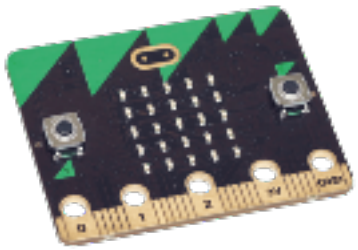
ROGERS CODING & COMMUNICATIONS CHALLENGE



LESSON GOAL

In addition to an introduction to the exciting Micro:bit, students will also have an opportunity to experience a brief history of telecommunications by creating their very own wireless communication device.

We are happy to announce a partnership with Rogers Canada to provide the series of activities below. Students are required to demonstrate their STEAM knowledge while coding and prototyping a new wireless communication device.

WANT TO JUMP DIRECTLY TO THE CLASSROOM CHALLENGES? TURN TO PAGE 5.

MATERIALS

- Set of three (3) Micro:bits complete with micro USB connections for transferring your code and battery packs
- Set of three (3) Micro:bit compatible buzzers

GRADE LEVEL

Grade 3 Invisible Forces
Grade 4 Light and Sound
Grade 6 Electricity and Space
Grade 9 Electricity and Space
Grade 11 Physics and Waves

SUBJECT AREAS

Elementary Science
Middle Science
Physics
Mathematics
Language Arts

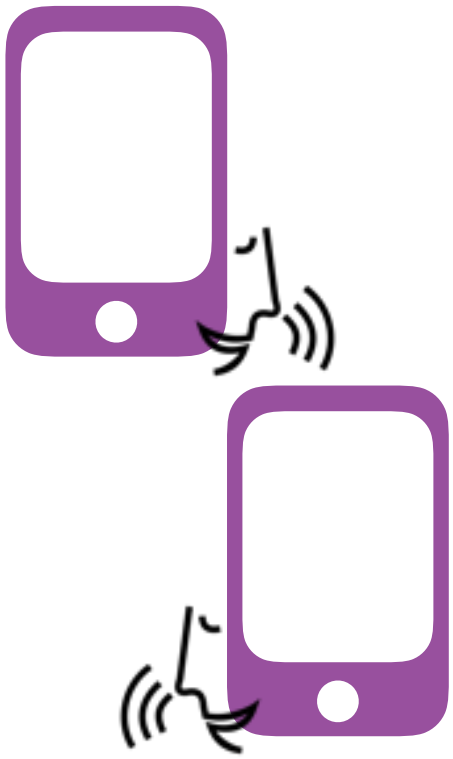
LESSON TIMELINE

- WATCH BL INTRO VIDEO HERE (INSERT LINK)
- EXPLORE TELE-COMMUNICATIONS HISTORY WITH STUDENTS
- TRY THE FIRST CHALLENGE TOGETHER
- INSPIRE STUDENTS TO TRY THE OTHER CHALLENGES
- REACH OUT TO US FOR MORE HELP.
- SHARE YOUR MICROBIT CREATION WITH US! VISIT RILLIANTLABS.CA FOR MORE INFO.

Ted Rogers Scholarship Fund

WE ARE INCREDIBLY THANKFUL TO HAVE PARTNERED WITH THE TED ROGERS SCHOLARSHIP FUND FOR THIS CHALLENGE.

INTRODUCTION



Many of us carry an amazing piece of technology with us wherever we go without even thinking twice about how it works. We depend on it to stay connected, for entertainment or for researching the answers to some of the questions that may come up throughout the course of the day. Of course, I am talking about our trusty cellphones or smartphones. Cellphones have become a major part of our lives over the last decade but most of us don't fully understand how this wireless piece of technology can connect with the world so easily.

Though it is a very complicated process, if we were to simplify it, we can think of a cellphone as a two-way radio consisting of a radio transmitter and a radio receiver. When you talk with your friend your voice is converted into radio waves that are sent to the nearest cell tower. This signal is then passed along the network of cell towers to the tower that is closest to your friend and transmitted to their phone. Their phone then takes this radio signal and converts it back into sound again so that they can hear your voice. The same thing happens when you are sending data through your phone in the form of texts, photos and so on. Having it explained like that makes it sound kind of simple, but there is a lot more going on there. So let's break it all down a bit more.

Let's start out with the actual cell tower itself. All of us have seen cell towers around our communities and along the highway. They are those big metal structures with lots of antennas on the tops of them. Your phone is always aware of the nearest tower and is always trying to make sure that its signal strength is as high as it can be. We can see signal strength in the form of the number of bars at the top of our cellphone screen. The more bars we see, the greater the signal strength (the more towers your phone can pick up on or the closer you are to the nearest tower).

INTRODUCTION

One cell tower can only handle so many signals (phone calls) at the same time. To make sure that they can handle the demand, cellular providers, like Rogers, must take many factors into consideration such as:

- ***Topography (the layout of the land)***
    - We typically see towers on the top of a big hill. Why do we think that is? Because the higher it is, the less objects are in the way of the signal transmission.
    - We typically see towers on the top of a big hill. Why do we think that is? Because the higher it is, the less objects are in the way of the signal transmission.
- ***Population Size (the # of people that live in an area)***
    - We typically see more cell towers in more populated areas. Why do we think this is? Because more people means that more cell phones need access to the network which means more towers are needed to support the demand.
- ***Transmission (how your call is sent to your friend)***
    - Depending on if your friend lives in the same area as you, in the same country or in another part of the world, the signal that leaves your phone can travel wirelessly from tower to tower, through fiberoptic cables, or even get bounced off satellites.

INTRODUCTION

SO, WHAT HAPPENS WHEN YOU MAKE A CALL?

Your phone sends out a radio signal.

The nearest tower picks up that signal and sends it through fiberoptic wires or wirelessly to another tower.

That second tower then transmits the signal to the receiving cell phone.

CAN WE RECRECREATE THIS PROCESS IN THE CLASSROOM?

Well, we don't have access to cell towers or fiberoptic cables but we can simulate this process using the ever versatile Micro:bit.

Follow the links below for a thorough introduction to the Micro:bit and its capabilities as well as an overview of the MakeCode interface (www.makecode.com).

The Micro:bit Up Close with Kayoe on the Go (https://youtu.be/MEV9t9NWaIk)

The MakeCode Interface with Kayoe on the Go (https://youtu.be/_88kHi_NLog)

INSTRUCTION

After a quick introduction to the Micro:bit, let's see if we can use it to communicate and send secret messages. The following is a list of challenges to help you and your students build fully functioning communication devices using the Micro:bit.

The purpose of these challenges is to help you facilitate the discovery of the capabilities of the Micro:bit. Although it may be tempting to help your students out by revealing the answers, it is our intention that this activity is implemented based on inquiry. The images and videos provided here are intended for you, as the educator, not your students. Use these resources as tools to help you better understand the mechanics of the code.

The challenges progress in complexity and difficulty – we encourage you to try to complete all 6 of them with your students but you are the best judge of their capacity, time needed, etc. The challenges are achievable by all grades yet can include more in-depth involvement for the upper grades. Simply push through knowing that your class will strive to complete challenges 1-5 and even 6 (ie. advanced) if your students are progressing well.

CHALLENGE 1

20 MIN

DISPLAY A MESSAGE ON THE LED SCREEN

Step one in this exercise will be to see if we can display a message on the LED screen so that we can send secret messages to our partner. Challenge your students (working in pairs) to see if they can display a message on the LED screen forever. To help you guide them to a solution refer to the screen shot below.

CHALLENGE PREVIEW

1
DISPLAY A MESSAGE ON THE LED SCREEN

2
MAKE SOUNDS WITH A BUZZER

3
USE INPUTS TO MAKE SOUNDS

4
USING A CONDITIONAL STATEMENT, CREATE YOUR OWN LANGUAGE

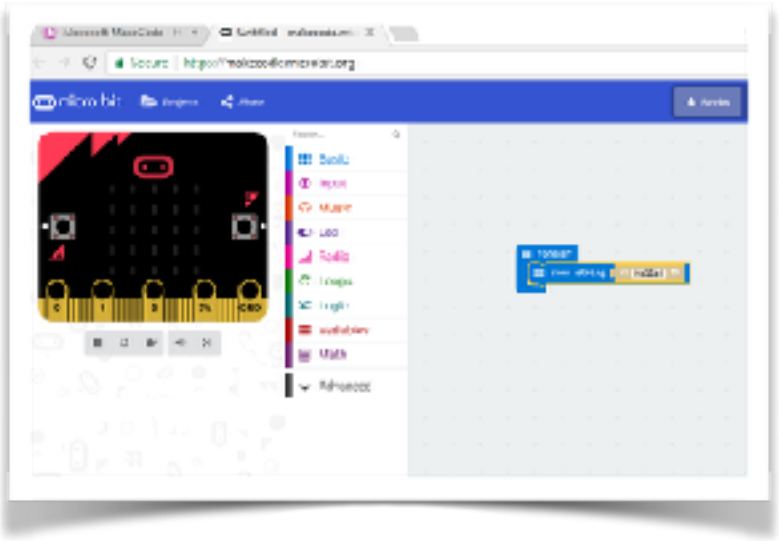
5
TWO-WAY WIRELESS CONVERSATION

6
ADVANCED! RELAYING THE CONVERSATION

CHALLENGE 1

Again, we encourage you to not provide them with the answer, but to help your students to discover a possible solution to the challenge. Have the group use the visual simulator on MakeCode to test their code and to fix any bugs before downloading it to the device. Encourage them to get creative with the message or image they choose to scroll or display on their device.

After everyone has successfully coded their device to display a message or image, open a discussion on how this new skill can help you in using the Micro:bit to communicate. Facilitate a discussion about how messages could be displayed that someone else could read.



TRY REPLACING “HELLO!” WITH YOUR OWN TEXT.

CHALLENGE 2

40 MIN

MAKING SOUND

After mastering using the on-board LED screen we can move into experimenting with sound. The MakeCode interface has a section called “music” where, you guessed it, any blocks that are associated with sound can be found.

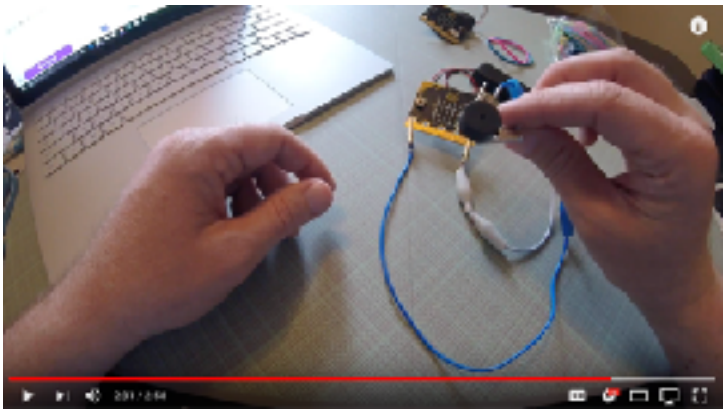
with the MakeCode visualizer and experiment with some of the sound functions. Allow them to discover that whole melodies or single notes can be played. When playing single notes allow them to see that the duration or number of beats can be modified as well.

As we already know, the Micro:bit doesn’t come with an on-board speaker. So, we must add one in order to make some noise. When they are adding sounds to their code, your students may also see that the visualizer is now showing how to hook up a speaker or buzzer using alligator clips so that they can hear the sounds.

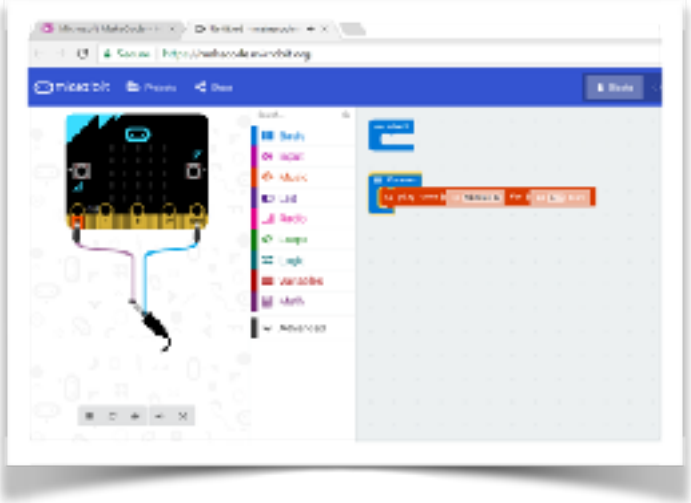
CHALLENGE 2 CONTINUED

Have your students refer to this setup and connect their speaker to their device. If they need a little bit more help, the video below is pretty good at explaining how to connect a sound device to the Micro:bit.

Open a conversation about how sound relates to how people communicate. How is sound important in how we communicate?



Piezo Speaker with Kayoe on the Go
(https://youtu.be/ZLBq9sPRGfo)



in how we communicate? Can you think of any examples where we rely on sound to express ourselves? Encourage your students to think outside the box. Not only do we rely on the transmission of sound for phone calls but also through video, music and many other mediums.

CHALLENGE 3 40 MIN

PLAY SOUNDS WITH INPUTS

Up to now we have been making our Micro:bits display messages and play sounds. But wouldn't it be nice if we could tell our device when to play these sounds? Much like how a phone only passes your voice down the line when you speak, it is always more useful if we can tell our device when to send these messages. The Micro:bit has many different types of "inputs" that can be used to activate something like a sound coming through a speaker.

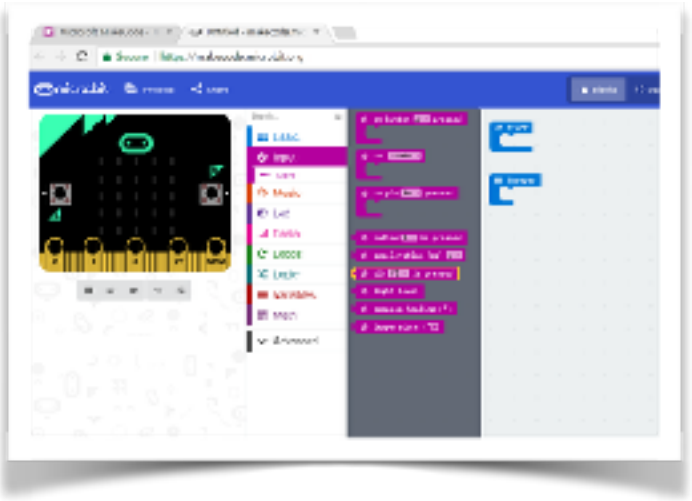
CHALLENGE 3

CONTINUED

Through these inputs we can now tell our device to play sounds when we want (for example, when a button is pressed). This is much more practical if we want to create a device that we can use to communicate with others.

Have your students experiment with the input section and assign an input to the sounds that they had been playing with in the previous challenge.

Open a discussion on how important it is to be able to control what messages you send out to someone. Imagine if your cell phone always sent everyone a certain emoticon. Doesn't it make more sense to be able to choose who you send which emoticons to?



CHALLENGE 4

40 MIN

USING CONDITIONAL STATEMENTS

We are doing great so far. Up to now we have been able to code our Micro:bit to display images and make sounds whenever we want (i.e. when we press a button). But if we look at the Micro:bit we can see that there are many inputs that we can use. Probably the most obvious of these inputs are the two buttons on the front.

What if we coded our device to play different sounds or display different images depending on what input we are activating? For example, your device could play the high C note when the A button is pressed or the low C note if the B button is pressed.

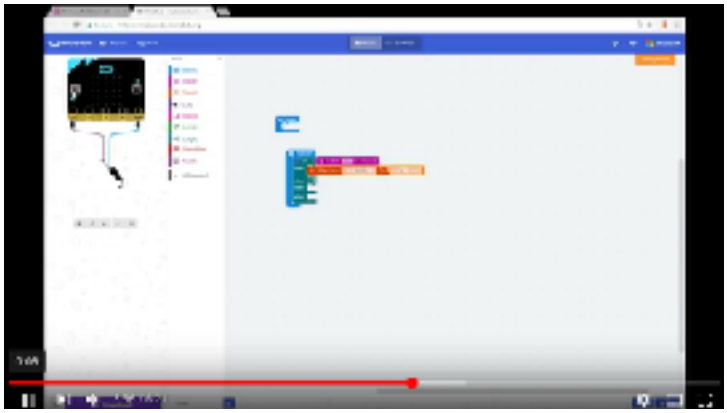
CHALLENGE 4 CONTINUED

If we code our device to do this, we could maybe use it to send and receive messages using a secret code.

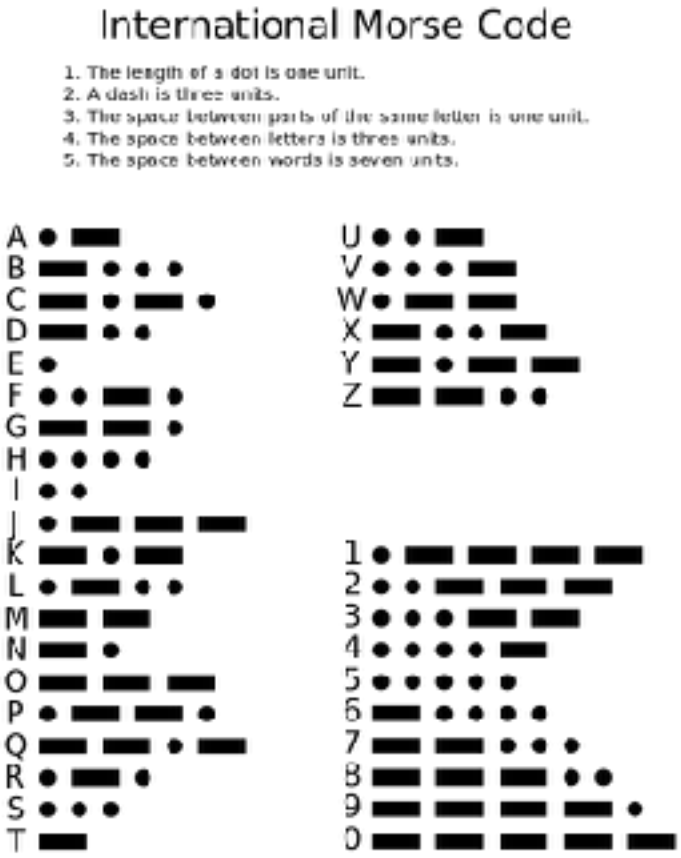
Morse code is a very good example of how people used to communicate over long distances by sending sounds through a wire to a receiving device. In the case of Morse code, we use patterns of long and short sounds (dots and dashes) to represent different letters and can build messages by representing the words using these dots and dashes.

Challenge your students to modify their code, using what is called a conditional statement, so that their device can produce two distinctive sounds (modifying the beats or the note) and have these two sounds connected to two separate inputs. Refer to the instructional video to your right, on conditional statements to help prepare your students for this challenge.

Feel free to show them a Morse code chart as an example of how we can use two sounds to communicate anything we want. Encourage them to get creative with this experiment. They can come up with their own code, play with the many unique sounds that the Micro:bit can produce. Again, they should be testing and debugging in MakeCode before they download to their device. Once they are happy with their code they can download it and experiment with their secret language. Challenge them to send each other messages using their newly coded communication device. When multiple groups have completed their device, challenge them to try to decipher each other's secret message and pick out the patterns.



Use this video to help with conditionals. (https://youtu.be/V1gzZOvRHGk)



(PHOTO COURTESY OF WIKIPEDIA.COM)

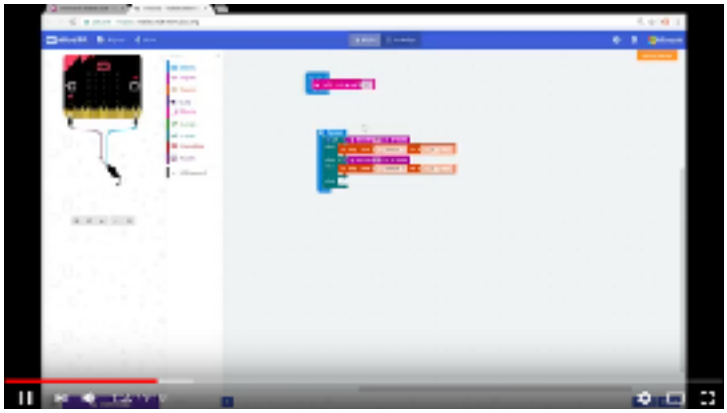
CHALLENGE 5

40 MIN

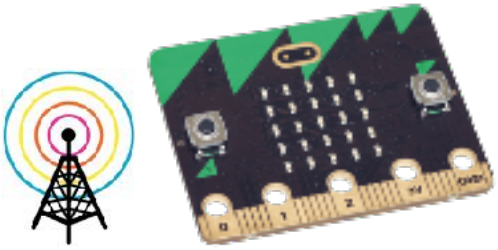
TWO-WAY WIRELESS COMMUNICATION

We now have a device that can produce two different sounds and have developed our own secret language that we can use to communicate with each other. We are getting closer to creating a device that we can communicate with. Wouldn't it be great though if we could wirelessly send and receive the same coded messages from one Micro:bit to another? If we could do this, we would be getting closer to what a real phone conversation is like. Lucky for us we can do this with the Micro:bit using the "Radio" function.

Refer to the example in the video to your right as your guide and challenge your students to code two Micro:bits so that they can communicate wirelessly. As an added challenge, students could combine sounds with visuals and use the LED screen to display an image as well. Making your own code that only the two of you know how to read is kind of like what happens when you make a cellphone call. Your cellphone chooses a specific radio signal to use to make the call and no other cellphones can use that signal while your phone uses it. This helps make your phone conversation private.



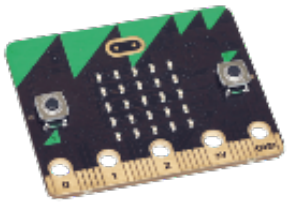
Learn more about Radio Signals with this video. (https://youtu.be/ig86L0aa25s)



YOU'RE ALMOST DONE!
THE NEXT CHALLENGE IS A DOOZY. FEEL FREE TO REACH OUT TO US FOR HELP.

ADVANCED CHALLENGE

RELAYING THE CONVERSATION



Getting your devices to communicate is only part of the equation though. We usually don't have to use a cellphone to talk to our friends if we are in the same room! Do you think that you could still use the same two Micro:bits to talk to your partner if you were in different classrooms? Try it out.
No such luck I guess. Why can't you send signals to your partner if they are in another classroom? There are a couple of things that could be affecting how well you communicate in this scenario. First, there could be objects like walls blocking the signal or the distance between the two devices might be too high. You can also take your Micro:bits outside and try testing their range. Try sending signals to each other as you slowly walk away to see how far you can be before you can't send a receive messages.

So obviously we have a couple of constraints with our set up. In order for two Micro:bits to send and receive messages they have to be able to see each other and be close enough together.

Let's see if we can use a third Micro:bit placed in a strategic position between the two original devices to help boost the signal and pass it along down the line. Doing this may help your Micro:bits send and receive messages even though they are either too far from each other or there are walls in between them. You will most likely have to code this third Micro:bit differently than your first two so that it can relay your messages down the line for you.

This relaying of your conversation from one device to the next down the line to the other person is similar to what happens with cell towers. When you make a call, the cell tower closest to you receives the signal from your phone and passes it along through the network of towers until it reaches the tower that is closest to your friend. Finally, the signal is sent from this last tower to your friend's phone so that they can hear your voice.

SUMMARY

PHEW!

If you have made it this far, you are officially a Brilliant Micro:Bit expert.
We hope that you have enjoyed this throwback to the yesteryear of telecommunications. The Micro:Bit offers a great introduction to wireless communications through code. However, there are even more capabilities of the Micro:Bit that we have yet to explore. For instance, you can attach any Arduino sensors or even Neopixel lights. Maybe you want to use a pH soil sensor and output that reading to a string of Neopixel LEDs, or even an emoji that lets you know if your plants require more water.

The Micro:Bit may seem simple, but the logic you have used to code throughout this lesson is very similar to the code that career oriented computer programmers use to create devices as simple as a toaster to as complex as a self-driving car.

For more information on getting started with the Micro:Bit, we encourage you to check back with Brilliant Labs (www.brilliantlabs.ca) as well as some of our favourite resources below.

MICRO:BIT RESOURCES	
http://learn.adafruit.com	http://microbit.org
http://blog.pimoroni.com	http://microbit.org/teach/
https://www.kitronik.co.uk/microbit.html	https://makezine.com/category/technology/

LEARNING IS A TEAM EFFORT

THANK YOU TO OUR TEAM WHO MAKES YOUR BRILLIANT LEARNING OUR REALITY.

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