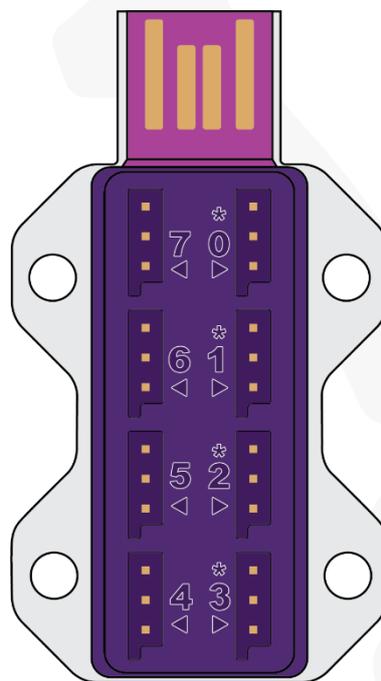


# Getting Started with Invention Engine

Quick start guide



## Invention Engine

The fun of inventing is the journey

# Invention Engine

Hello there! Thank you for choosing Invention Engine! We hope that you design, create, make and code brilliant inventions.

Let's get you started on your invention journey. In this document you will find tips, tricks and basic instructions. For more detailed explanations see our lesson plans, teacher guides and additional resources at <https://inventionengine.net/lesson-plans/>

## Troubleshooting your invention

Inventing, engineering and learning are all akin to words like process, iteration, and trial and error. As we say – The fun of inventing is the journey. Let's have some fun!

If your journey gets 'stuck' we are here to help! Please reach out, and our team will guide you, so that you can continue your journey.

<https://inventionengine.net/support/contact-us/>

Exploring Invention Engine – Sample pack introduction activity by



Illustrated by  
Emma Dewar

Contributions from  
Whymaker

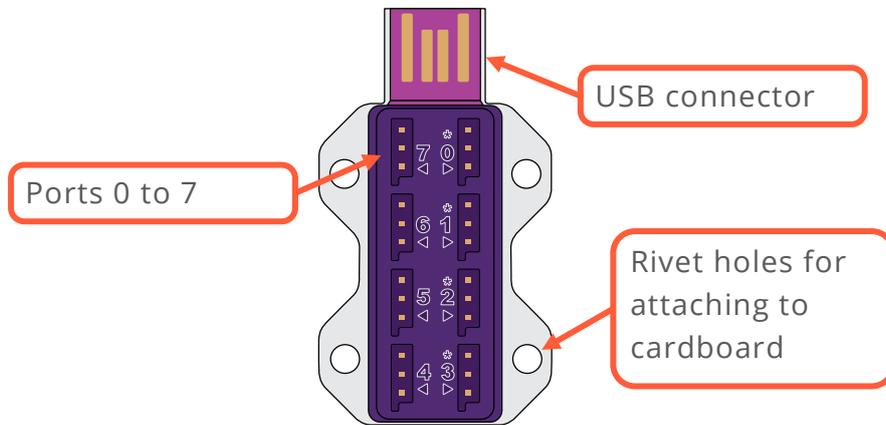
This work is licensed under the Creative Commons Attribution-ShareAlike 4.0 International License. To view a copy of this license, visit <http://creativecommons.org/licenses/by-sa/4.0/>



# Getting to know Invention Engine

## The hub

The hub stores your programs and tells the bits what to do and when to do it. You can see the circuit board and the microcontroller (tiny computer) through the transparent underside. The top side of the hub has eight ports to plug in the bits.



The hub is a USB device that plugs directly into the USB port of your computer. Once your hub is plugged in and connected you will be able to download Invention Engine programs on the hub to control the bits.

The hub requires a power source to operate. It can be powered via the USB port on your computer or by connecting it to the battery bit.

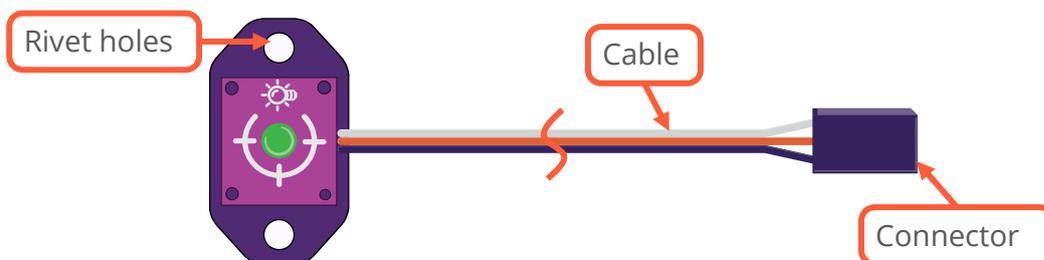
## The bits

Invention Engine bits connect to the hub. There are a wide range of bits that you can use to create your inventions.

Each bit has a specific job as an input or an output.

- Bits used for sending information in to the hub are called an input bit.
- Bits used for sending information out of the hub are called an output bit.

All bits have the following parts:



The datasheets include detailed information about each of the Invention Engine bits.

<https://inventionengine.net/meet-the-bits/>

## The battery bit

The battery bit is used whenever an invention needs to operate away from the power of a computer.

You can unplug your hub from the computer and plug it in to the battery bit instead. Your program will still run because the hub stores the last program you downloaded.

The battery bit uses 4 x AA batteries, has an on/off switch and a USB socket on a lead.



It comes with a holster that can be mounted to cardboard. When mounting the battery bit to cardboard, consider how it can be positioned so that the power switch is still accessible.

Don't forget to switch your battery bit on when you are ready to use your invention.

## Other power options

The hub is a USB device so it can be powered from any USB power outlet. This includes mains power USB adaptors and USB power banks.

## USB extension cable

Invention Engine has a USB extension cable to connect the hub to the computer when mounted on an invention. This can be helpful, if you need to tweak with your program but don't want to dismount your invention.

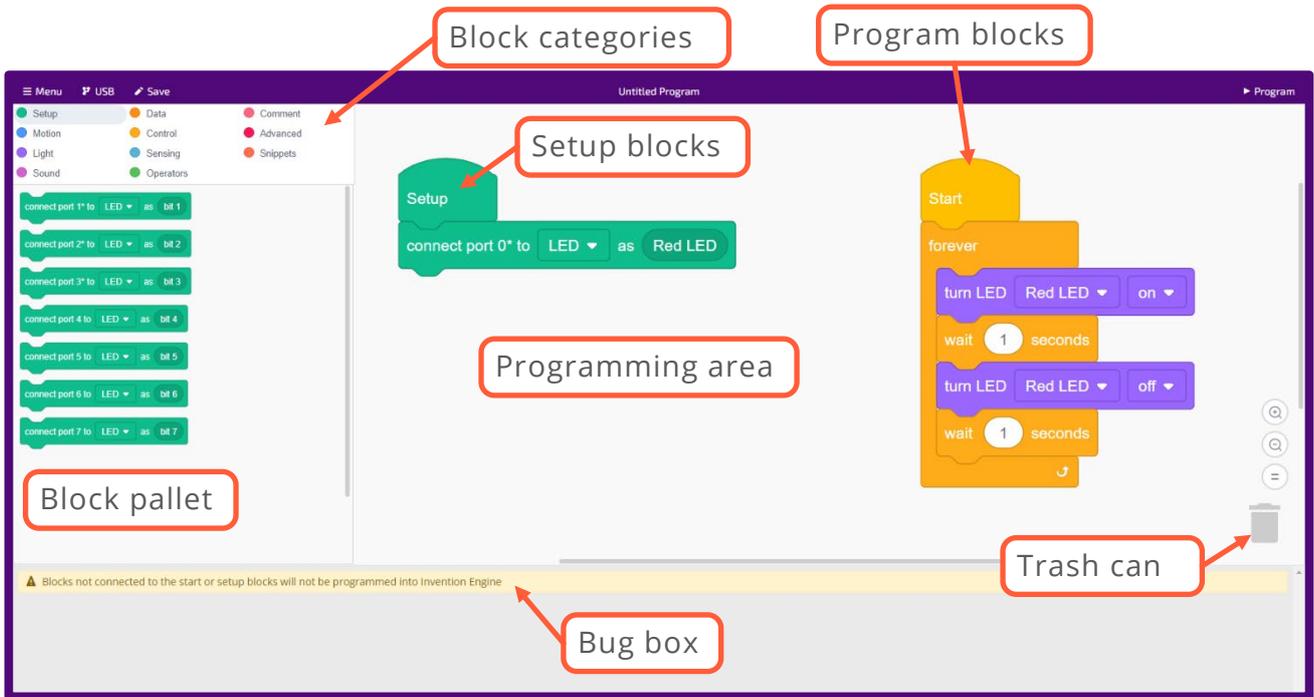


# Programming with Invention Engine

To tell Invention Engine, the hub, and the bits, what to do and how to talk to each other, you will write a computer program.

The programming language we will use to 'program' or 'code' Invention Engine is a Scratch based language called **Invention Engine Blocks**. Scratch based languages use a graphical coding system that use coloured blocks of code to form programs.

Click **Invention Engine Blocks** to open the app and follow along in your browser.

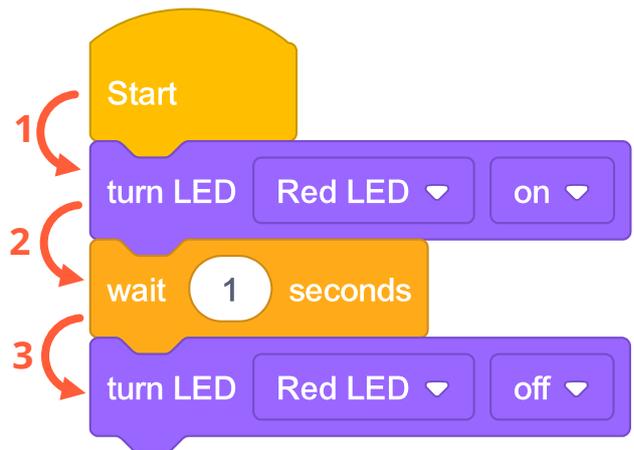


Your computer program, will tell Invention Engine what to do and in what order to do it.

Each block is one action you are telling Invention Engine to take. Invention Engine will do the actions in order, starting with the top block and moving down one by one.

Computers, including Invention Engine, follow the instructions in a program exactly as they are written, and in the order, they are written.

This is the simplest form of programming and is known as **sequence**.



A simple sequence program follows the steps 1, 2, 3

## Input parameters

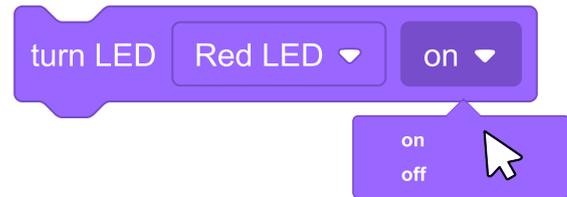
Input parameters are the things you can change inside a block. These are the numbers you can enter and choices you can make using the drop-down lists.

Each input parameter in a block gives a different piece of information for Invention Engine to be able to run that block. You can think of input parameters as the answers to questions that the blocks have about what you are asking them to do.

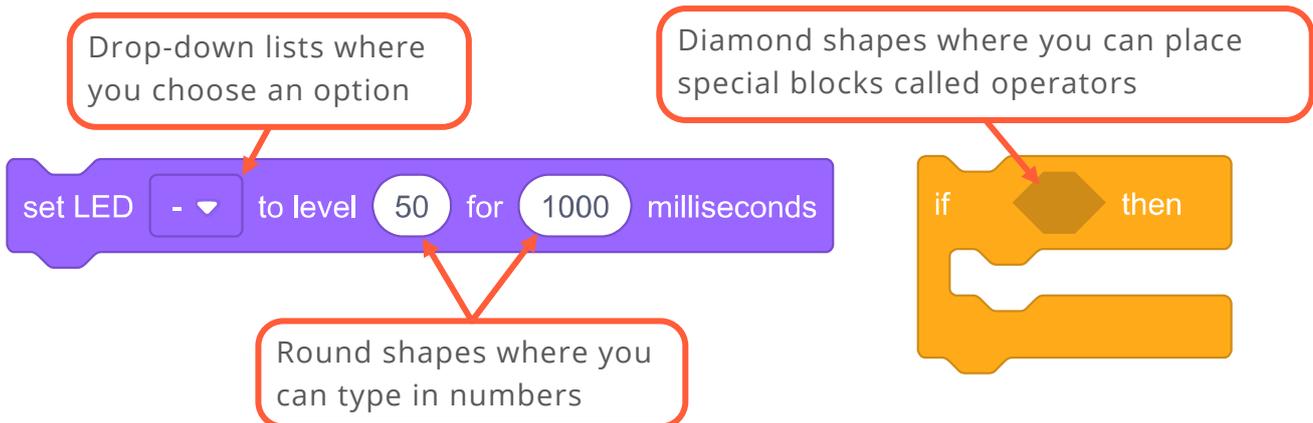
For example:

Question: Do you want to turn the Red LED on or off?

Answer: on, *please*



There are three types of input parameters in the Invention Engine Blocks App:



## Setup blocks

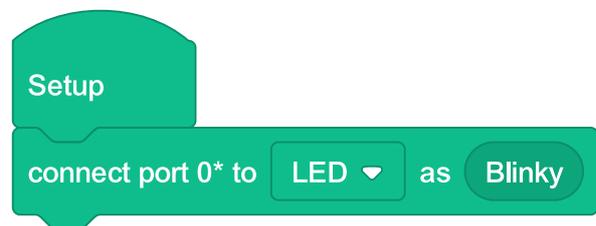
**Setup** blocks are used to tell the hub which bits are plugged into which ports. This allows the computer chip inside the hub to set up the ports to either be an input or an output. The setup blocks also tell the ports what kind of signal to expect to receive if they are an input, and what kind of signal should be sent if they are an output.

How to program the setup blocks:

1. Click on the green **Setup** category
2. Drag the top block that says '**connect port 0 to LED as Bit 0**' and attach it under the green Setup block
3. Click on the block's drop-down arrow and select LED
4. The word 'bit 0' can be edited. In the example we have named our LED '**Blinky**'

Your Setup blocks should look like this:

Now our program and hub know exactly what is plugged into which port.



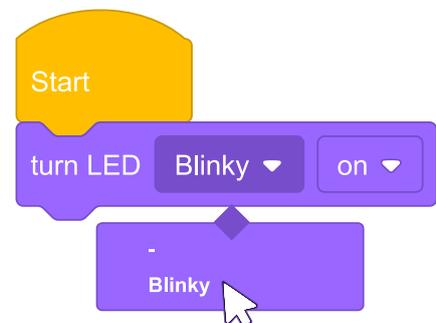
## Programming blocks

The programming blocks are what make up our program. Each block tells the computer inside the hub what to do and when to do it.

Programming blocks are placed under the '**Start**' block in the programming area.

This is where we write our program. Each block tells a bit what to do, when to do it and in what order to do it.

1. Click on the light category
2. Drag the '**turn LED on**' block and attach it under the yellow start block
3. Click on the block's drop-down arrow and select 'Blinky'



As an experiment, see what happens when you don't select Blinky.

Do you notice the red error message in the bug box at the bottom of the screen?

⚠ A code block does not have an assigned bit

The bug box is letting you know there is a problem with your program. Be sure to check the bug box regularly for potential bugs in your program!

## Bug box errors

**Yellow warning** messages are caution messages. This is the Blocks App saying “Heads up! This might not work the way you want it to work”. You can download a program even if there are yellow messages in the bug box.

**Red warning** messages are like “Stop” messages. These messages are the Blocks App saying “Sorry! This program won’t make sense to Invention Engine”. If there are any red warning messages in the bug box, you will not be able to download the program to Invention Engine.

The Bug Box only detects bugs on the Invention Engine App (bugs within your program). It will not know if a bit is plugged into the wrong port.

## Download your program

To download your program from the Invention Engine Blocks app to the hub:

1. Plug the Invention Engine hub to the USB port on your computer
2. Click **'Program'** in the top right corner of the Invention Engine Blocks app
3. Select **'Invention Engine - Paired'** from the pop-up box and click **'Connect'**

Your program is now stored in the hub.

## Saving and uploading your program

It is important to save your programs often, as the Invention Engine Blocks app DOES NOT automatically save your program for you.

To save your program:

1. Click **'Save'** at the top right of the app
2. Type the name you want to give your program
3. Click **'Save to computer'**

To open a saved program:

1. Go to **'Menu'**, then click **'Load from computer'**
2. Click **'Select file to upload'**
3. Click on your program and click **'Open'**

It’s always a good idea to save your program regularly, so you don’t lose all your great work.

**Note** that the hub can only store one program at a time. Each time you download a program, it writes over the previous program.

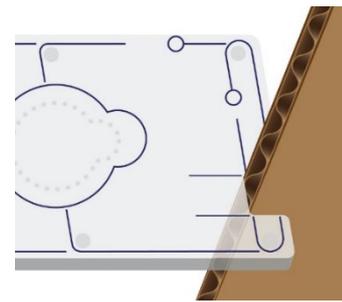


# Guide to building with Invention Engine

Follow these steps to mount the hub and bits to cardboard.

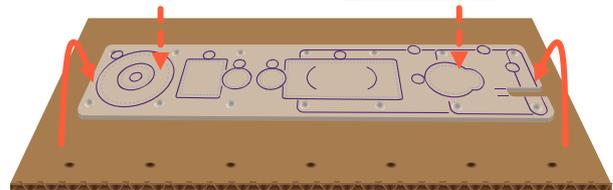
## Selecting your cardboard

The stencil has a cardboard thickness gauge. Suitable cardboard must fit inside this gauge.



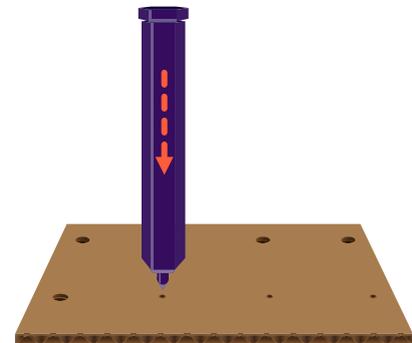
## Make a grid

The stencil has 'feet' that act as tiny hole punches and are used to create a grid for accurately placing your bits. Lay the stencil on the cardboard and press down to form your grid.



## Punch the rivet holes

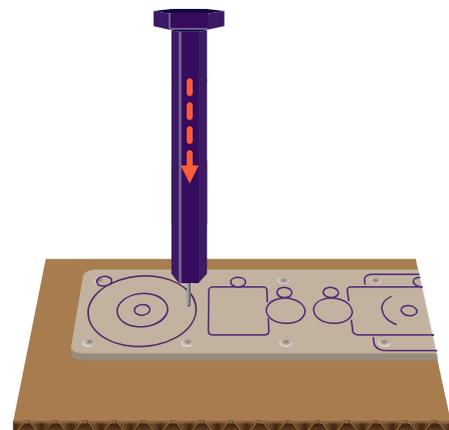
Use the outer punch tool to punch out the grid holes from the step above to create holes for the rivets.



## Make perforated cut outs

The stencil has different patterns of tiny holes. Each pattern of holes has a number that aligns with an associated bit (see the stencil bit guide below).

Use the inner punch tool to poke holes through the cardboard. Once all holes have been punched, then the perforated shape can be pushed out by hand.



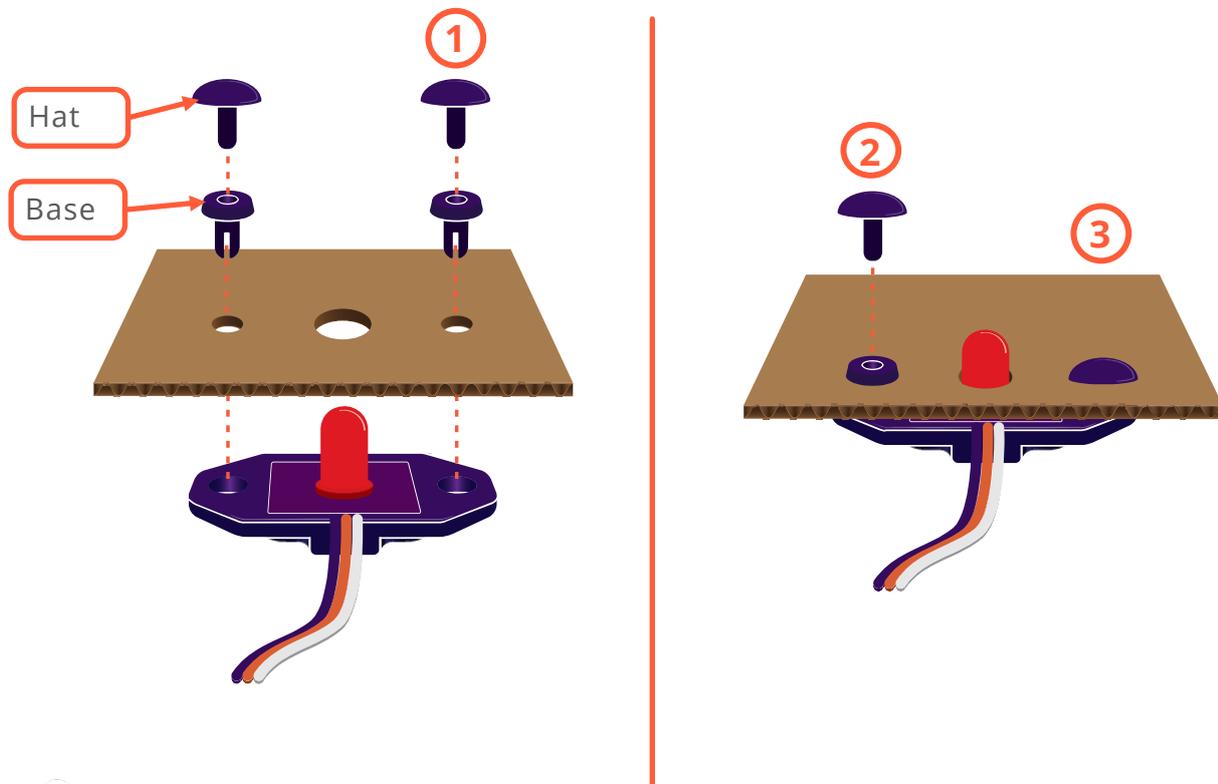
## Stencil bit guide

Bit	#	Bit	#	Bit	#
Hub	Ⓑ	Digital display bit	Ⓔ	Noise sensor bit	Ⓔ
Battery bit	Ⓒ	Tilt sensor bit	Ⓑ	Magnet sensor bit	Ⓐ
LED bit	④	Light sensor bit	④	Magnet bit	Ⓐ
Speaker bit	①	Dial bit	③	Temp. sensor bit	④
Button bit	②	Servo bit	⑧	IR transmitter bit	④
Proximity sensor	⑦	Motor bit	⑧	IR receiver bit	④



## Attaching the bits

The rivets are made up of two separate parts. The base and the hat. The base must be inserted first, and then the hat.



### Don't forget

Remember to reuse Invention Engine. Take the rivets off the bits and save them. Recycle any unused cardboard.



### Safety when using Invention Engine

1. Be careful! The inner punch tool has a point.
2. Protect the work surface when using the punch tools by putting a piece of cardboard on the table or surface.
3. The cardboard should always be flat when using the punch tool.
4. Do not put your hand under the cardboard when using the punch tool.



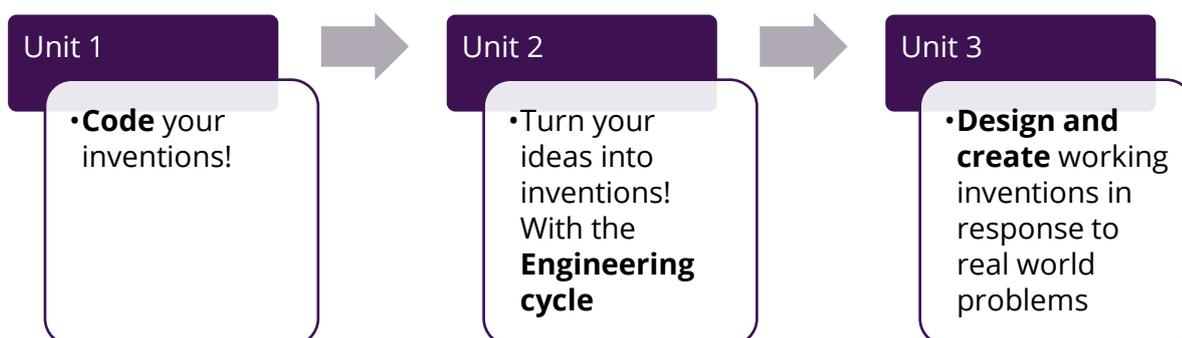
## Invention Engine resources

There are three units for learning with Invention Engine and each unit has a different focus. In all three units, the focus is on developing coding skills, thinking like an engineer and looking for opportunities to solve problems in the real world.

You can download all of our resources at <https://inventionengine.net/lesson-plans/>

The three units feature different bits. The unit bundles correspond to the lesson plans and teacher guides developed for each of the units.

The unit 1 bundle is the base bundle and is built upon by the unit 2 and unit 3 bundles.



### 10 student class packs

#### Unit 1 bundle

- Invention Engine hub
- Punch & stencil
- Battery bit
- LED bit pack
- Button bit
- Display bit
- Speaker bit
- Proximity sensor bit
- USB extender
- Rivet 350 pack

#### Unit 2 bundle

- Button bit (top up!)
- LED bit (top up!)
- Light sensor bit
- Magnet sensor and magnet bit
- Tilt sensor bit
- Dial bit
- Servo bit
- Rivet 350 pack (top up!)

#### Unit 3 bundle

- Temperature sensor bit
- Infrared transmitter and receiver bits
- Noise sensor bit
- Motor bit
- Rivet 350 pack (top up!)

