WEEK ONE: EXPLORING CIRCUITS

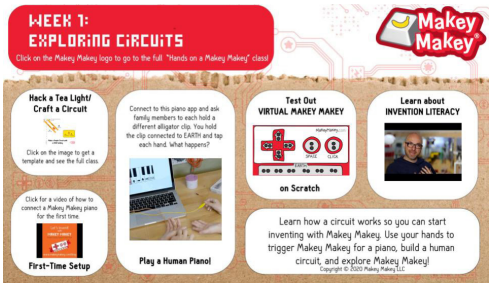
We recommend combining these first two lessons to drive home the idea that a Makey Makey is a way to complete a circuit. This will help students with inventing in later projects.

Lesson One Objectives: Craft a Simple Circuit

- Learn how to craft a simple circuit
- Learn how Makey Makey works by completing a circuit
- Learn how humans can connect to make a key press on a computer
- Make observations about other materials that can complete a circuit

Lesson Two Objectives: Hands on a Makey Makey

- Make a simple sketch of Makey Makey
- Use hands to trigger piano notes
- Build a human circuit
- Play and explore with Makey Makey



Use this interactive Google slide in your classroom: https://bit.ly/MakeyClassroomSlides.

LESSON ONE: CRAFT A SIMPLE CIRCUIT (30 MIN.)

Overview of Activity

In this 30-minute activity, students will craft circuits with foil, LEDs, and a battery. They can hack a tea light candle for all these parts! By taking apart a common object and building their own circuit, students will begin to grasp the idea of Invention Literacy. If students have never built a paper circuit, this lesson walks them through crafting their first circuit. In the coding world, we like to say, "Hello, World!" with our first line of code. With paper circuits, we say, "Hello, Light!" Download the template and follow along (http://MakeyMakey.com/LessonOne).

Before You Begin

This class is optional, but it is a great way to teach students about circuits. Make sure you have enough of the required materials, plus extra foil (or copper tape, if you are using it), as kids are sure to make mistakes and require extra materials. Set aside enough tape or foil for each student to craft a circuit. **Teacher Tip**: Tell students ahead of time that copper tape is costly. You don't want to overspend when creating or crafting circuits! For this reason, you can supplement with foil and let students cut their own circuit tape; they could even cut it curvy or with different shapes if they would like.

Required Materials

- Downloadable Template (PDF) (http://bit.ly/MakeySimple)
- 3 V coin cell battery
- 3 mm or 5 mm LEDs
- Aluminum foil
- Makey Makey Classic

Video Options

- Craft a Foil Circuit: http://bit.ly/MakeyFoilCircuit
- Hack a Tea Light : http://bit.ly/HackTealight

Student Build Guide:
www.MakeyMakey.com/LessonOne

Print this QR code for students to scan:

TEACHING GUIDE FOR LESSON ONE

VOCABULARY COVERED IN THIS LESSON

Simple Circuit: A circuit is a closed loop that allows current to flow. In our simple circuit, the electrons flow from the battery, up through the LED, and back to the power source. A closed circuit requires a conductive path, a power source, and a nonconductive area. You can open and close a circuit; we will learn more about this in the next few lessons!

Short Circuit: Electrons are lazy! If they can skip ahead, they will. Your electrons will skip the LED if they can find a conductive path around it! When using Makey Makey, the most common short circuit is the wires connecting or alligator clip heads touching.

Polarity: There are two types of poles in electricity: a positive (+, cathode) and a negative (-, anode). Some electrical components have specific polarity requirements. For instance, an LED will only light up if you have wired the polarity correctly to your power source, whereas some motors do not require a specific current direction and will power either way you hook them up. Instead, the way you hook it up will change the direction of the spinning motor!

LED: An LED is a light-emitting diode. That means it is a particular type of diode that converts electrical energy into LIGHT! You are surrounded by LEDs. Can you think of things in your house that have LEDs inside that create a light source?

RUNNING THE ACTIVITY: PAPER CIRCUITS IN THE CLASSROOM

Main Activity (30-45 min.)

Today, students are creating a circuit (a closed loop that allows current to flow and light up an LED, power a motor, etc.). Make sure each student has a battery and an LED to start.

Ask students to see if they can create a loop with just the LED and battery. (Usually, a few students are confused by this, but a few will pop the LED on the battery and have light instantaneously!)

Once most students have success with the LED and battery, explain how the LED has a specific polarity and that the long leg is the positive leg of the LED and needs to connect to the positive side of the battery. Then explain that the loop is completed by connecting the short leg (the negative side) to the negative side of the battery. Share with students that electricity is lazy! If it can find a way to close the loop before lighting the LED, it will, and this is called a short circuit. When we are using Makey Makey, sometimes we will experience a similar short circuit. In the case of Makey Makey, you might have accidental key presses if the alligator clip heads are touching. Hand out foil and the Simple Circuit Template (http://MakeyMakey.com/LessonOne).

PAPER CIRCUITS IN THE CLASSROOM CONTINUED

During today's activity, students are going to extend the wiring of the LED legs by using foil to make a circuit on paper. If the two strips of foil that lead to the LED touch, then electricity will not flow through the LED (this is a short circuit). Share a working example of a paper circuit and explain that all this knowledge is required to understand how Makey Makey works!

For a Makey Makey circuit, students will need a positive input (this is the key press) and a negative input (this is the EARTH input). You need both inputs to complete a circuit and close the loop to send a signal to the computer.

Give students time to make a circuit on the template. Encourage students to ask for help from shoulder buddies if they get stuck. Remind students that if they have trouble, they can "debug" their paper circuit, much like they would debug code in a computer program. They may have to tinker to problem solve why their LED is not working.

Teaching Tips

Teaching students how to craft paper circuits takes patience and listening ears. If you can, it's best to teach this activity in small groups of four to five students. If it is possible, host four to five different circuit station activities with an expert at each station to help students. To do this, you might teach a small group of students beforehand how to complete and lead each activity at each station. Then during class, each small group will be led by a student leader! Here are some other circuit stations you could use during this class (http://bit.ly/MakeyCircuitStations).

You'll also want to make sure students know that only the top of the foil will be conductive once they use a glue stick to adhere the foil to the paper. (The glue stick might be conductive while it is moist, but once the glue dries, it will act as an insulator!)

One of the best things about teaching paper circuits is that you will give kids clear directions, but students often have to tinker to get their paper circuit working. Tinkering to problem solve will help your students learn, through hands-on making, how a circuit actually works. So make sure to let them tinker and try to solve the problems on their own!

TROUBLESHOOTING TIPS

It is important to note that electrons are lazy, and if they find an easier way to close the loop, it will short the circuit and the LED won't light up! So this means if students are having trouble lighting an LED with this simple circuit template, they might want to review this list:

- Does the positive circuit trace ever come in contact with the negative circuit trace? Make sure to leave a gap under your LED. (If your positive trace goes directly to your negative trace, then the electrons will not be forced THROUGH the LED.)
- Do the circuit traces accidentally touch where you've made your battery connections?
- Is your LED wired correctly?

Wrap-Up of Paper Circuits Activity: Discuss a Makey Makey Circuit

To wrap up the class, tell the students how a Makey Makey circuit works and explain that they will get hands-on with Makey Makey in the next class.

The great news is that when you Makey Makey a circuit, you don't have to worry about polarity, and you only have to have two conductive items and something that bridges that circuit to make the circuit a closed path. For example, one person can hold an EARTH wire and another person can hold a KEY PRESS wire, and when they fist-bump, it will complete the circuit and activate the Makey Makey. Alternatively, if one person holds both wires, the loop will always be closed and the circuit always complete! In the next class, you will create circuits using your hands and Makey Makey.

Extensions

- Make a Circuit with Makey Makey (http://makeymakey.com/LED)
- What Will Makey Makey My Heart Light Up? (http://makeymakey.com/Valentine)

LESSON TWO: HANDS ON A MAKEY MAKEY (15 MIN.)

Overview of Activity

In this 15-minute activity, students will learn how Makey Makey works so they can start inventing! Students will make a simple sketch of Makey Makey, use their hands to trigger Makey Makey like a piano, build a human circuit, then play and explore with Makey Makey.

Before You Begin

Before even alligator clipping, it's great to get some hands-on experience with Makey Makey. This will help students cement the idea that they need two connections (an EARTH and a KEY PRESS) for building their circuits

Purposes/Objectives

Students will do the following:

- Make a simple sketch of Makey Makey
- Use hands to trigger piano notes
- Build a human circuit
- Play and explore with Makey Makey

Required Materials

- Makey Makey
- Family members
- Student Guide: http://makeymakey.com/LessonTwo

Video Options

- Invention Literacy with Jay Silver (http://makeymakey.com/InventionLiteracy)
- First-time setup and connecting to apps (http://bit.ly/MakeyBanana)

Student Build Guide:
www.MakeyMakey.com/LessonTwo
Print this QR code for students to scan:

TEACHING GUIDE FOR LESSON TWO

RUNNING THE ACTIVITY:

Main Activity (15-30 min.)

Sketch It! The best way to learn to use Makey Makey is with some hands-on experience—literally! Ask students to get Makey Makey out of the box, look at the front and back, and even draw it on a piece of paper. The experience of drawing it will help them know where all the inputs are located.

Plug It! Show students how to plug in the USB, open the Makey Makey piano, and use their hands to trigger the piano keys. If students need more visual help, then have them check out this guide for the first-time Makey Makey setup. (https://makeymakey.com/LessonTwo)

Show students how to hold **EARTH** and use their other hand to press inputs. We suggest also showing this while having problems not making a connection because you haven't plugged in the USB or have dry hands—just to show them you can make a really simple mistake and to help them brainstorm what they need to check if it doesn't appear to be working. Make sure they know that if their hands are too dry, it will impact their conductivity. Ask students to open makeymakey.com/apps and pick an app. When the page loads, they can hold **EARTH** and tap on the **Arrow Keys** to control the app.

Wrap-Up: Play It! After using the hands on method, show students how they can extend the connections by adding alligator clips to Makey Makey. They will need one clip connected to **EARTH** along the bottom row and then add alligator clips to the **Arrow key** inputs and **Space** to control our new apps. The other end of the alligator clip needs to be clipped to something with some conductivity like paperclips, bananas, or lemons. This video reference is a great guide: (https://makeymakey.com/HandsOnApps)

They can even build a human piano with other students. For instance, individual students can hold an alligator clip connected to an **Arrow key** input, and the main player will hold an alligator clip connected to the **EARTH** input. Now the player can tap each person's hand like their hand is a piano key!

Teaching Tips

Students love exploring with Makey Makey for the first time. It's always magical to tap a banana to play a piano. It's a great hook to engage them, but don't stop there! Let students play with materials to find out what is conductive, and show them how to write code in Scratch and control their own inventions. Open the door to all the possibilities by letting students be inquisitive and curious.

TROUBLESHOOTING TIPS

- Is the small end of the USB (red cable) plugged into the Makey Makey?
- Is the wide USB-A end of the red cable plugged into the computer?
- When the USB is plugged in, all the LEDs on the front of the Makey Makey should flash.
- When Makey Makey is plugged into the computer, it should have a red light on the back showing that the power is on. Is it lit? If not, something is wrong with the computer, the USB cable, or the circuit board.
- When students hold EARTH and press on a key press input, they should see an LED light up on the front of the Makey Makey.
- Does the student have dry hands? Try using lotion to moisturize!

MORE RESOURCES ! STAY CONNECTED!

Our team is constantly updating and sharing new ideas on our how-to page (makeymakey.com/howto) and hosting webinars with educators just like you! Sign up for our newsletter to learn more ways to go beyond the banana!

- **How-To Page:** https://makeymakey.com/pages/how-to
- **Resources for Beginner and Intermediate Inventors:** https://bit.ly/MakeyAtHomeProjects
- **Information about Webinars and Teacher Projects:** https://makeymakey.com/blogs/blog
- **Sign Up for Our Newsletter:** http://bit.ly/makeysignup
- **Join Our Facebook Educator Group:** https://www.facebook.com/groups/makeymakeyeducators/

EMAIL

Placing an order for your school or classroom?
Education orders: education@joylabz.com

Interested in carrying Makey Makey in your store?
Retail orders: sales@joylabz.com

Have a question about an event? A project you want to bring to life?
General inquiries: info@joylabz.com

Having issues with your board? Have a tricky technical question?
Tech support: support@joylabz.com

Have a question about ordering, or about an existing order?
Orders and shipping: support@joylabz.com

PHONE

You can reach us Monday - Friday, 9:00 - 5:00 (US Pacific Time) at: +1-831-460-6242
If you don't get an answer right away, shoot us an email.

THE INTERNET

We're on social media! We love to see you there and the things you invent. Tag us and send us your students' creations on:

Facebook.com/makeymakeykit

Twitter.com/makeymakey

Instagram.com/makeymakey

Youtube.com/c/makeymakey

