

WEEK 5

DAY 1: CODING SOUND & SWITCHES



INTRODUCTION

In this session, makers continue to explore user interface and user experience (UI/UX) by connecting momentary and locking buttons to the Micro:bit microcontroller.



ESSENTIAL QUESTIONS

- How can we connect buttons to the Micro:bit and code music for a fun, interactive experience?
- How do artists, engineers, and makers solve problems when they're working?



LEARNING OUTCOMES

1. Learn how to connect buttons to the Micro:bit.
2. Learn how to code music blocks.
3. Engage in project-based learning through problem-solving and troubleshooting by creating a game with a Micro:bit and code.



VOCABULARY

User: People playing/interacting with the game

User interface (UI): Physical and digital method or “interface” of how the user interacts with the game

User experience (UX): How natural, intuitive, and enjoyable those interactions are

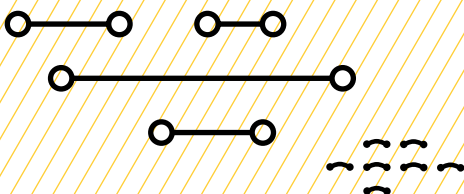
Button (or switch): Devices for making and breaking the connection in an electric circuit

Momentary button: Switch that doesn’t make contact unless it’s held down

Locking button: Switch that latches in a set position

Speaker: Device that receives and amplifies an audio signal so it can be heard

Troubleshooting: Using resources to solve issues as they arise

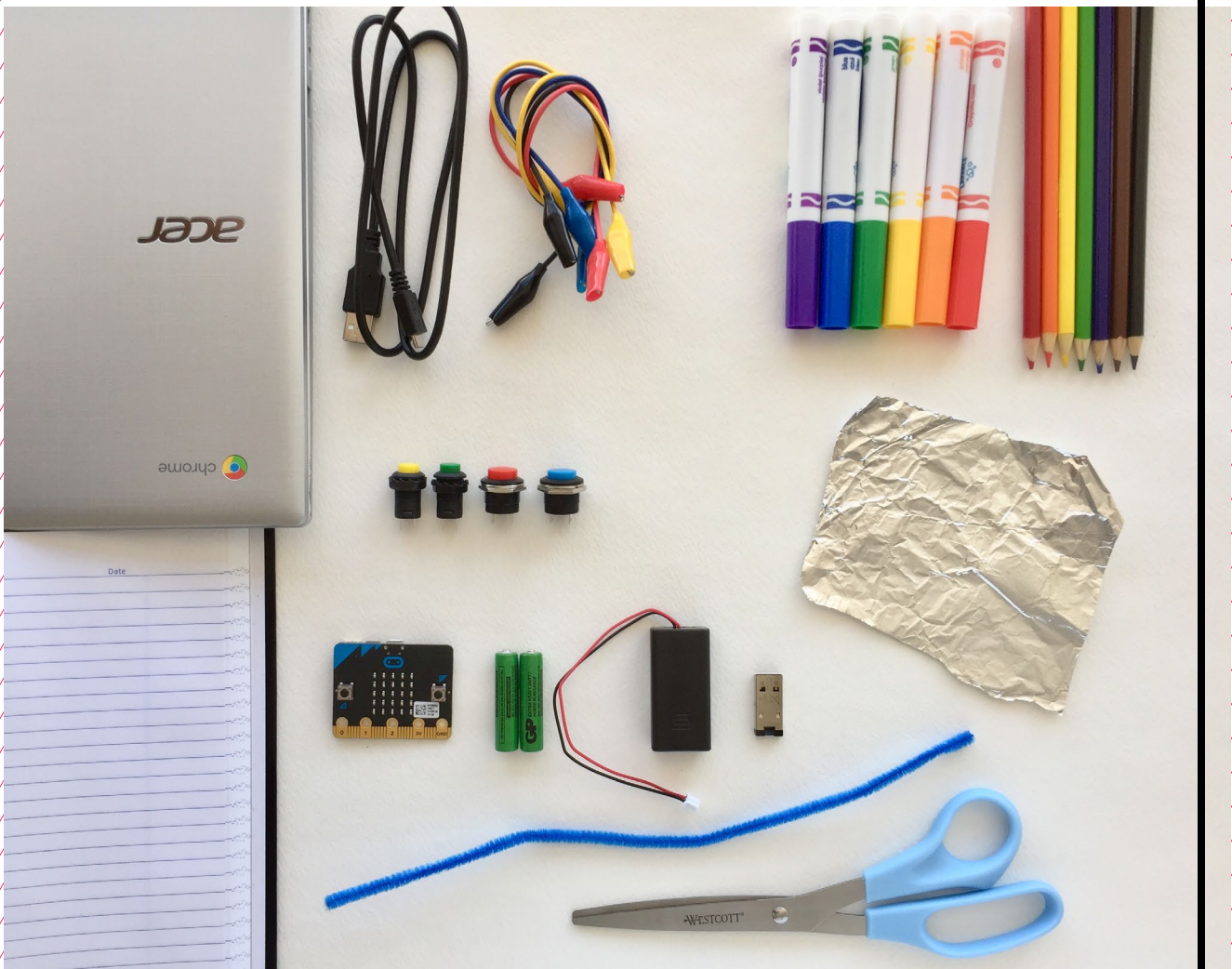


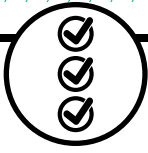


MATERIALS LIST

EACH PAIR OF MAKERS NEEDS:

- Micro:bit microcontroller
- Laptop with internet connection
- USB to micro-USB cord
- USB flash drive
- Battery pack
- AAA batteries (2)
- Alligator clips (4)
- Momentary buttons (2)
- Locking buttons (2)
- Notebook
- Markers or colored pencils
- Aluminum foil
- Pipe cleaner
- Scissors





TEACHER PREP WORK

1. Ensure the internet connection is working, and connect your laptop to a projector or screen.
2. Preload videos and slideshow to save time.
3. Code the button keyboard in Step 2 and upload it to a Micro:bit as an example.
4. Set aside for each group: 2 momentary and 2 locking buttons, plus 4 alligator clips.
5. Print the [Troubleshooting Tips](#) at the end of the lesson and post in the classroom.

FACILITATION TIPS

Makers will likely be curious and want to explore other music blocks during Step 2. They should stick with the instructions and program individual notes on the keyboard. This will support the intended UI/UX experience for the lesson. Remind them that they'll have time afterwards to explore the software further.

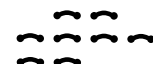
Electronics: Tinkering with electrical connections can be tricky, especially when connecting multiple alligator clips to one terminal on the Micro:bit. It can be helpful to extend the metallic terminal from Pin or GND with a small piece of aluminum foil or other conductive material (see the images in Step 3).

Inspiring creativity: Take note and celebrate surprising discoveries. Give makers opportunities to share the cool things they figure out with the rest of the class.

Collaboration: Let smaller issues work themselves out. Record specific positive examples that you can share with makers in the moment or at the end of the project. These examples provide models for all learners.

Frustration: When frustration levels aren't high, let learners figure it out or keep facilitation low touch by asking a question and walking away. When frustration levels are high, intervene more directly to help makers find some success.

Circulate among the makers and monitor for both collaboration and frustration.

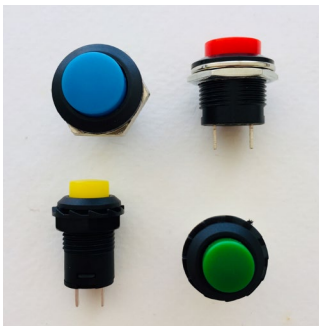


CODING SOUND & SWITCHES

STEP 1



Introduce buttons: momentary vs. locking.



EXPLAIN



Today, we'll continue programming the Micro:bit and connecting switches to play with the UI/UX. Let's check out some of these cool arcade switches and buttons. They might look familiar, similar to something you see on your game controller at home or at an arcade.

Next:

- Give each group 2 **locking buttons** and 2 **momentary buttons**.
- Let them play around with clicking them and see if they feel a difference.
- Ask them to draw one in their notebook, noticing what parts the buttons have and what they might do.

They'll probably notice that one of the buttons clicks but doesn't stay down, while the other clicks and stays locked. They have to press it again to unlock it.

EXPLAIN



The button that clicks but doesn't stay down is a **momentary button**, and it only completes the circuit when the button is held down. The button that clicks and stays locked is a **locking button**. When you press this button, the circuit stays connected until pressed again. These buttons will be available as you continue to design UI/UX for your own games.

STEP 2



Code pins and music!

EXPLAIN

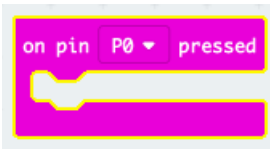


Now we'll continue exploring the Micro:bit, and learn how to program 2 pins to play different sounds. Then we'll connect 2 switches and a **speaker**. Choose your driver and navigator roles and let's begin. Navigators, watch closely and instruct your driver to follow these steps.

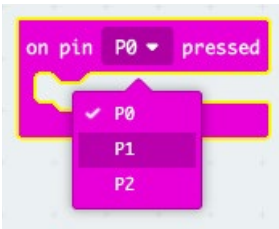
DEMONSTRATE AND HAVE MAKERS FOLLOW ALONG:



1. Start by opening a new project. Then, click and drag an **on pin pressed** block from the **Inputs** menu into the coding space.



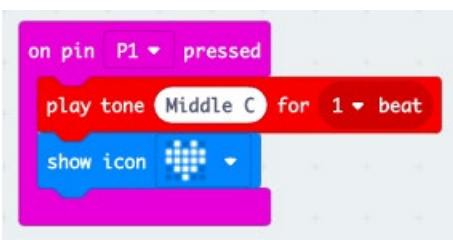
2. Click on the **P0 dropdown menu** and change it to **Pin 1**.



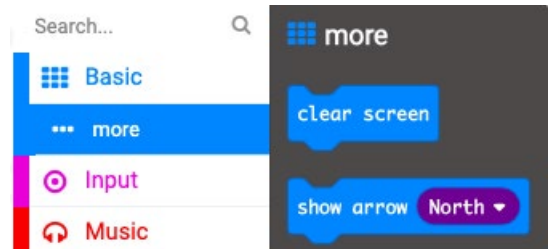
3. Next, go to the **Music** menu, drag over a red **play tone** block, and nest it into the first block.



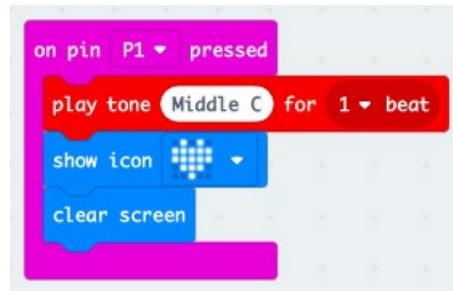
4. Drag over a **show icon** block from the **Basic** menu and add it to the sequence.



5. Then, go to the **Basic** menu and click on **more** to find the **clear screen** block.



6. Drag over a **clear screen** block to add into the sequence.



7. Next we want to duplicate this entire sequence of blocks. We can do this a few ways:

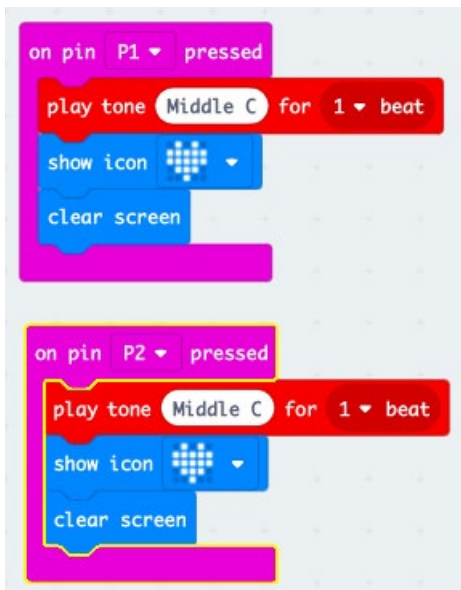
- Repeat Steps 1–6.
- Go to the top **on pin pressed** block and use two fingers to press down on the trackpad.
- Hold down the alt key and click on the block to show a dropdown menu. Then choose the Duplicate option.



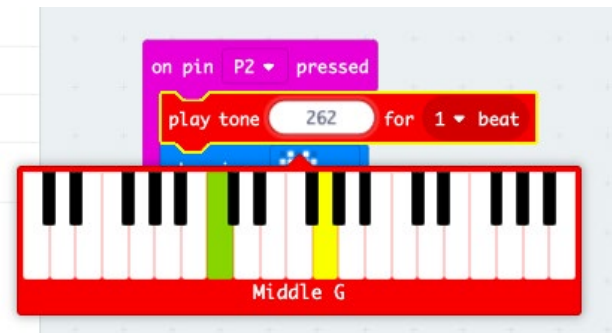
8. You should see a copy of these blocks, but one is greyed out because it's inactive.



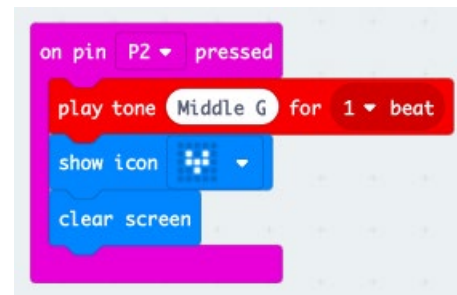
9. Change the first block to be **on pin P2 pressed**, and the blocks should be no longer greyed out.



10. Click on the text “Middle C” to change the note. You’ll see a keyboard pop up. You can choose any second note to play.



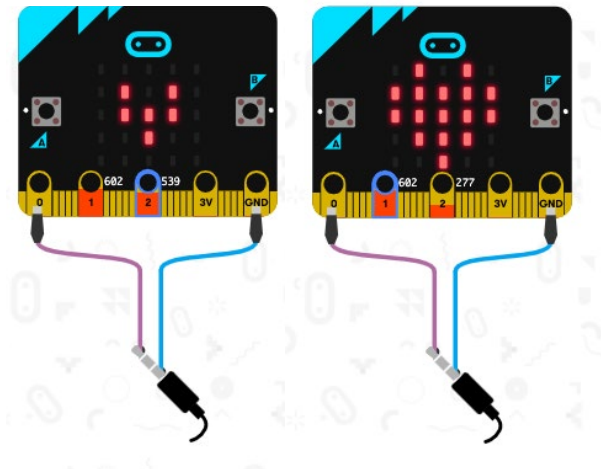
11. Next, change the **show icon** block display to be a small heart.



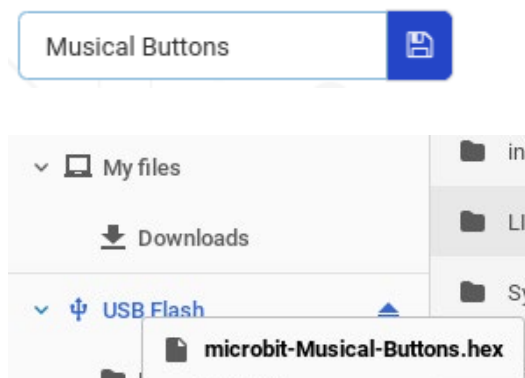
You should now have the two sequences of code shown here.



12. Next, in the simulator, test the code by clicking on **Pin 1** and **Pin 2**. You should hear the tones playing through the computer speaker!



13. Notice that the simulator shows **Pin 0** and **GND** connected by wires to the end of a plug. This is showing us how to connect to a speaker. We'll do that later, after we upload the code to our board.
14. Once we've coded the two sequences:
- Name the file with a unique name.
 - Save the file to the USB flash drive.
 - Connect the Micro:bit with the USB cord.
 - Click and drag the file into the Micro:bit to upload.



STEP 3



Connect the pins.

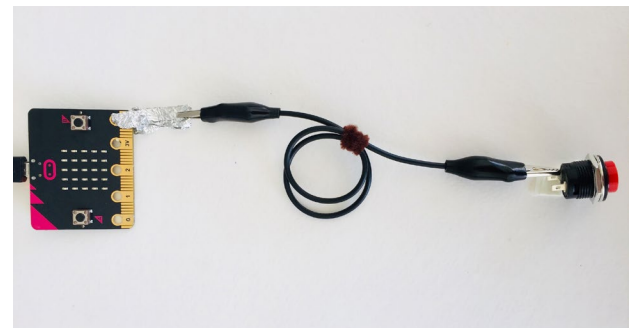
Note: Makers should leave the board connected to the laptop while doing this step to reduce troubleshooting issues from the battery pack.

It's time to connect 2 buttons to the board. Give each group 4 alligator clips. Have makers swap driver and navigator roles from the last step. (Drivers are the ones with their hands on the board with wires. Navigators instruct and support their partner to follow the steps below.)

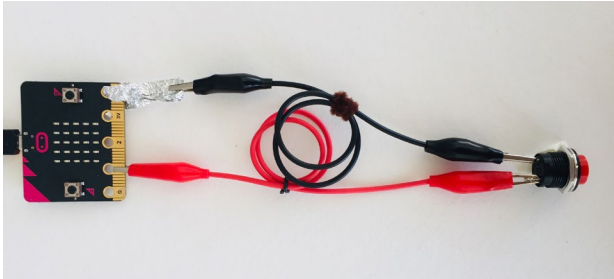
DEMONSTRATE AND HAVE MAKERS FOLLOW ALONG:



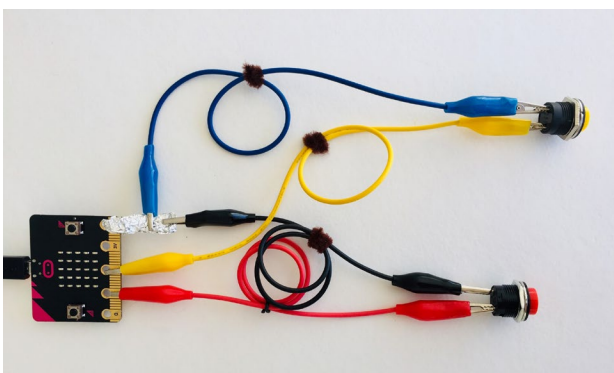
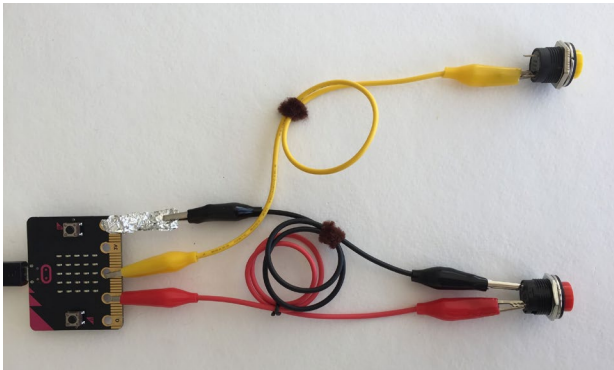
1. Connect an alligator clip to **GND** and the other side to one terminal of the **momentary button**. It can be helpful to twist some aluminum foil and loop it through **GND** because we'll be adding more alligator clips to **GND**.



- Next connect an alligator clip to **Pin 1** and the other end of the alligator clip to the other side of the momentary button terminal.



- Repeat Steps 1 and 2 but connect to **Pin 2** with a second button. You can connect to the aluminum foil on **GND** or connect to the metal alligator clip that's already on **GND** because the metal clip is conductive.



- When you press the button connected to Pin 1 and Pin 2, you'll see the animation of the heart but you won't be able to hear the music. This is because the Micro:bit isn't connected to a speaker. We'll connect a speaker during the next session.

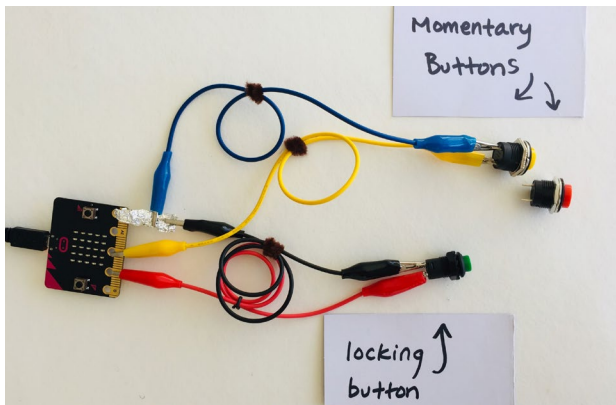
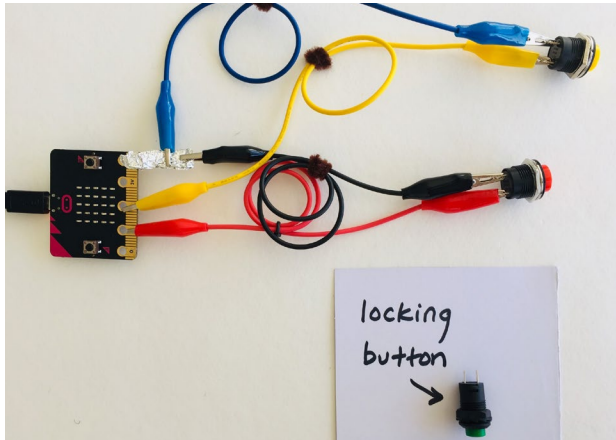
Note: In Steps 3 and 4, anticipate that connections to the board and alligator clips will be tricky and inconsistent. Encourage makers to check to see if the connections are secure as they work. You can use a pipe cleaner to twist the alligator clips together so it's easier to see how the wires are connected.

STEP 4



Switch to locking buttons.

Once makers have the code and both buttons connected and working, triggering the heart animation but without the sound, give each group 2 locking buttons. They'll switch out the momentary buttons for locking buttons to experience the difference of the UI/UX. They should note that the locking buttons have to be pressed twice quickly to trigger the code, creating a different **user experience**.



STEP 5



Share and reflect.



Ask makers to share:

1. Which UI/UX did you enjoy more?
Clicking twice quickly with the locking buttons, or just clicking once with the momentary buttons?
2. What was challenging about connecting the buttons to the Micro:bit? How did you work through it?

STEP 6



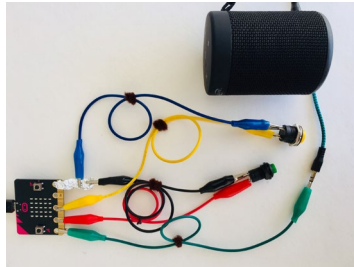
Clean up.

Makers will:

- Make sure to save their files with a unique name.
- Safely disconnect the Micro:bit from the computer.
- Safely disconnect alligator clips from the Micro:bit.
- Put materials away in their bins.
- Put technology away and make sure laptops are charging.
- Return tools and materials that can be used again to the right place.
- Clear tables of garbage and recycling.

WEEK 5

DAY 2: SPEAKERS, SOUND & DIY SWITCHES

**INTRODUCTION**

In this session, makers continue exploring UI/UX using various switches, programming sounds, and connecting a speaker to the Micro:bit.

**ESSENTIAL QUESTIONS**

- How can we connect switches and a speaker to the Micro:bit and program music for a fun, interactive experience?
- How do artists, engineers, and makers solve problems when they're working?

**LEARNING OUTCOMES**

1. Learn how to connect an external speaker to the Micro:bit.
2. Engage in project-based learning through problem-solving and troubleshooting while exploring coding music with a Micro:bit.



VOCABULARY

User: People playing/interacting with the game

User interface (UI): Physical and digital “interface” or method of how the user interacts with the game

User experience (UX): How natural, intuitive, and enjoyable those interactions are

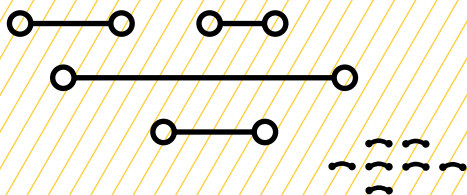
Button (or switches): Devices for making and breaking the connection in an electric circuit

Momentary button: Switch that doesn’t make contact unless it’s held down

Locking button: Switch that latches in its set position

Speaker: Device that receives and amplifies an audio signal

Troubleshooting: Using resources to solve issues as they arise





MATERIALS LIST

EACH PAIR OF MAKERS NEEDS:

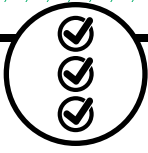
- Micro:bit microcontroller
- Laptop with internet connection
- USB to micro-USB cords
- USB flash drive
- Alligator clips (6)
- Momentary switches (2)
- Locking switches (2)
- External speaker with $\frac{1}{8}$ " cable
- Notebook

ALL MAKERS NEED ACCESS TO:

- Colored pencils
- Markers
- Cardboard scissors
- Aluminum foil
- Cardboard
- Paper clips, metal fasteners
- Metal containers, silverware, playdough (optional)

Items can be portioned out per table or set up in an area where students can access them freely.





TEACHER PREP WORK

1. Ensure the internet connection is working, and connect your laptop to a projector or screen.
2. Preload videos and slideshow to save time.
3. Connect a speaker to the Micro:bit (follow Steps 2) to share as an example.
4. Arrange materials—cardboard, tin foil, paper clips, etc.—where makers can easily get them.
5. Print the [Troubleshooting Tips](#) at the end of the lesson and post in the classroom.

FACILITATION TIPS

Electronics: Tinkering with electronics can be tricky and frustrating when things don't work right.

In Step 2, if makers don't hear the sounds when they touch GND and Pin 1 and Pin 2, suggest they try using paper clips or other conductive material. Skin can be used as a "switch" but may not work 100% of the time, depending on humidity and temperature.

Inspiring creativity: Take note and celebrate surprising discoveries. Give

makers opportunities to share the cool things they figure out with the rest of the class.

Materials management: It's up to you as the educator to decide what works best for your class. You can portion out maker materials into paper trays for each table, or have a dedicated area where makers can access materials freely as needed.

Collaboration: Let smaller issues work themselves out. Record specific positive examples that you can share with makers in the moment or at the end of the project. These examples provide models for all learners.

Frustration: When frustration levels aren't high, let learners figure it out or keep facilitation low touch by asking a question and walking away. When frustration levels are high, intervene more directly to help makers find some success.

Circulate among the makers and monitor for both collaboration and frustration.

ADDITIONAL RESOURCES

[Connecting Audio to the Micro:bit](#)

[Creating a Controller for a Micro:bit Game](#)

SPEAKERS, SOUND & DIY SWITCHES

STEP 1



Review UI/UX with coding music.

Ask makers: What did we do last session? How did the different types of buttons affect the UI/UX of the code?

A. Coded sounds and connected momentary and locking switches to the Micro:bit.

B. The momentary switches only needed to be pressed once, but the locking switches needed to be pressed twice.

EXPLAIN

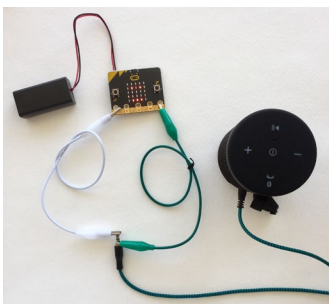


Today we'll get a bit more creative with coding different sounds and using a variety of buttons/switches. But first, we'll learn how to connect an external **speaker** to your Micro:bit.

STEP 2



Connect a speaker to the Micro:bit.



EXPLAIN

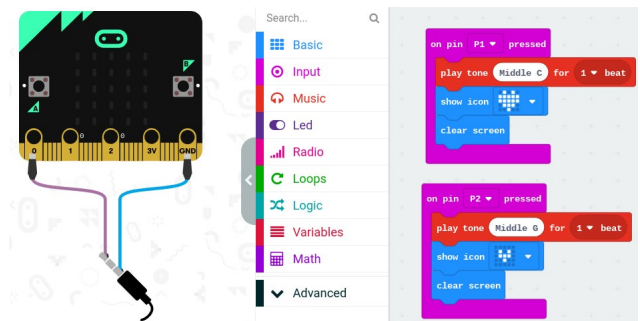


The Micro:bit doesn't have a speaker on it, so even if the code is running, the audio signal has nowhere to be heard or amplified. Next, we'll connect to an external speaker with an audio cable just as is shown on the simulator. We'll start by reconnecting the Micro:bit to the laptop and check to make sure the code we uploaded last session is still uploaded.

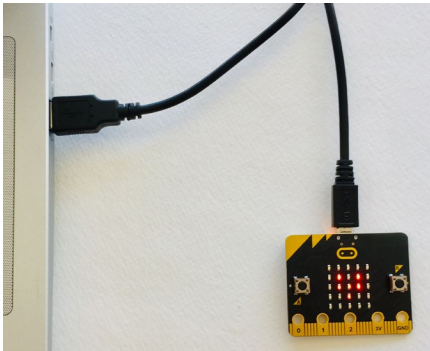
DEMONSTRATE AND HAVE MAKERS FOLLOW ALONG:



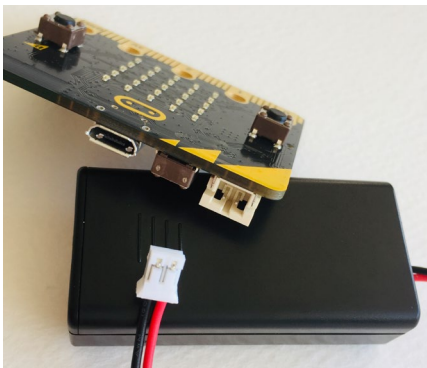
1. Open the saved MakeCode project from the last session. Notice that in the simulator there's an image of an audio cable connected to **Pin 0** and **GND**. This is the same type of cord you might find on your headphones or a speaker at home.



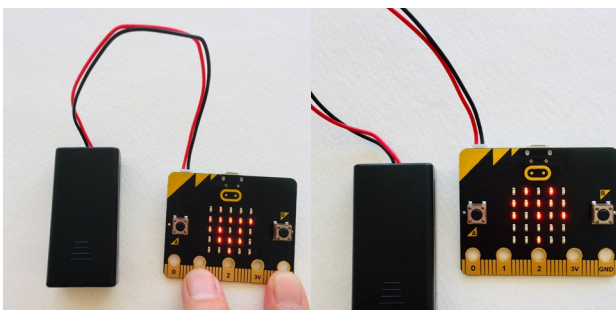
2. Connect your Micro:bit to the computer with the USB cord. Once powered up, make sure it still has your code from last session saved on it.



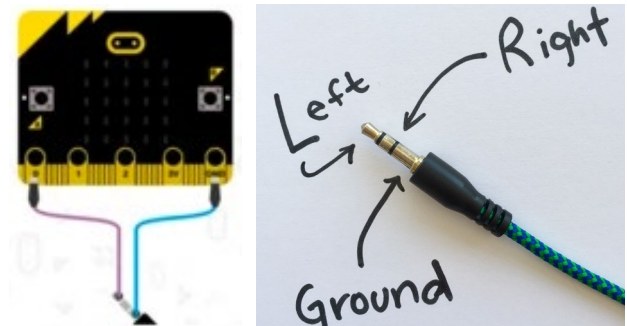
3. Safely disconnect the Micro:bit from the computer and connect it to a battery pack.



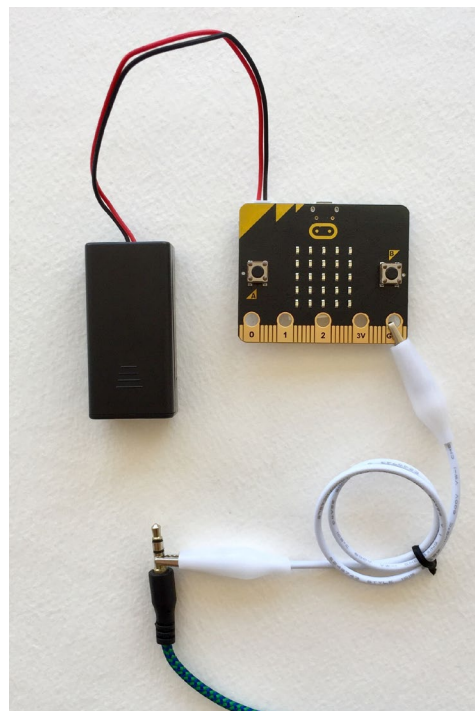
4. Using your fingers, press **GND** and **Pin 1** at the same time. Then try **GND** and **Pin 2**. You'll see your animations displayed, but you still won't hear any sound.



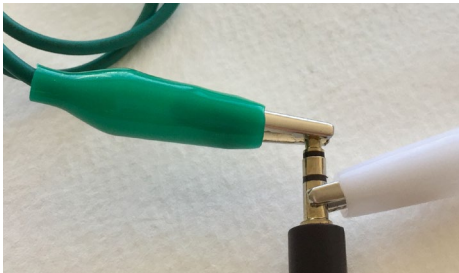
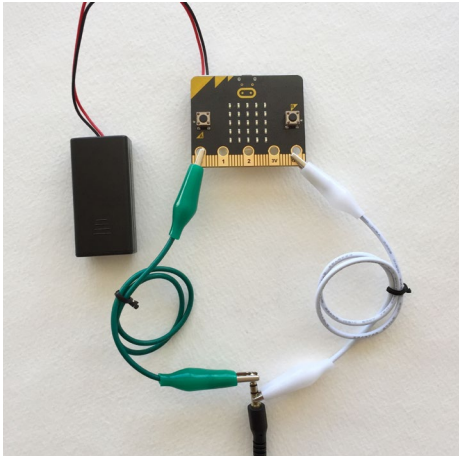
5. If you look closely at the cord from the speaker, you'll see 2 black stripes on the tip of the cable. On this audio plug, the bottom row is ground, and the middle and top of the cable are right and left audio.



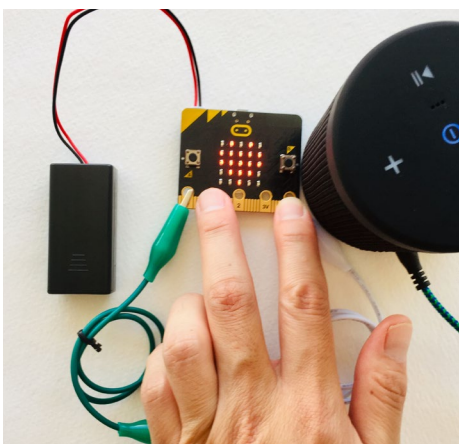
6. The bottom row is ground, so that will connect to **GND** on the Micro:bit. Connect an alligator clip from **GND** on the board to the lower section of the 1/8" plug (ground).



7. Next, connect an alligator clip from **Pin 0** on the board to the top section of the 1/8" plug (left audio).



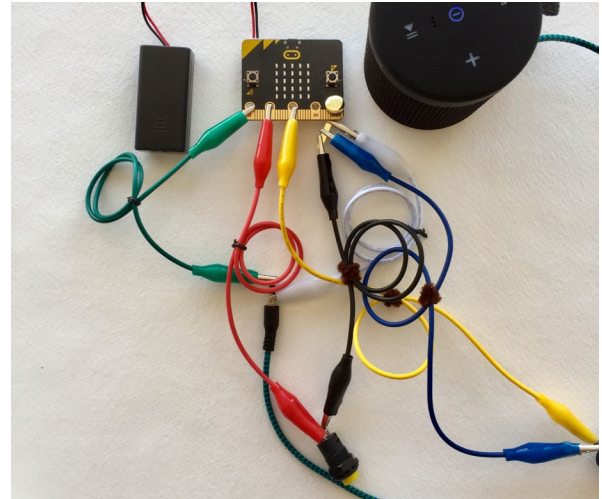
8. Now, test the sound again by pressing **GND** and **Pin 1** or **Pin 2** with your fingers. You should now hear sounds through the speaker!



STEP 3



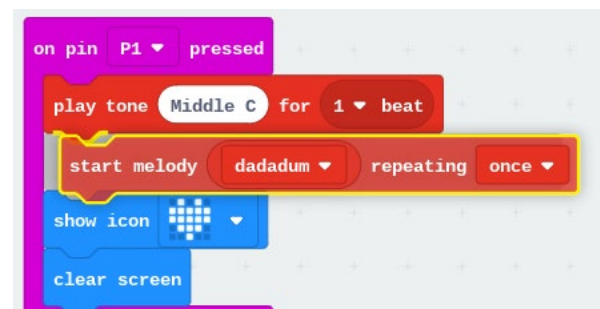
Remix code and add switches and buttons.



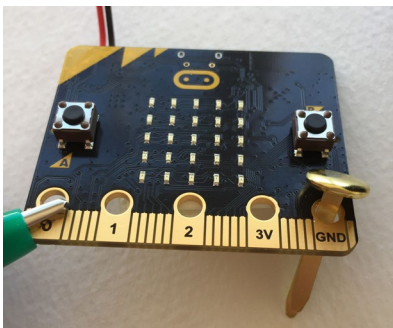
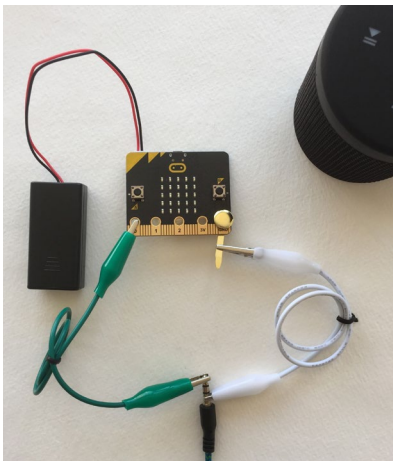
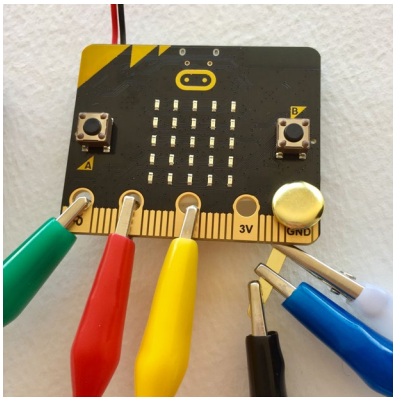
Once makers have successfully connected the speaker in Step 3, they can:

1. Explore remixing the code.
2. Add buttons with the speaker connected.

If makers choose to remix the code, they should connect the Micro:bit to the computer and explore remixing or creating new MakeCode projects with the remaining time.



If makers choose to add buttons with the speaker connected, they should extend GND with foil or paper fastener so they can connect 3 alligator clips to it.



Makers can also experiment with using different buttons and switches (**locking**, **momentary**, and homemade) with their

projects. Some examples of homemade switches are shown here.

1. Using 2 pieces of foil with a metal object that bridges the circuit:



2. Making a pushbutton with foam or cardboard:



3. Using aluminum foil on fingers or hands to make a wearable switch:



STEP 4**Share and reflect.**

Give makers 10 minutes to present either as a whole group, gallery walk style, or in small groups.

Ask them to share:

1. How is the UI/UX of the project? Is it easy and fun to use?
2. What would you want to change if you had more time?

STEP 5**Clean up.**

Makers will:

- Save their file (using unique names) on to USB flash drive.
- Safely disconnect the Micro:bit from the computer.
- Put materials away in their bins.
- Put away technology and make sure laptops are charging.
- Return tools and materials that can be used again to the right place.
- Clear tables of garbage and recycling.

TROUBLESHOOTING TIPS

The board isn't showing what we coded.

File version check

- Check to see that you've uploaded the most recent copy of the code.
- Resave the latest version and drag and drop onto the Micro:bit.

The code isn't doing what we expected.

Check for bugs

- Read through the code.
- Read it out to a friend.
- Check to see if there are extra blocks that aren't supposed to be there.

The LED on the Micro:bit is not flashing when we click Upload.

Bad cable or port

- If the Micro:bit isn't showing up in the computer menu, try a different cable.
- Try a different USB port on the laptop.

Our code isn't uploading correctly to the board. The board feels hotter than usual.

Burnt board

- Try pressing the reset button on the board.
- Try uploading to a new Micro:bit board.

The board isn't turning on when connected to the battery pack.

Battery

- Check the batteries to see if they're charged.
- Check to see if the batteries are flipped.

We have alligator clips connected to the board, but the code isn't running.

Alligator clips

- Make sure alligator clips are secure on the correct pins and are touching the metallic parts.
- Try switching alligator clips.

It's hard to keep the connections in place.

Alligator clips

- Use painter's tape to hold alligator clips in place.
- Try using foil to extend the metal parts of the board.

TROUBLESHOOTING TIPS

Print and use the empty rows to fill in with other problems and solutions that can be shared.

[illegible]