Play an Electronic Drumset with a Raspberry Pi


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Experimental Procedure

Getting Started
This project will let you take everyday metal objects and convert them into a customizable electronic drumset. If you have not already, you will need to set up your Raspberry Pi (https://www.sciencebuddies.org/science-fair-projects/project-ideas/CompSci_p054/computer-science/electronic-drumset-raspberry-pi) before you begin. Watch this short video for a demonstration of the project:

https://www.youtube.com/watch?v=LwDNYWUEN4

Writing Your Program
To make your drum set, you will need to write a program that tells your Raspberry Pi to play a sound each time the drumstick touches one of the drums. If you have never written a program in Scratch before, watch this video to learn how:

https://www.youtube.com/watch?v=-X3XcWlw-Lg

First, you will need to create a variable. You can do this by clicking Data and then Make a variable. Name your variable "delay" and then several new blocks will appear:

Figure 2
You will also need the following blocks:

- **when (green flag icon) clicked**, available under Events.
- **set gpio ___ to ____ and gpio ___ is high?**, available under More blocks. If you do not see these blocks, click Add an extension, then click PI GPIO and select OK.
- **not**, available under Operators.
- **wait, if _____ then, and forever**, available under Control.
- **play sound ____**, available under Sound. You can import more sounds on the Sounds tab.

Using these blocks, write a program that looks like this (remember that you can import additional sound effects by clicking the Sounds tab). Note that some blocks snap inside each other. For example, the not block snaps inside the if _____ then block, then the gpio ___ is high? block snaps inside the not block.
Building Your Circuit

To build your circuit, you will need to use a breadboard. If you have not used a breadboard before, watch this video before you continue:

https://www.youtube.com/watch?v=6WRfFkfuIuk

To assemble the circuit, you will need male-male jumper wires and alligator clips from your kit (five of each).
You will also need five metal objects (not included in your kit): four to use as drums, and one to use as a drumstick. The example project uses measuring cups and a whisk, but any metal objects will work as long as you can attach the alligator clips to them. For example, you could also use aluminum foil.

First, connect jumper wires to your breadboard, as shown in Figure 7. For this circuit, you will only plug one end of each jumper wire into the breadboard.

<table>
<thead>
<tr>
<th>Part</th>
<th>Picture</th>
<th>Hole</th>
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</thead>
<tbody>
<tr>
<td>Red M-M jumper wire</td>
<td></td>
<td>A6</td>
</tr>
<tr>
<td>Green M-M jumper wire</td>
<td></td>
<td>A7</td>
</tr>
<tr>
<td>Blue M-M jumper wire</td>
<td></td>
<td>A8</td>
</tr>
<tr>
<td>Yellow M-M jumper wire</td>
<td></td>
<td>A9</td>
</tr>
<tr>
<td>Black M-M jumper wire</td>
<td></td>
<td>A17</td>
</tr>
</tbody>
</table>
Your circuit should now look like this. Notice how only one end of each jumper wire is plugged into the breadboard, and the other ends are free.

Next, use alligator clips to connect your jumper wires to each of your metal objects. Connect the colored jumper wires to your drums, and the black jumper wire to your drumstick. This video shows you how to use the alligator clips.
Here are some close-up pictures that show the alligator clips connected to the jumper wires. Note: There is no blue alligator clip or white jumper wire in your kit, but the colors do not need to match the ones we used.

![Figure 9](https://www.youtube.com/watch?v=ZE70on8_n-k)

And to the drums:

![Figure 10](https://www.youtube.com/watch?v=ZE70on8_n-k)

Finally, here is a picture of the complete setup, with four drums and one drumstick. **Important:** Remember to avoid short circuits! Do not let your drums or the exposed metal parts of the alligator clips touch each other.
Remember that you can also use aluminum foil if you do not have other metal objects handy.

Testing Your Drum Set

Now it is time to test your drum set! You need to run your Scratch program by clicking the green flag toward the top of the Scratch window. Then, take your drumstick and tap it against each one of your drums, one at a time, to test the sound. Each drum should play the sound effect that you programmed! Now, have some fun playing with your electronic drum set. Try changing the sound effects to find the ones you like best.

Troubleshooting: I do not hear any sound! [Show] [i]
Going Further

Here are some suggestions you can try to modify or improve your drum set:

- Make each drum play multiple sound effects.
- Try using different objects as drums and drumsticks.
- Add more than four drums (see note below about GPIO pins).
- Make each drum light up an LED (see note below about LEDs).

Learn More About: Which GPIO pins can I use as inputs? [Show]

Learn More About: Adding LEDs [Show]

Frequently Asked Questions (FAQ)

Kit General Questions

- Who is the kit appropriate for? [get-question2]
- Are the kit parts reusable? [get-question3]
- Aren’t there other Raspberry Pi kits on the market? How is yours different? [get-question5]
- I already have a Raspberry Pi. Can I just buy the circuit parts separately? [get-question-have]
- What programming language do the projects use? [get-question4]

Setting Up and Using Your Raspberry Pi FAQ

These answers apply to the Raspberry Pi Model 3B+ which comes with the Raspberry Pi Projects Kit. If you are using a different Raspberry Pi model you will need to do some research on your own—we suggest starting with the Raspberry Pi Foundation’s Setting up your Raspberry Pi page (https://projects.raspberrypi.org/en/projects/raspberry-pi-setting-up).

- How do I connect my Raspberry Pi to my TV or computer monitor? [question1]
- Can I use a laptop as a display and/or keyboard? [question4]
- How do I connect my Raspberry Pi to the internet? [question-how]
- How do I shut down or reboot my Raspberry Pi? There’s no power button! [question-reboot]
- How can I adjust the Raspberry Pi’s display resolution? [question-ras]
- I have everything connected properly, why can’t I hear any sound? [question5]
- Why won’t my Raspberry Pi turn on? [question2]
- My Raspberry Pi starts to boot up, but then it freezes or the screen goes blank. What is wrong? [question-boot]
- My Raspberry Pi froze and is not responding to mouse or keyboard input. What should I do? [question12]
- My Raspberry Pi is acting strangely (it suddenly will not boot up properly, certain programs do not work, etc). What is wrong? [question13]
- I think I corrupted my Raspberry Pi’s SD card. What should I do? [question14]
- I need help with a question, related to my Science Buddies Raspberry Pi Projects Kit or Raspberry Pi Circuits Parts Only Kit, not listed here. Who can I ask? [question-last]

Kit General Answers

Q: Who is the kit appropriate for?
A: The kit is meant for anyone (ages 8 and up) who wants to learn some basic programming and electronics skills while having fun. Students up to age 10, or older if their reading skills are behind grade level, may need adult assistance in reading and following the on-screen instructions. The projects included in the kit were beta tested and approved by students ages 8 to 16.

Q: Are the kit parts reusable?
A: Yes, all the electronics components in the kit can be re-used to do new projects or to repeat the projects.

Q: Aren’t there other Raspberry Pi kits on the market? How is yours different?
A: Yes, there are other Raspberry Pi kits, and some of them are quite good! The Raspberry Pi Projects Kit (http://www.sciencebuddies.org/store-send?url=https%3A%2F%2Fwww.homesciencetools.com%2Fproduct%2Fraspberry-pi-projects-kit%2F%3Ffa%3B%3B1) and Raspberry Pi Circuit Parts Only Kit (http://www.sciencebuddies.org/store-send?url=https%3A%2F%2Fwww.homesciencetools.com%2Fproduct%2Fraspberry-pi-circuit-building-kit%2F%3Ffa%3B%3B1) have been designed to contain the specific materials needed to do the accompanying Science Buddies Raspberry Pi projects. Our kit and associated projects are specifically meant for people who have no prior experience programming or connecting circuits. The projects are 100% beginner friendly with clear on-screen instructions, pictures, and videos. We think the kit, with its associated projects, is one of the most fun kits out there! But, if you are already an ace programmer or electronics guru, you may not find this the best fit for your own personal use. Even so, it may be a fun way for you to introduce others to programming and electronics.

Q: I already have a Raspberry Pi. Can I just buy the circuit parts separately?

Q: What programming language do the projects use?
A: The projects use Scratch 2. Scratch is a “graphical” programming language developed by the MIT Media Lab. It allows you to write code by clicking,
dragging, and snapping together color-coded blocks. This allows beginners to write working code without worrying about formatting or typos. On the Raspberry Pi, Scratch allows you to control the general purpose input and output (GPIO) pins so your program can interact with a circuit in the physical world.

Note: three different versions of Scratch (1, 2, and 3) are available for the Raspberry Pi. The instructions for the Science Buddies projects (including example code) are specifically written for Scratch 2, which runs well on the Raspberry Pi model 3B+. If you have an older model Raspberry Pi, Scratch 2 may run more slowly, or may not run at all. If you want to use a different version of Scratch, you will need to consult the official documentation for Scratch 1.4 (https://www.raspberrypi.org/documentation/usage/gpio/scratch1/README.md) or Scratch 3 (https://www.raspberrypi.org/blog/scratch-3-desktop-for-raspberry-pi/) and modify the programming steps accordingly.

Setting Up and Using Your Raspberry Pi FAQ Answers

Q: How do I connect my Raspberry Pi to my TV or computer monitor?
A: The easiest way to set up your Raspberry Pi is to use an HDMI cable (included in the Science Buddies Raspberry Pi Projects Kit (http://www.sciencebuddies.org/store-and?utm_source=www.homesciencekits.com%2Fproduct%2Fraspberry-pi-projects-4%2F3%2F%3D581)) to connect to a TV or computer monitor that has built-in speakers. If you are using a computer monitor with an HDMI port but no built-in speakers, you will also need separate speakers or headphones with a 3.5 mm audio plug (a regular "headphone jack").

If your TV or monitor does not have an HDMI port, you will need an HDMI to DVI or HDMI to VGA adapter (see pictures in table below). DVI and VGA do not transmit sound, so you will need separate headphones or speakers if you are using one of those options.

<table>
<thead>
<tr>
<th>HDMI</th>
<th>DVI</th>
<th>VGA</th>
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<tbody>
<tr>
<td><img src="image" alt="HDMI Cable" /></td>
<td><img src="image" alt="DVI Cable" /></td>
<td><img src="image" alt="VGA Cable" /></td>
</tr>
</tbody>
</table>

Q: Can I use a laptop as a display and/or keyboard?
A: The short answer is “not easily.” Many newer laptops have HDMI ports, but they only function as HDMI out, to send a video signal from the laptop to a television or projector. They do not work as HDMI in to display an external signal on the laptop's screen. The laptop's keyboard is only designed to work with the laptop itself, not as a standalone keyboard for an external device like the Raspberry Pi.

The longer answer is that, similar to the Remote Desktop feature on Windows and Mac computers, you can use special software to remotely operate a Raspberry Pi that is connected to the internet. This would allow you to control a Raspberry Pi using your laptop's screen and keyboard. This option is only recommended for advanced users, and you can find instructions here (https://www.raspberrypi.org/documentation/remote-access/rdp/).

Q: How do I connect my Raspberry Pi to the internet?
A: Unlike earlier models, the Raspberry Pi 3B+ contains built-in Wi-Fi functionality. It does not require an external USB Wi-Fi adapter. You can connect your Raspberry Pi to the internet by clicking the internet icon in the taskbar and searching for available Wi-Fi networks, just like you would on a Windows or Mac computer. Your Raspberry Pi also has an ethernet port, which you can use to plug directly into a router for a hardwired connection.

Q: How do I shut down or reboot my Raspberry Pi? There's no power button!
A: Unlike most computers, the Raspberry Pi does not have a power button. You can shut down or reboot by clicking the raspberry icon in the upper left corner of your desktop, then select Shutdown. After the Raspberry Pi has shut down, it is safe to unplug the micro-USB power cable. Plug the cable back in to reboot. Important: never unplug the power cable while the Raspberry Pi is still running. This can corrupt the SD card.

Q: How can I adjust the Raspberry Pi's display resolution?
A: Click the Raspberry Pi logo in the top-left corner of your desktop. Select Preferences, then Raspberry Pi Configuration, then click the Set Resolution... button on the System tab.

Q: I have everything connected properly. Why can't I hear any sound?
A: Right-click the speaker icon on the desktop taskbar. This allows you to manually select HDMI or analog (the headphone jack) for sound output. Make sure you have the proper output selected. Also, make sure your Scratch program is set to play a sound. You can write a simple program to test if your sound is working using the "when space key pressed" and "play sound meow" blocks.

Q: Why won't my Raspberry Pi turn on?
A: If your Raspberry Pi will not turn on (the screen remains blank after everything is plugged in), go through this checklist to make sure everything is set up properly.

1. Make sure your SD card is pushed in all the way (see Figure 1).
2. Make sure the red power LED on your Raspberry Pi (labeled "PWR," near the micro-USB port, see Figure 2) is on. This means the Raspberry Pi is receiving power from the micro-USB port. If the LED is not on, make sure you pushed the micro-USB connector into the micro-USB port all the way.
3. When you first plug the micro-USB cable in, the green LED (labeled "ACT," next to the PWR LED, see Figure 2) should flash several times. This LED flashes when the Raspberry Pi reads data from the SD card. After the Raspberry Pi is done booting up, it should turn off. If it does not flash at all, your SD card might not be inserted properly. Go back to step 1.

4. Make sure your display (television or monitor) is turned on. If your display is turned off, you will not see anything on the screen, even if the Raspberry Pi is on.

5. Make sure your display is set to the correct input. Many modern TVs have more than one HDMI input, and some computer monitors have DVI or VGA inputs in addition to HDMI.

Figure 1. A micro-SD card that is inserted properly (left) and one that is not pushed in all the way (right).

Figure 2. The PWR (red) and ACT (green) LEDs near the micro-USB port.

Q: My Raspberry Pi starts to boot up, but then it freezes or the screen goes blank. What is wrong?
A There may be a problem with your Raspberry Pi or SD card. If you are using the Raspberry Pi or SD card that came with the Raspberry Pi Projects Kit or Raspberry Pi Circuit Parts Only Kit purchased from our partner Home Science Tools, please contact them directly at service@homesciencetools.com for assistance.

Q: My Raspberry Pi froze and is not responding to mouse or keyboard input. What should I do?
A: First, be patient and give the Raspberry Pi a few minutes to try and process whatever it was doing. If you click on a whole bunch of things in rapid succession, or run a really complicated Scratch program, the Raspberry Pi might slow down or freeze temporarily.

Next, if you are using a wireless keyboard and mouse, make sure they have fresh batteries.

Finally, as a last resort, if your Raspberry Pi is not responding, unplug the micro-USB cable and plug it back in. In general, you want to avoid doing this, because suddenly cutting power to the Raspberry Pi without properly shutting it down first can corrupt the SD card, and prevent the Raspberry Pi from working properly.

Q: My Raspberry Pi is acting strangely (e.g. it suddenly will not boot up properly, certain programs do not work, etc.). What is wrong?
A: If your Raspberry Pi is not “dead,” but seems to be behaving strangely, there is a chance that your SD card has become corrupted. This can happen if you unplug the Raspberry Pi’s power cord without properly shutting it down first. See the next question.

Q: I think I corrupted my Raspberry Pi’s SD card. What should I do?
A: If the SD card came with the Raspberry Pi Projects Kit or Raspberry Pi Circuit Parts Only Kit you purchased from our partner Home Science Tools, please contact them directly at service@homesciencetools.com for assistance. Make sure to include a detailed description of the problem you are having. They will work with you to resolve the issue.

Q: I need help with a question, related to my Science Buddies Raspberry Pi Projects Kit or Raspberry Pi Circuits Parts Only Kit, not listed here. Who can I ask?
A: Science Buddies has a special area of our Ask an Expert forums dedicated to the Raspberry Pi Projects Kit (http://www.sciencetools.org/science-buddies-projects/phpBB3/viewforum.php?F=44). Please note that the forums are staffed by volunteers, and it may take a few days to get a response. If you are doing a science project, please do not wait until the day before the project is due to ask an urgent question.