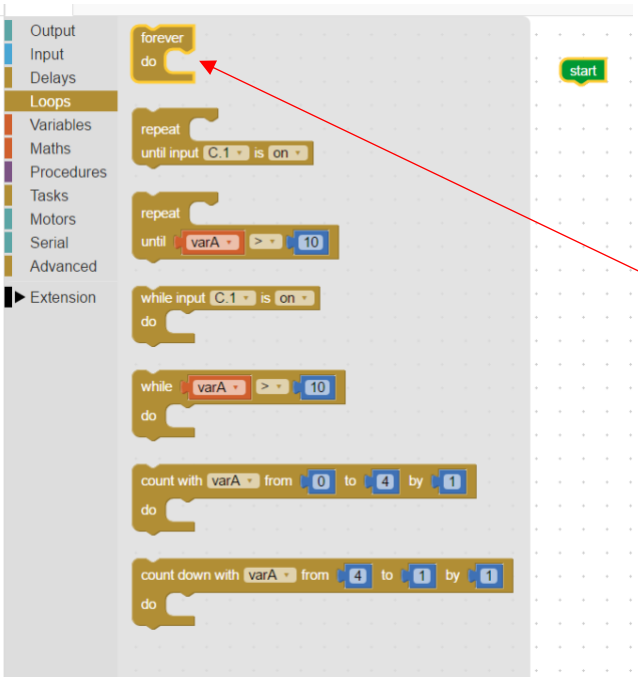




Starter Program: On/Off Sequence.

This demonstration explains how to program a simple sequence to turn a component on and off.

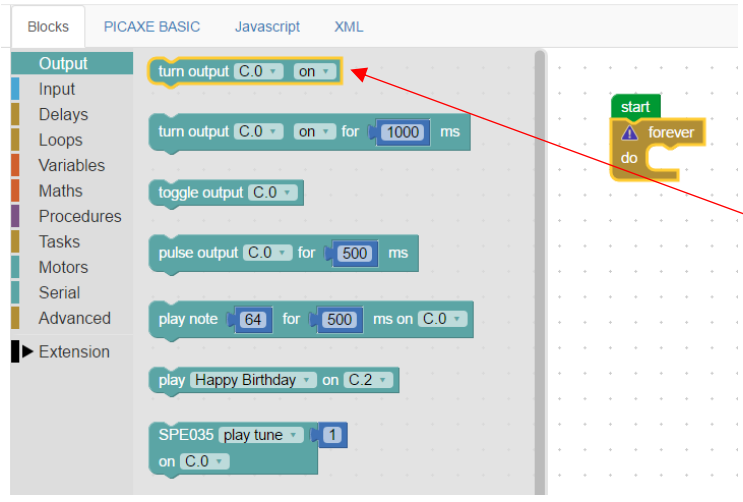
In this case, we will use the LED that is built into the Igloo.



Click on the ***Loops*** tab in the toolbox.

The top piece will create a looping sequence. This means the pieces you add next will continue to loop forever while the power is on.

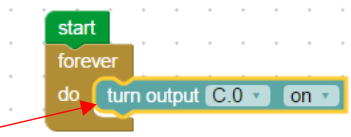
To attach the piece to your project, click and drag it from the toolbox and place it under the ***start*** piece on the workspace.

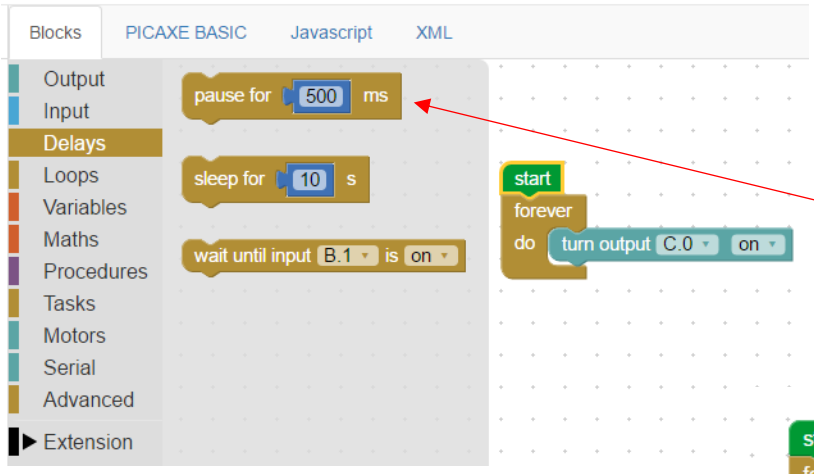


Click on the ***Output*** tab in the toolbox.

The top piece works to select a specific pin (or part) of the Igloo and will turn it on by default.

Drag it over to the looping piece and slot it into the opening on the right side. It should ‘click’ into place.

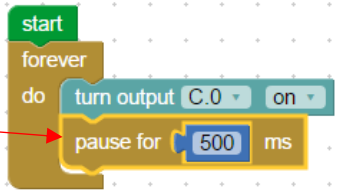




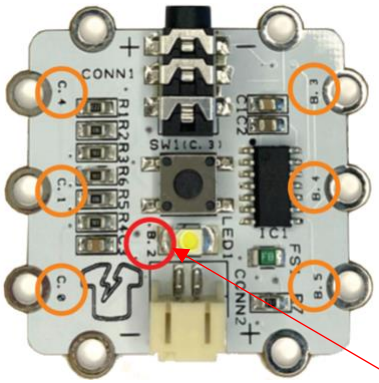
Click on the ***Delays*** tab in the toolbox.

This piece pauses the previous output tab for a certain amount of time.

Drag it over and place it below the output piece.

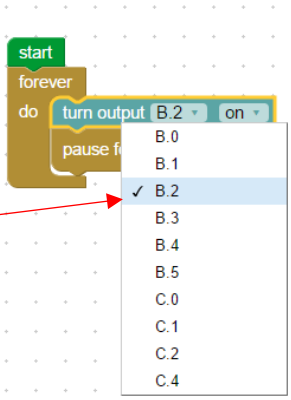


Editing Pieces



Each number on the Igloo is for an assigned pin or part.

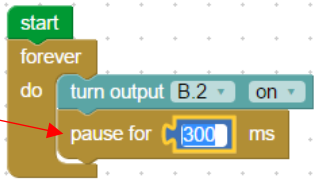
In Bockly, on the **output** piece, click on the dropdown menu and select the pin you would like to add the sequence to.

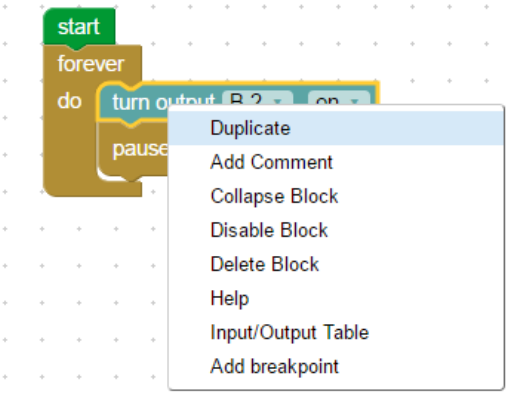


Because we are selecting the LED on the board, the number to select is B.2

The **pause** piece determines how long the delay will take in milliseconds. Edit the number to how long you would like the LED to remain on for.

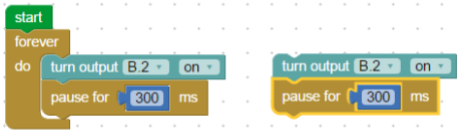
1000 milliseconds = 1 second.

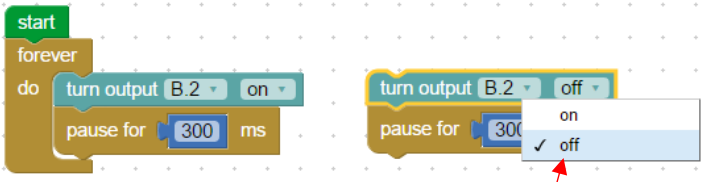




Copy and paste the **output** piece and the **pause** piece.

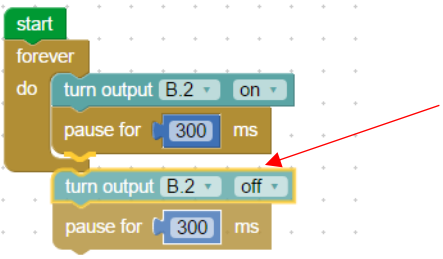
This can be done by either right clicking on each piece and duplicate+paste, or Ctrl+C and Ctrl+V.



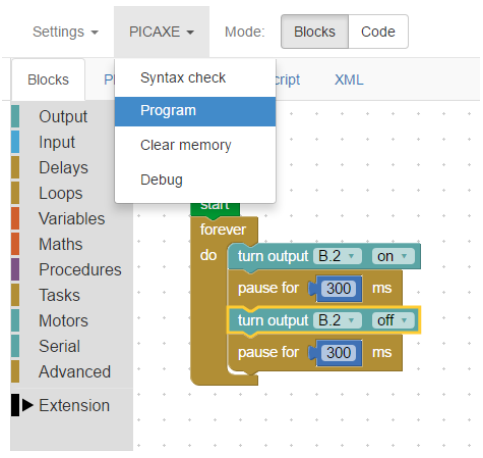


On the copied output tab, click the ON tab and turn it OFF.

This means the pause tab below will turn the LED off for a certain amount of time.

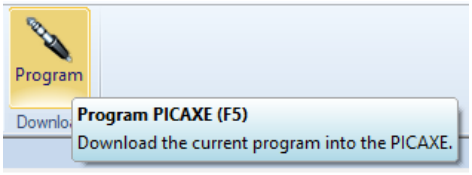


Slot the copied pieces below the original pause piece.



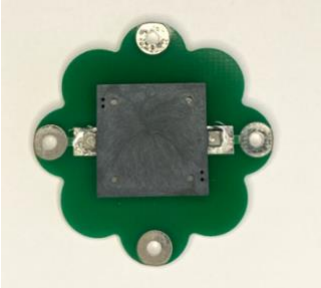
Once you are ready to send the program, turn on the battery connected to the Igloo. Select **'Program'** in the menu and it will take a moment to send to the device.

Once the program is successfully sent, the sequence should start playing instantly with the LED flashing on and off.

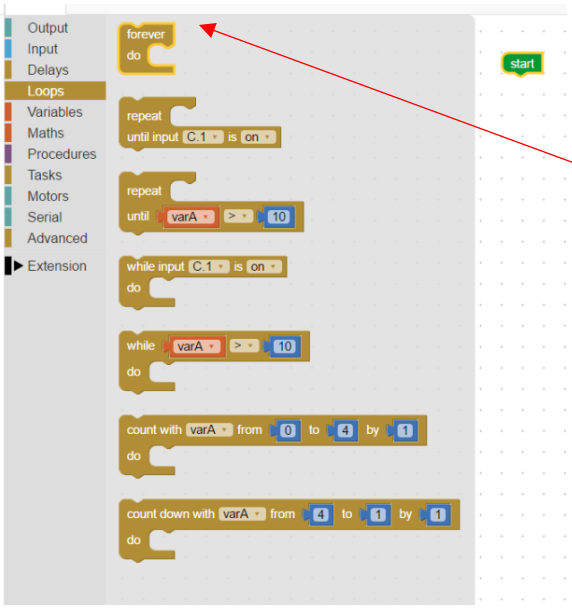


Starter Program 2: Sound Generator

This demonstration requires a sound generator/buzzer component, which will be connected to the Igloo through one of the pins and programmed with a tune to play.



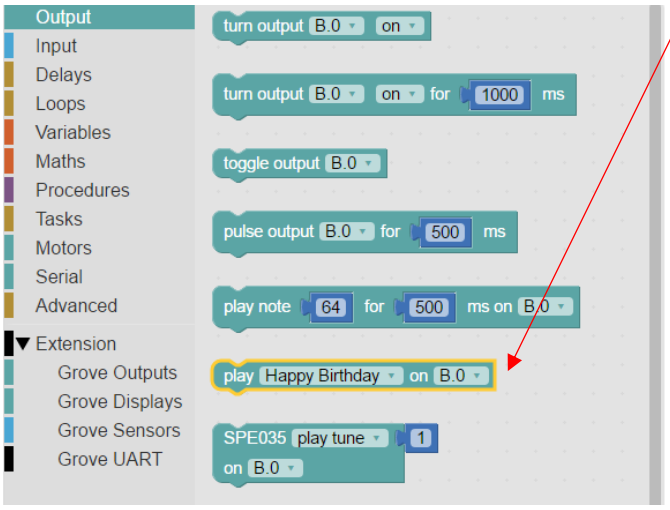
DAISY PIEZO SOUND GENERATOR

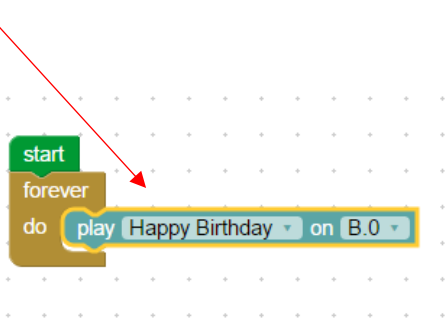


Start by adding the forever loop piece from the **Loops** panel.

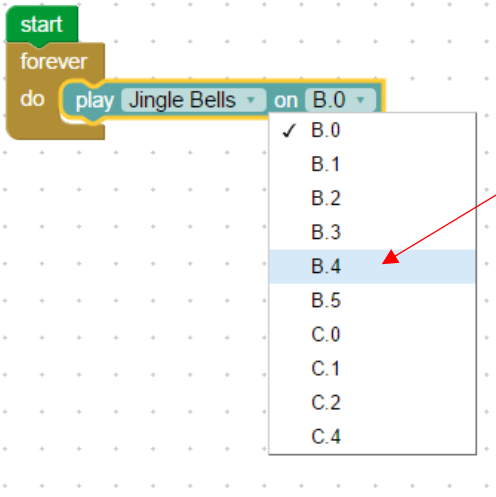
In the **Output** tab, there are various **play** pieces which will send a single note or tune to the sound generator.

For this demonstration, select the pre-programmed option from the tab and connect it to the forever loop piece.

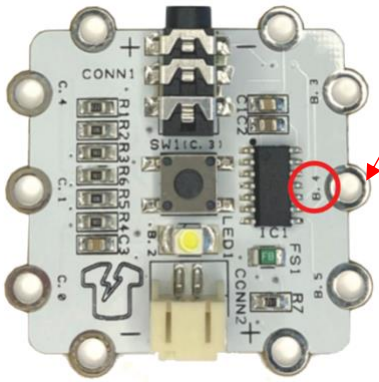




The first dropdown menu on the play piece has four pre-programmed tunes to choose from. Select which one you would like the sound generator to play.



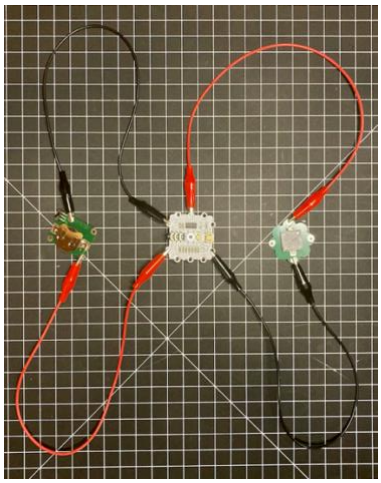
The second dropdown menu determines which pin the program will be sent to. It can be any of the outside pins, but for this demonstration, B.4 was selected.

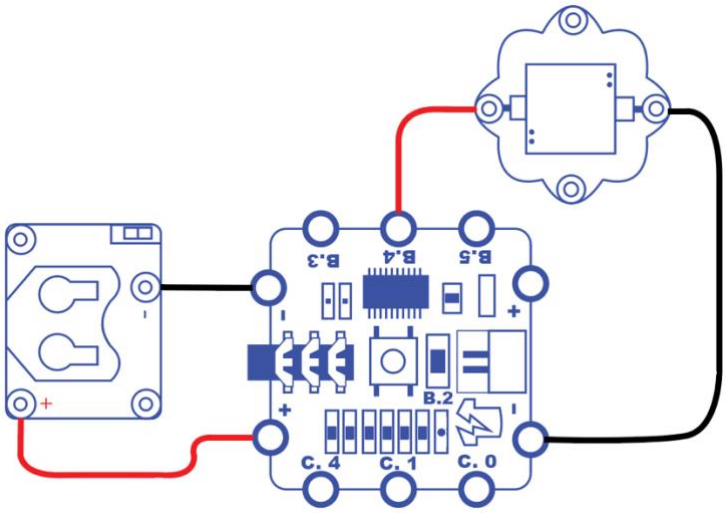


As with the previous demonstration, turn on the Igloo, select **Program** to send your program to the device. Once it has finished downloading, the circuit can be made for the sound generator.

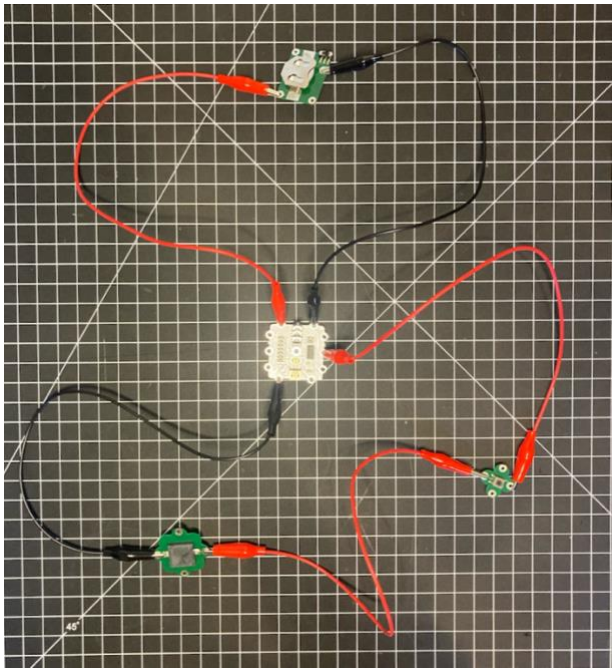
The numbered pins act as the positive (+) for the circuit. Connect the sound generator to the numbered pin the program has been sent to (B.4)

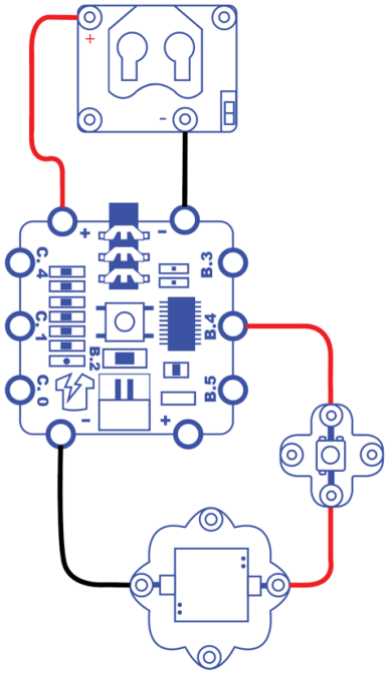
The other end of the sound generator needs to be connected to a negative (-) pin on the Igloo to complete the circuit. When switched on and connected to a power source, the speaker will play the tune on repeat.





An additional switch can be added to the circuit so the tune will only play when it is pressed.





Important!!!

About Conductive Thread

Before moving onto planning and making your own Igloo project, it is important to understand how soft circuits are made, and their limitations.

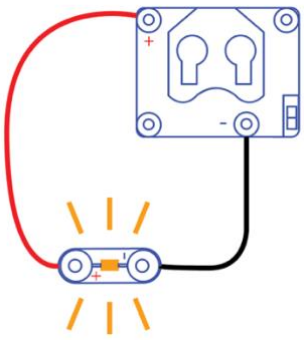
A soft circuit swaps the alligator clips for **conductive thread**. Conductive thread is similar to conventional sewing thread, but there is one key difference. This thread is coated with a conductive material which carries electric currents when used to make a circuit.

Conductive thread can be either sewn by hand, or hand-wound onto a bobbin to use on a sewing machine. However, hand sewing is easier to control as you need to wind the thread around the component pins in order to complete the circuit.

Conductive thread is not encased in a protective rubber coating like the alligator clips, which means it is exposed while carrying the electric current. The issue here is that if the threads touch each other in the circuit, this will cause your project to **short circuit** and stop working. This is very important to remember when planning your circuit, there must be <u>no</u> threads crossing over each other.

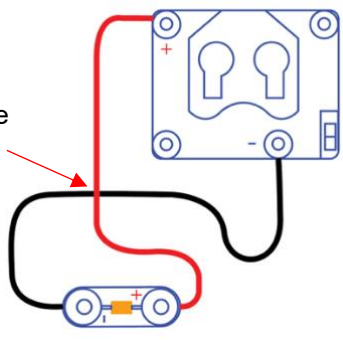
Yes!

The 'threads' are separate from each other. This circuit will work correctly.



No!

The 'threads' are crossing over in the middle, this causes a short circuit and will not work.



Planning your Igloo Project

The next step is to gather ideas for your Igloo project. What you will be sewing onto is equally just as important as the circuit itself.

Here are some things to think about while planning:

- How much space do you have to work with? The larger the surface area, the easier it will be to make your circuit/s.
- What do you want it to look like? If there are LED's, do you only want the LED's to be visible, or the entire circuit?
- Will the fabric move a lot? On clothing, if it is placed on an area that will move or fold when worn, this may cause the project to short circuit and come loose over time. Good areas would be the chest or back of a garment, bad areas are elbows or knees.
- What fabric are you sewing the project to? Try to use a medium weight fabric if possible. Lighter fabrics are flimsy and do not have enough support, but thick heavy fabrics are difficult to sew through. Below are some possible fabrics that are suitable for beginner Igloo projects.

***Suitable Fabrics**:*

- Felt
- Drill fabrics
- Denim
- Calico
- Faux leather (plastic leather)

Unsuitable Fabrics:

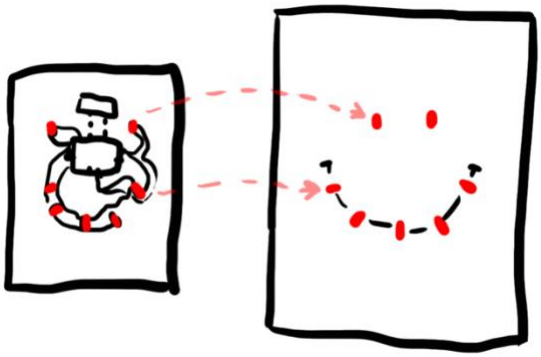
- Heavy leather (too thick to sew through)
- Satin (light/flimsy fabrics)

(Some light fabrics could have an iron-on interfacing applied first to help add stability)

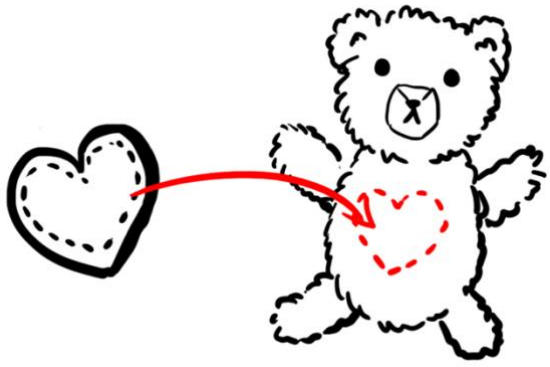
Tips and Tricks:

If you are sewing onto a large piece of fabric, use an embroidery hoop if available.

If you do not want the thread 'wires' showing on the outside, sew your circuit on a piece of felt and attach it to the **inside** of your project. On the outside, cut a hole for the components you would like to show. But keep in mind where the on/off switch is located as you will need to reach it.



If the item you are applying the circuit to is made from an unsuitable fabric, the circuit could be sewn on another fabric and applied like a patch on the outside instead.



Circuit Planning:

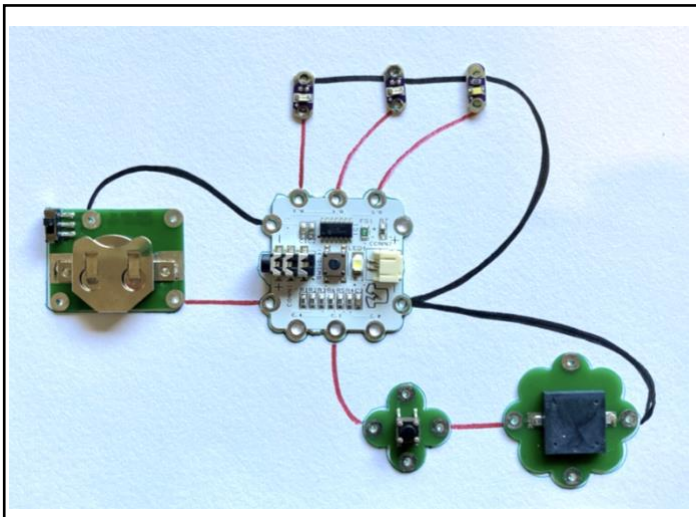
It is important to plan your circuit before programming and applying it to your project.

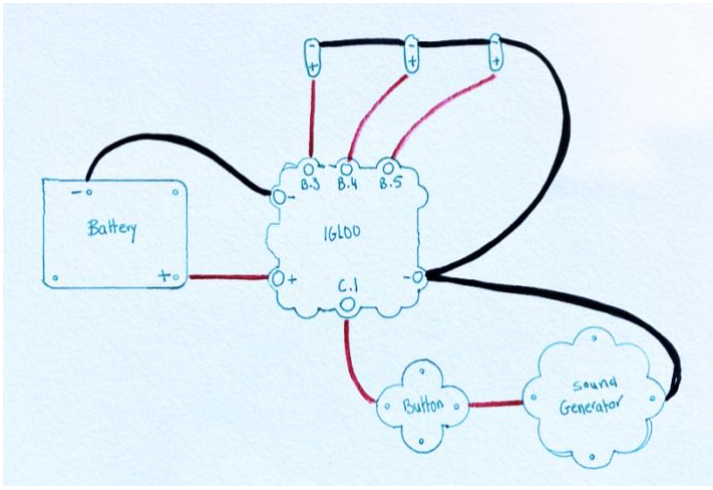
Using a sheet of paper similar to the size of the space you have available on your project, trace around the components you will be using and draw where the conductive thread 'wires' will connect them.

This will help inform:

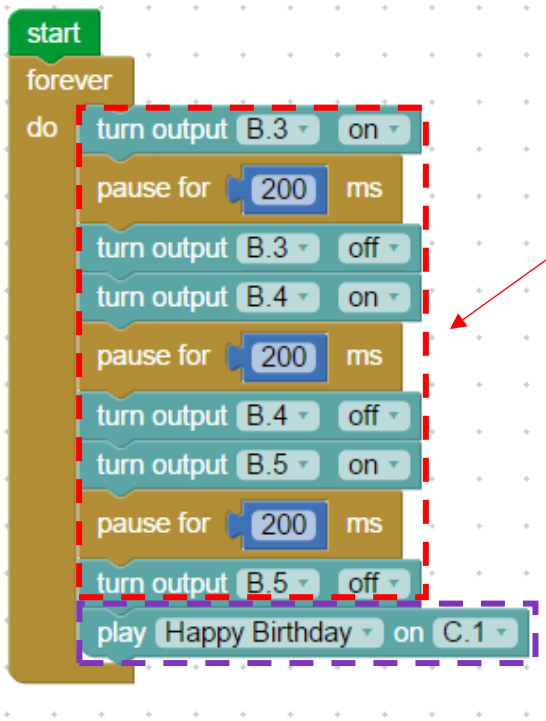
- Which pins you will need to program
- How much room you have to sew the conductive thread
- Ensure there are no cross-over threads in your circuit

Once you have this information, you can now create your program using Blockly and upload it to the Igloo.





This example circuit uses the sound generator on pin C.1, with a button to turn it on/off. There are additional LED's on pins B.3, B.4 and B.5. Because the LED's are each on different pins, they can be programmed to light up at different times. All of these components lead back to the same negative pin on the Igloo to complete the circuits.



This is the program used for this example circuits.

The first part turns one of the LED's on at a time for 0.2 seconds.
There is only a pause for when the LED's are on, which means that the next LED will turn on instantly instead of a having delay between them.

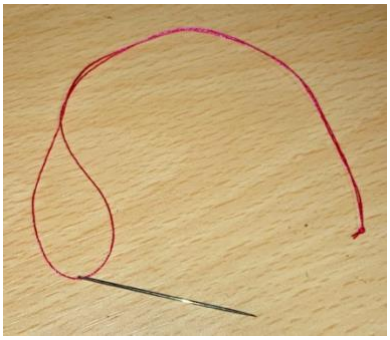
Once the lights have finished flashing, the tune "Happy Birthday" will play, then the circuit will repeat from the beginning.

Once your program is sent to the Igloo, test your program is working with the circuit before continuing. If you do not have enough alligator clips, try one individual circuit at a time. The program can be edited again later if you need it to adjust it slightly.

Sewing Equipment:

Along with the conductive thread and sewing needle, it helps to also have some standard sewing thread on hand. This can be used to sew down the pins that will not have conductive thread sewn to them, which will help prevent the component from wiggling around or falling off. Alternatively, sticky tape can be used to hold down small pieces like LED's.

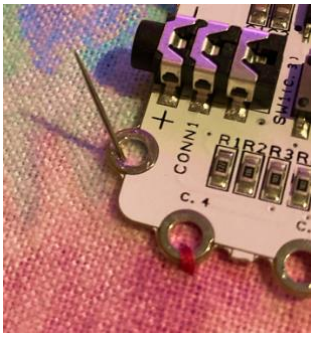
Sewing the Circuit:

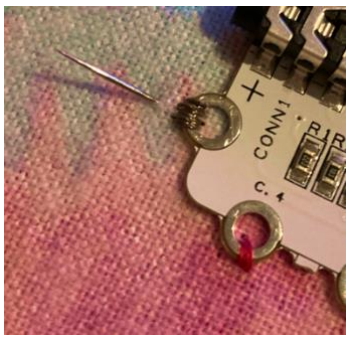


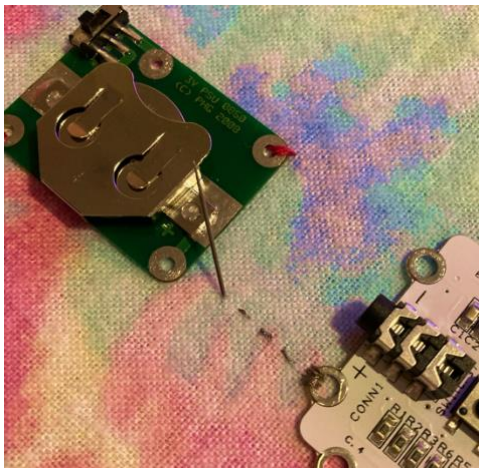
You can either thread your needle with a single thread or double thread. Single thread is less likely to tangle, double thread is stronger but will need to be well secured without loose threads.

Conductive thread in particular is prone to unravelling and can make threading the needle difficult. Ensure the end is cleanly cut. Hold the end of the thread as close to your fingers as possible and push the eye of the needle through your fingers to catch the thread. Tie a knot at the end and repeat over the same knot so it's just big enough to not pull through your fabric. Keep the knot tidy and cut off any loose ends as any threads might accidentally touch another part of your circuit and cause it to stop working.

Begin by looping the conductive thread around the pin about 4-5 times, to ensure it is well secured and has a strong connection. These stitches must be reasonably tight and touching the metal on the component.







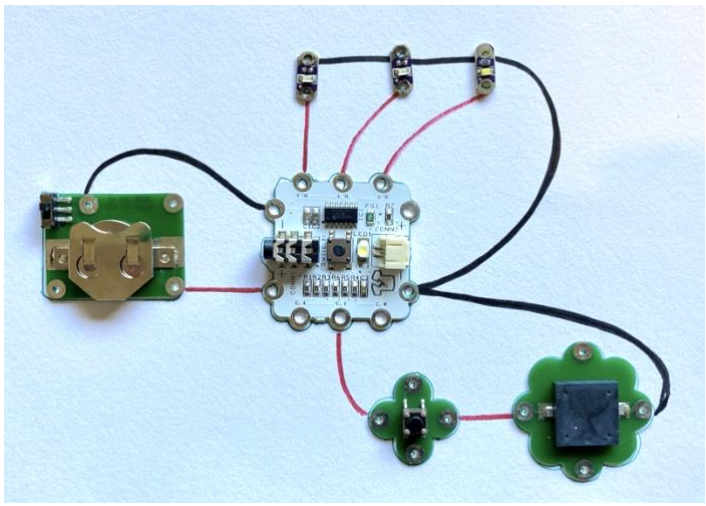
Now you can begin to connect the circuit pieces to one another. Keeping the same thread you looped around the first component, start to sew to the next piece using a **running stitch**. Ensure your thread is not too tight or too loose, it just needs to rest on the fabric without pulling it inwards.

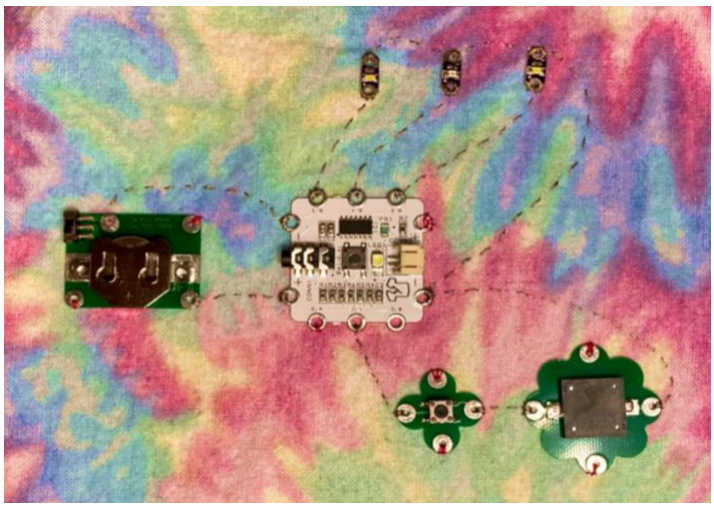
Loop around the next component pin 3-4 times again, as before. Then finish the thread by making a loop and knot it on the wrong side of the fabric. Repeat a few times and clip the loose threads to avoid any issues.

TIP: Do your best to use only one length of thread when connecting one component to another. If you run out and have to re-thread the needle it can get messy, as you need to make sure the threads are connected in order for the circuit to work.

Continue to use this technique to connect all of the components together, following the plan drawn up from earlier.

Once your circuit is all done and working correctly - to help keep the stitching secure, dab a small amount of nail polish over the knots on the wrong side of the fabric and let dry.





The example circuit plan (left) alongside the completed circuit (right)

Troubleshooting:

If for any reason you are unsure how things are going, test your circuit to check. If there is an issue, think back to when it was working last, and go through each of the possibilities that may have caused the problem.

- Are all of the threads tidy and resting flat against the fabric?
- Are the components snugly attached to the conductive thread?
- Is my connection too weak between the battery pack and the Igloo?
- Are all of the positive and negative pins lined up correctly?
- Is my program linked to the correct pins on the igloo?