Best Beginner Boards for Teachers

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https://learn.adafruit.com/best-beginner-boards-for-teachers
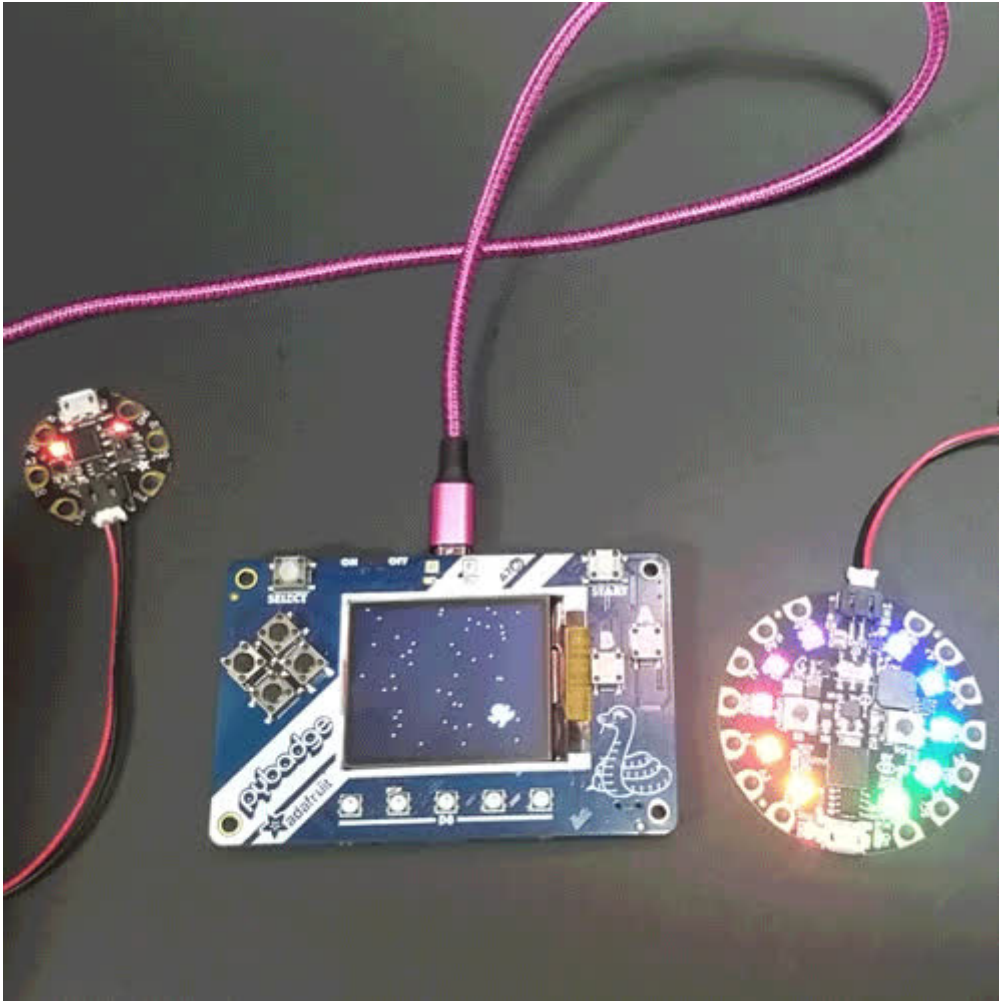
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Overview

Microcontrollers are small programmable circuit boards that supply processing power to many kinds of electronics projects.

They're also a great way to introduce kids to coding and building. Just add a few components and everyday crafts or recycled material and you can build everything from a simple circuit to a fully-functional robot!

If you've got a bit of electronics background, or you're up for a challenge, there are plenty of microcontrollers to choose from.

But if you (and your students) are new to coding and electronics, your best bet is something powerful, expandable -- and simple enough to use right out of the box.

Luckily, getting students started with microcontrollers is easier than ever before! Here's a look at three boards -- the Circuit Playground Express, the Gemma M0, and the PyBadge -- that are great for teachers who are ready to learn coding and electronics themselves, and/or working with students who have little or no coding background.

Adafruit's beginner boards are newbie-friendly in many ways:

- They can use MakeCode drag-and-drop block programming (and toggle back and forth to text-based Javascript).

- They are designed with clip-able connections.

- They include built-in inputs for physical control, like sensors that can register tilt or sound.

- They include built-in outputs like speakers and lights.

- When students are ready to move on to the next level, the boards can be programmed with more advanced languages like CircuitPython and Arduino.

Keep reading for tips on which boards are best for beginner educators and students, and suggestions for how to get started!

Suggested Boards

Adafruit caters to educators by offering boards and the accessories you need to get started individually as well as in classroom sets and in kits that include all the basics and more.

On Adafruit's Educator Page (https://adafru.it/FsJ), you'll find links to products and information on educator discounts. Combine them with discounts for bulk purchases for extra savings.
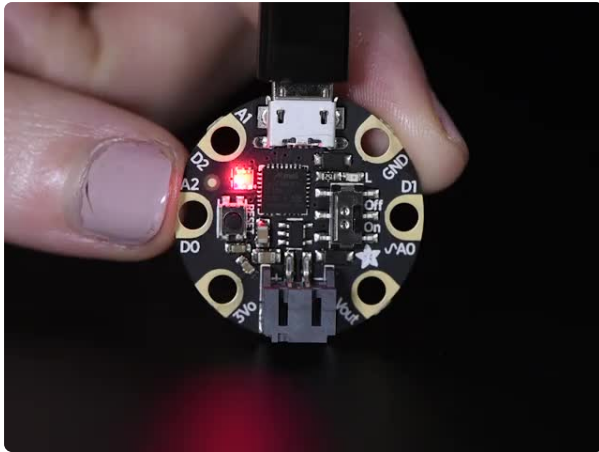
The list below is just a sample of the options available!
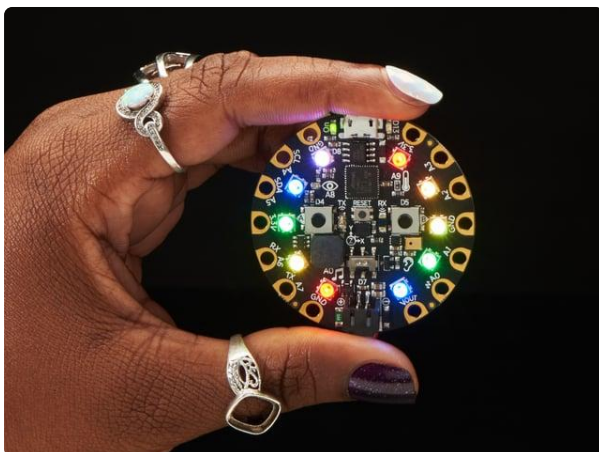
Circuit Playground Express
Circuit Playground Express is the next step towards a perfect introduction to electronics and programming. We've taken the original Circuit Playground Classic and...
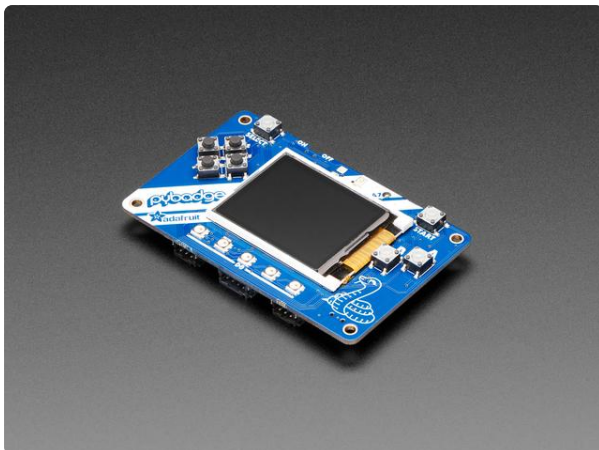https://www.adafruit.com/product/3333

Adafruit GEMMA M0 - Miniature wearable electronic platform

The Adafruit Gemma M0 is a super small microcontroller board, with just enough built-in to create many simple projects. It may look small and cute: round, about the...

https://www.adafruit.com/product/3501

Adafruit PyBadge for MakeCode Arcade, CircuitPython, or Arduino

What's the size of a credit card and can run CircuitPython, MakeCode Arcade or Arduino? That's right, its the Adafruit PyBadge! We wanted to see how much we...

https://www.adafruit.com/product/4200

Circuit Playground Express - Base Kit

It's the Circuit Playground Express Base Kit! It provides the few things you'll need to get started with the new

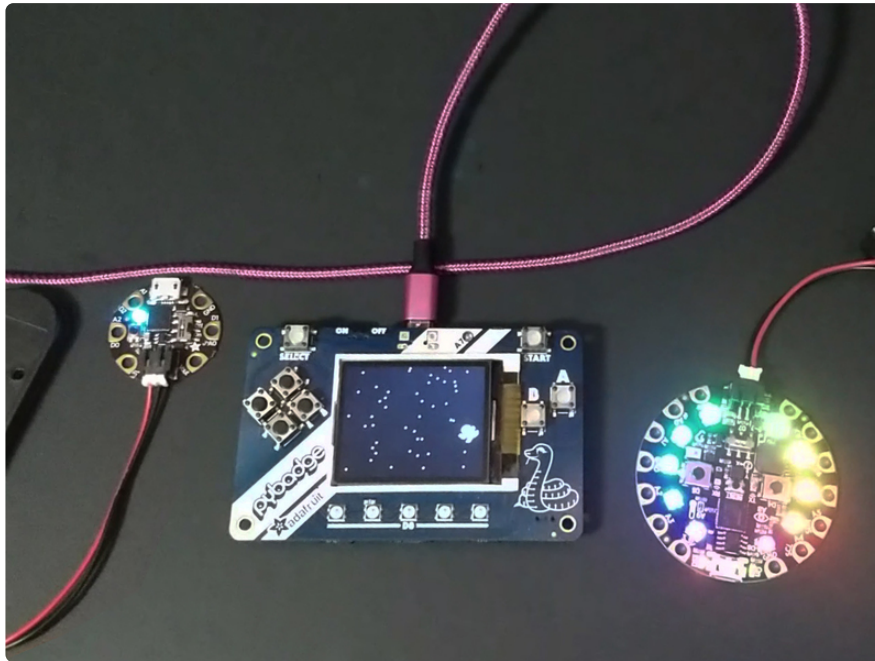https://www.adafruit.com/product/3517

Code.org Circuit Playground Express Educators' Pack

For many years, instructors and teachers have asked us to come up with a better way to teach programming and electronics. We have worked on Circuit Playground Express for over a year...

https://www.adafruit.com/product/3399

What to Look For

The best boards for absolute beginners have features like these:

- They're easy to code -- with a programming language that can be used and tested even without a board, so students can practice outside the classroom.
- They're easy to connect directly to a circuit -- so soldering or breadboards aren't required to get started.
- They're easy to attach to a base, holder, robot body, or other part so you can use them in the physical world. (That's why we call it "physical computing.")
- They let you easily add electronics and software -- so students can move beyond the basics as their abilities grow. (Keep in mind that students will probably catch on quicker than you!)

Find out more about software and hardware to look for in the pages below.

Start with MakeCode!

The Adafruit boards in this guide may be programmed in Microsoft MakeCode (https://adafru.it/FsK). The laser tag program above was written by teens using MakeCode for Circuit Playground Express (https://adafru.it/wmd). MakeCode Arcade (https://adafru.it/DCY) works with PyBadge. And Maker MakeCode (https://adafru.it/C9N) works with several other Adafruit boards, including Gemma M0.

All versions of MakeCode work pretty much the same for all Adafruit boards -- only the blocks available are different. They're great for students for many reasons.
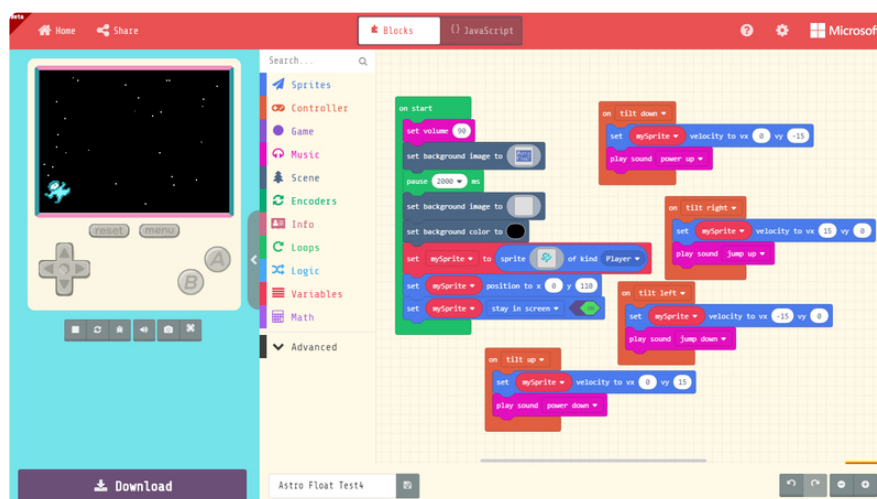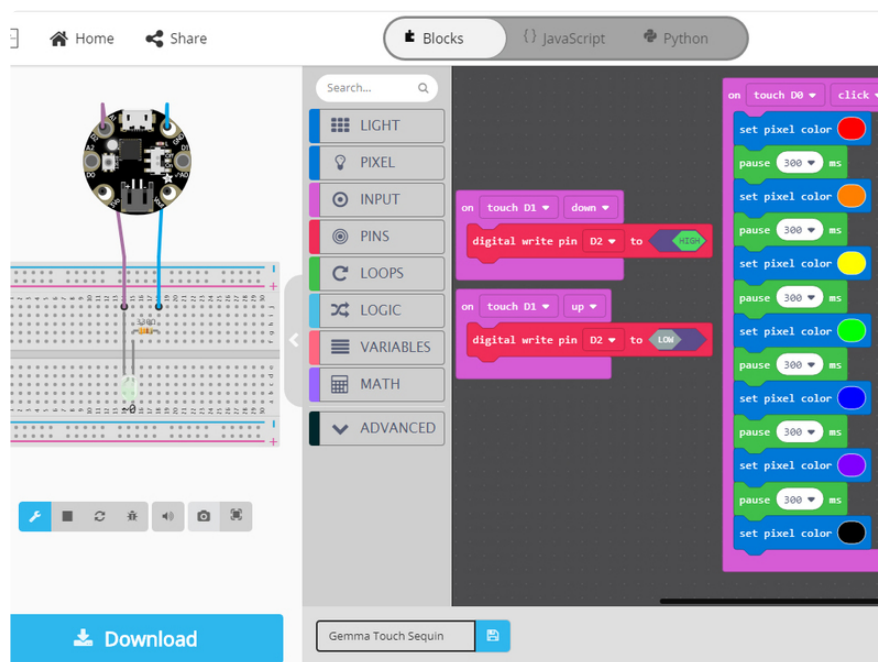
MakeCode is Easy to Learn

The quickest and easiest way to get started coding electronics is with a drag-and-drop programming language (sometimes called a graphical or visual programming language). The best-known and most popular graphical language, Scratch (https://adafru.it/DDV) from MIT, is the basis for many languages used by educational kits and products, including MakeCode.

Drag-and-drop languages let you build programs by picking command blocks from a menu and sticking them together on the computer screen -- eliminating the need to type in commands or to pay attention to formatting and syntax.

But that doesn't mean a block-based codes aren't real computer languages! They teach the same basic concepts of programming as text-based languages. With MakeCode, it's possible to write complex programs using just the standard basic blocks, which include loops (repeat), logic (if-then-else), math, and variables. There are also advanced blocks that let you create functions, arrays, strings, and more.

All versions of Microsoft MakeCode are designed to be run only in the Chrome/Chromium browsers at this time. Fortunately this web browser is available for Mac, PC, Linux variations, portable devices and Chromebook.

MakeCode is Easy to Use

MakeCode can be used online, for free, from almost any computer or mobile device. There's nothing to download -- it will keep running in the Chrome browser, even if you go offline.

If you have Windows 10, you can also download an app that works offline (https:// adafru.it/Eql) and lets you read data from your board's sensors in real time.

Best of all, since MakeCode is designed specifically to work with physical boards, it shows you a simulation of the board you're using (and sometimes additional electronics as well). That means students can continue to work on projects outside the classroom and test them out, even if they don't have the microcontroller at hand!

In addition, saving your work is a breeze. Unlike Scratch, students don't have to sign up for an account. They can just "publish" their project, which creates a URL link they can open again from any computer. They can also share the link with others.

However, the MakeCode site doesn't let students search through user-created programs to find a specific project or kind of project (although you can sometimes find them with a general Google search).

Helpful Hardware
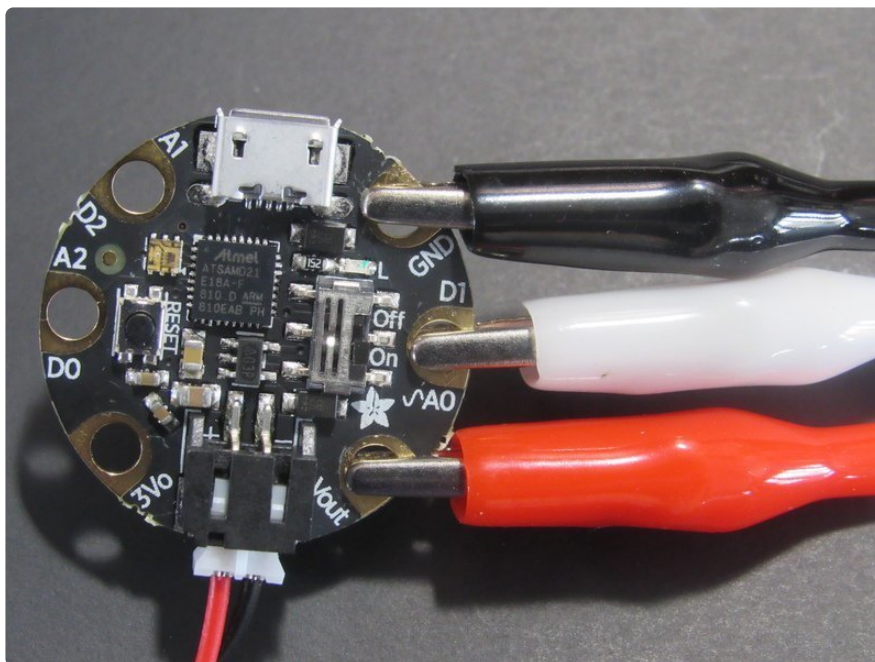
The boards in this guide are all self-contained. You can use them without adding any additional switches, sensors, lights, or buzzers.

But it's also simple to add more components -- without soldering or breadboards! Large holes around the edges of the CPX and Gemma let you work with the boards in multiple ways:

- You can attach alligator clip wires to the holes.
- You can attach conductive foil or fabric tape.
- You can sew through the holes with conductive thread.
- You can attach component wires with small screws.

And because the boards are small and light, you can wear them using stick-on pin backs or hang them from lanyards (http://adafru.it/3987). You can also connect them to their battery cases or to your project with common craft materials, such as glue dots or peel-and-stick Velcro tabs. This makes them easy to re-use when the project is done.

> Adafruit recommends that beginners stick to AA or AAA batteries to make their projects portable. The smaller, lighter LiPo or Li-Ion batteries require special charging. They also need to be handled carefully, so it's best to avoid them in projects for kids.


Best Board Run-Down

Thanks to MakeCode, educators who know nothing about programming or electronics can learn enough to use them with their students in a very short time.

And students can jump right in and start building and coding in their very first session!

But which board should you use? The Circuit Playground Express is the most versatile microcontroller for beginners in Adafruit's arsenal, but there are times when the Gemma M0 or the PyBadge really fit the bill.

The following pages below should help you find the board that's best for your needs.

Circuit Playground Express
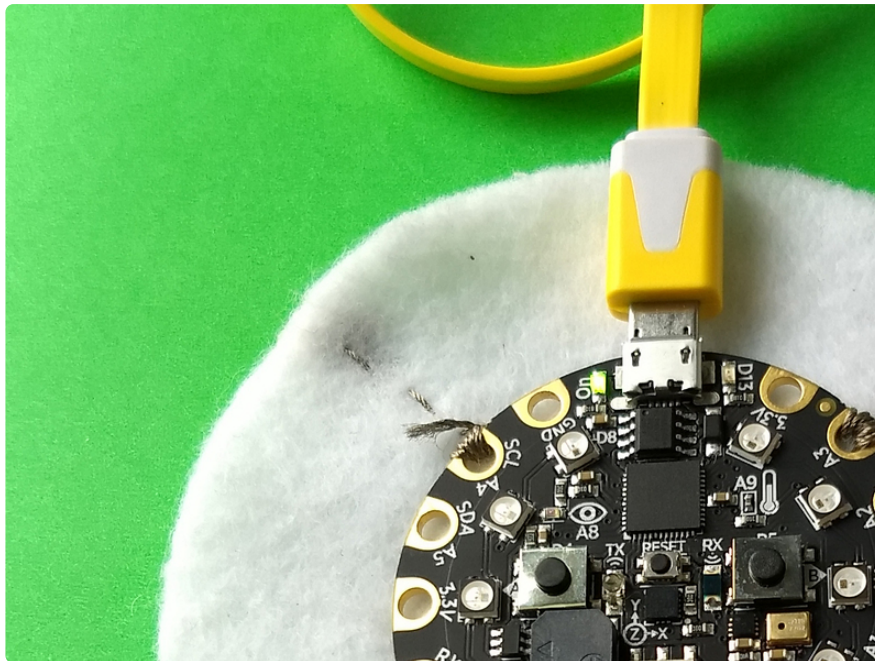
Circuit Playground Express

The Circuit Playground Express (https://adafru.it/adafruit-cpx) is the top choice for educators and parents because it has so much packed into it! Use it when you want sensors, buttons, and touchpads to trigger events like lights and sound. It also has an infrared (IR) transmitter and receiver that lets you create interactive games or turn it into a remote control.

MakeCode's extensions allow you to control peripherals you connect to CPX, such as strips of color-changing NeoPixel lights (http://adafru.it/3811) or micro servo motors (http://adafru.it/169).

Its sensors can even provide you with real-time data. "Graph" it on the built-in ring of NeoPixels, or read it streaming on your computer screen when you use the MakeCode Adafruit app for Windows 10 (https://adafru.it/Eql).

How to Power it

Once you've programmed it, you can detach CPX from the computer and power it with a case that holds three AA batteries (http://adafru.it/3287).
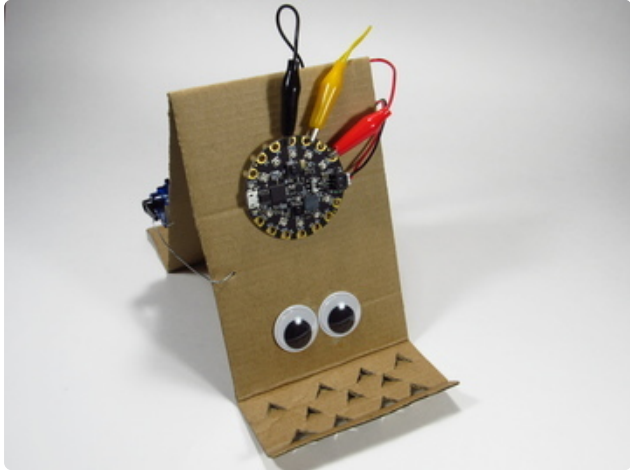
Suggested CPX Learning Guides for Beginners

Scroll down the MakeCode page for the CPX to see tutorials for beginning projects. You can also find more easy projects on the Adafruit Learning System. Most use just the board (plus a USB cable to upload code and a battery case if it's portable), or the board and one or two other inexpensive components. Here are a few to try:
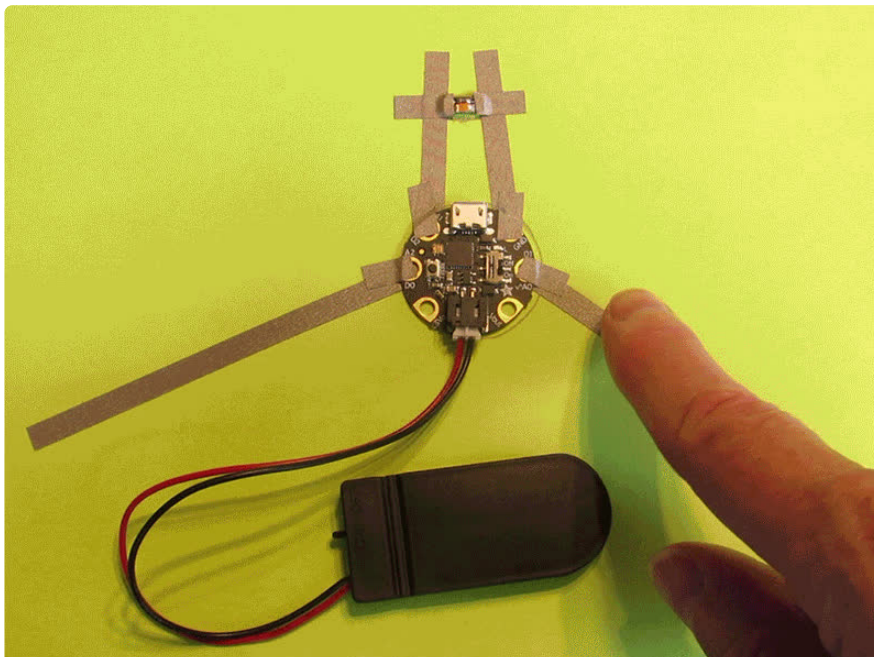
Buttermilk Boat (https://adafru.it/FsL)
Cardboard Robot Inchworm (https://adafru.it/FsM)
Musical Glove (https://adafru.it/EKO)
Tappy Hand (https://adafru.it/FsN)
Adabot Operation Game (https://adafru.it/FsO)

Gemma M0

Gemma M0

The [Gemma M0 (https://adafru.it/yev)](https://adafru.it/yev) (read "M zero") is an update of an earlier Gemma board. Its small size and low price make it perfect for wearables and other projects where you want to build the microcontroller in permanently.

Although tiny, the Gemma has a built-in output in the form of an RGB color-changing LED light. And even though it doesn't have sensors, it does have input -- touch pads that let you trigger events. It also has an on/off switch (something that is always handy).

The big holes around the edges make it easy to connect additional components like lights or servo motors using alligator clip wires, sewable conductive thread, or peel-and-stick foil or fabric conductive tape. It's easy to hold in place on your project with a single glue dot.

How to Power It

For small projects like wearables with lights, you can run Gemma using a case that holds [two 3 volt coin batteries (http://adafru.it/783)](http://adafru.it/783) (CR 2032).

## Suggested Gemma M0 Learning Guides for Beginners

Beginner learning guides for the Gemma M0 tend to be wearables, which means they suggest you cut down on weight by soldering components and using LiPo batteries (which require special recharging).

But you can adapt many Gemma projects by substituting a battery case and using short alligator clips instead of soldering components to the board. Here are some ideas to try:

[Infinity Mirror Candy Box (https://adafru.it/FsP)](https://adafru.it/FsP)
[Hidden Ink--UV Message Reader (https://adafru.it/FsQ)](https://adafru.it/FsQ)

PyBadge
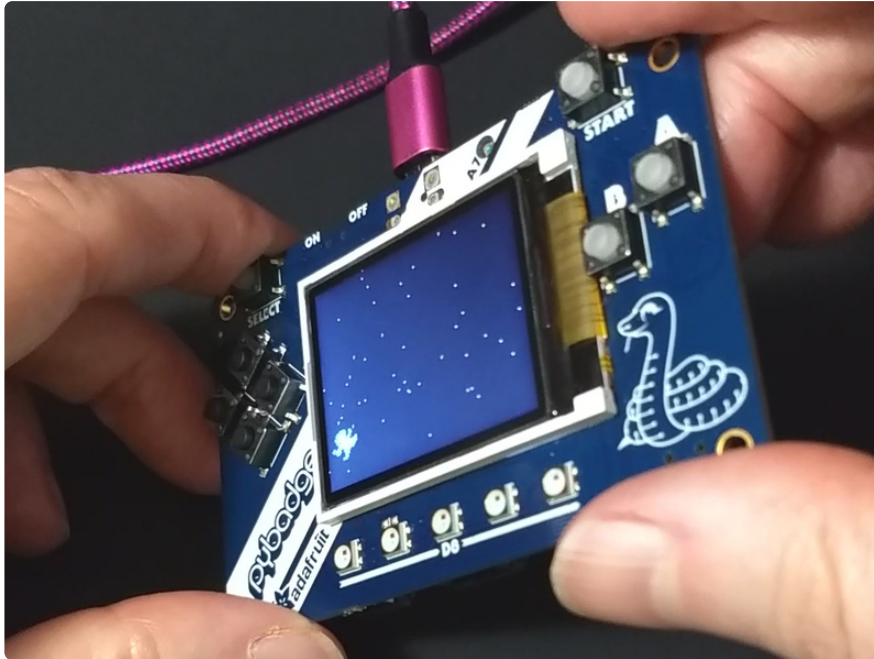

The PyBadge (https://adafru.it/Fnt) is the middle entry in a line of boards (https://adafru.it/FsR) that look and act like mini game controllers. All feature full-color display screens that let you draw your own 8-bit-style designs and bring them to life!

The PyBadge has built-in accelerometer (tilt sensor) and light sensor inputs, in addition to directional controls (four buttons that can be used like a joystick) and other programmable buttons.

For outputs, along with that amazing display, it has a row of RGB NeoPixel lights and a built-in speaker.

That makes a nice compromise between the lower-cost PyBadge LC (which doesn't have an accelerometer) and more self-contained than the higher-end PyGamer (which has a built-in joystick but requires an add-on speaker).
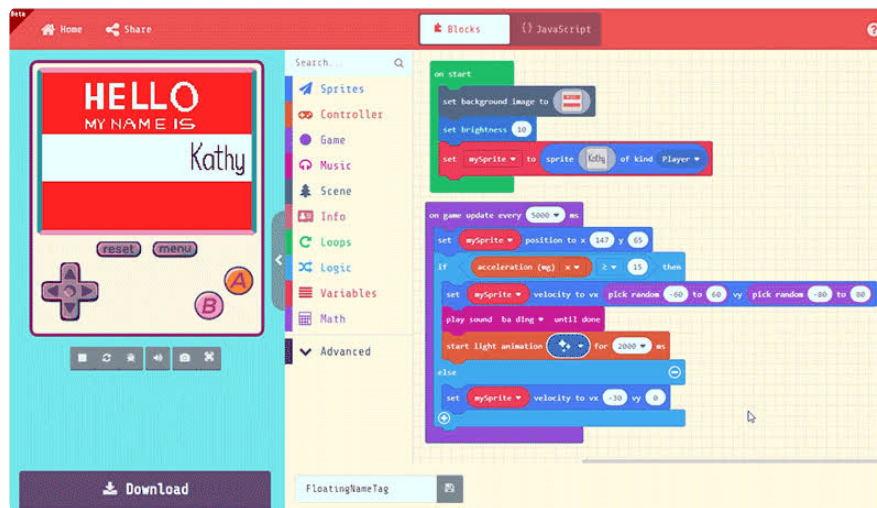
How to Power It

Unlike CPX and Gemma, you can't use a AA battery holder with a JST plug to make the PyBadge portable.

Instead, you can use an extra long (six foot) USB cable (http://adafru.it/4148) attached to your computer or any USB charger.

You can also use a AA battery holder with a USB connector (like this one (https://adafru.it/FsX)).

Suggested PyBadge Learning Guides for Beginners

There are lots of helpful tutorials and examples on the MakeCode Arcade site. And the number of guides on the Adafruit Learning System is constantly growing as well. Here's a sampling:

Sparky Invaders (https://adafru.it/EYf)
Name Tag (https://adafru.it/FsS)
Marble Labyrinth (https://adafru.it/FsT)

Other Boards to Check Out

Adafruit boards and MakeCode are a powerful combination. They meet almost all the needs of students getting started with physical computing.

But if you're curious about comparable boards by other makers, here's a quick look at three that are also popular with educators.

Many projects designed for other boards can be adapted fairly easily to work with the Adafruit Circuit Playground Express or other Adafruit boards.
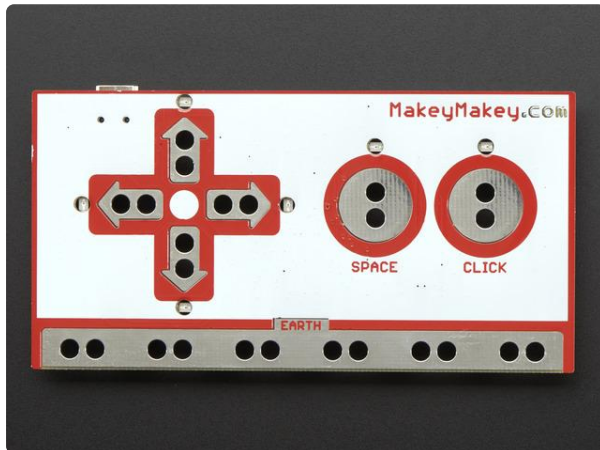
MaKey MaKey by Jay Silver and Eric Rosenbaum - Made by JoyLabz
Ever played Mario on Play-Doh or Piano on Bananas? Alligator clip the Internet to Your World.
https://www.adafruit.com/product/1068

Makey Makey

Makey Makey by JoyLabz is an Arduino-based board that lets you use conductive objects as keyboard keys. Unlike the Circuit Playground Express, you don't have to program it. All you do is plug in the USB connector into a computer and it's ready to go.

You can use the Makey Makey to run any kind of program your computer runs, as long as it can be controlled by the keys available -- up, down, left, right, space, and mouse click. (The back of the board has connections for additional keys.)

Because it was designed by some of the same people who developed MIT's Scratch, it also works very well with Scratch programming. The latest version, Scratch 3.0, has its own Makey Makey extension.

If you want to build a stand-alone project that doesn't need to be connected to a computer, however, the Circuit Playground Express is still your best bet. The Circuit Playground Express capacitive touchpads (https://adafru.it/udX) are also a little simpler to use than the Makey Makey keys, which have to be connected to ground (marked as "Earth" on the board) to activate. And the Circuit Playground Express is about half the price.

And you can also use MakeCode to program a Circuit Playground Express to trigger keyboard keys. And input -- touchpads, buttons, or sensor readings like shake or light -- can be used to trigger a key. See the Make It a Keyboard guide (https://adafru.it/C1U) for more info.
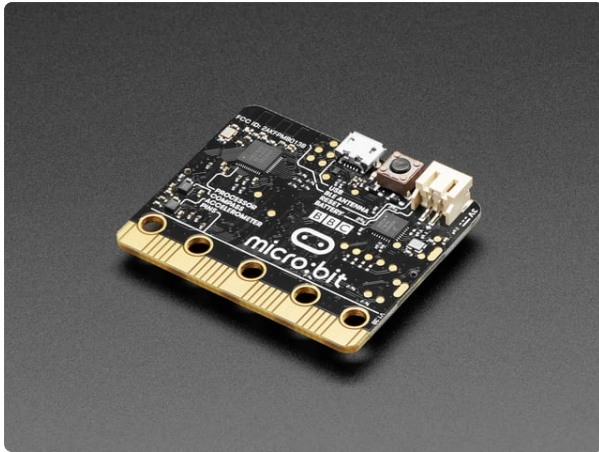
micro:bit

The BBC micro:bit falls somewhere between Gemma M0 and Circuit Playground Express in both functionality and cost. It works with MakeCode and has its own Scratch extension.

It can measure tilt and light and receive input through touchpads. Its output is a matrix (grid) of red LEDs that can be programmed to display icons, scrolling text, and data on a graph. But it doesn't have a built-in microphone or speaker or multicolor LEDs.

However, with Bluetooth capability, it can send and receive signals from other micro:bits and from a smartphone.

In the time since it was first introduced to students in schools throughout the United Kingdom, it has developed a large following. Educators around the world have been creating teaching materials and projects. There are also many kits and accessories made by third parties that use the micro:bit, such as the MiniMu musical glove (http://adafru.it/4141).

However, while Circuit Playground Express is more expensive, it includes accessories you have to buy separately for micro:bit, such as a speaker. It's easy to adapt MakeCode projects for micro:bit to work with Circuit Playground Express. And Circuit Playground Express Bluefruit (https://adafru.it/FgZ), coming later this year, will have Bluetooth radio communication as well.
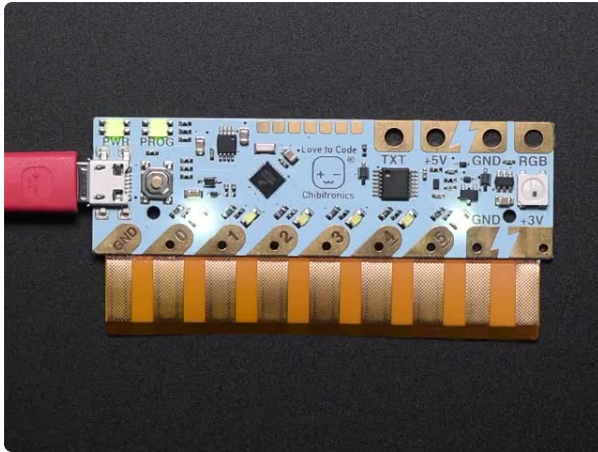
[Love To Code Chibi Chip with Cable](#) Interested in coding, but overwhelmed where to start? Looking to add cute, blinky LEDs to a paper craft project? The Love to Code (LTC) system from Chibitronics is designed for... https://www.adafruit.com/product/3674

Chibi Chip

Chibi Chip from Chibitronics is designed specifically to work with paper projects. It's made by the same people who created the peel-and-stick Circuit Stickers (http://adafru.it/1976), the easiest way to attach lights to paper art.

An optional clip (http://adafru.it/3698) clamps Chibi Chip right onto a circuit made with conductive tape, paint, or other material. In fact, the Love to Code Creative Coding Kit (http://adafru.it/3854) comes with a book that lets you clip Chibi Chip right onto over the illustrations to complete circuits while you learn.

You cab also get a Chibi Scope (http://adafru.it/3901) with a display screen that can display text, voltage, and more.

Chibi Chip works with MakeCode, and connects to the device you're programming on with an earphone-type plug. That actually makes it possible to write code and download it directly from a smartphone or tablet with an earphone jack!

If you want to use Circuit Playground Express or Gemma M0 to create paper projects similar to those made with Chibi Chip, you can attach conductive fabric or foil tape directly to the Adafruit boards' touchpads.