Phenomenon

What do you notice or observe?

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What questions do you have?

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What question has your class decided to answer?

____________________________________________________________________
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## OWL Tracker

### Driving Question:

<table>
<thead>
<tr>
<th></th>
<th>Observe</th>
<th>Wonder</th>
<th>Learn</th>
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<tr>
<td><strong>Discovery 1:</strong></td>
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<tr>
<td>How can we use sound to send messages?</td>
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<td><strong>Discovery 2:</strong></td>
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<td><strong>Discovery 4:</strong></td>
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<tr>
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<tr>
<td><strong>Discovery 5:</strong></td>
<td></td>
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<tr>
<td>What is the future of long-distance communication?</td>
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</tbody>
</table>

### Driving Question Response:

Name: _____________________________
Using Technology:

Take five minutes to look at the front and back. Share your observations aloud with your classmates.

- What parts do you notice?
- What about the micro:bit looks interesting to you?
- Does this technology look similar to anything you’ve used before?
- How is it different or unique from other kinds of technology?

Now that you’ve pondered on your own, let’s officially learn the different parts of this new technology.

What is the micro:bit?
- The BBC micro:bit is a handheld micro-computer.
- In this module, we will program the micro:bit to become a long distance communication device.
- In each Discovery of this module, we will learn to use a different function of the micro:bit.
The Microsoft MakeCode editor makes it easy to program your micro:bit with blocks.

Step 1: Go to MakeCode for micro:bit
https://makecode.microbit.org/#

Step 2: Open a New Project by clicking on New Project in MakeCode

The simulator provides a real-time option if you do not have the hardware. The virtual micro:bit will display your program and you can see how the changes you make in real-time.
Step 3: Locate the blocks you need
- Find the [Show String "Hello!"] block from the blue basic tab.

Step 4: Grab the block that you need, drag and drop the block into the correct location.
- Drag the [Show String “Hello!”] block into the [Forever] block.

Step 5: Check the code in the simulator.
- Look at the simulator. It will automatically run your code.
- The micro:bit simulator shows you what your code will do when it is downloaded to a real micro:bit.

Your “Hello” code should look like this:
Let’s Analyze the Code

Step 6: Analyze the code
- The [Show String “Hello!”] block will scroll the text “Hello!” across the LED screen.
- The [Forever] block makes whatever is inside the Forever block appear continuously. In this case, “Hello!” will scroll across the screen over and over.

![Show String Block]

Let’s Download the Code

Step 7: Connect the micro:bit to your computer with a USB cable. The microUSB port is on the top of the micro:bit.
- On the purple Download button, click on the three dots to the right. Choose “Connect to Device” and make sure your micro:bit is connected to the program.
- Next, click the purple Download button. The file will automatically be sent to your micro:bit.

The code is now downloaded to your micro:bit!

To use the micro:bit away from your computer, disconnect the micro:bit from the USB cable and connect the battery pack.

DID YOU KNOW
It is a tradition that the first program used is “Hello, World”.
https://en.wikipedia.org/wiki/%22Hello,_World!%22_program
Discovery 1
How can we use sound to send messages?

What do you see in the picture?

________________________________________________________________________

________________________________________________________________________

What questions do you have about this picture?

________________________________________________________________________

________________________________________________________________________

Do you think it is possible to communicate with someone using only a drum?

________________________________________________________________________

________________________________________________________________________

After viewing the image, update the Observe and Wonder section of the OWL Tracker for Discovery 1: How can we use sound to send messages?
A drum makes noise by being ______________________________________________________________________.

What type of instrument is a drum? ______________________________________________________________________

How are drums usually played? ______________________________________________________________________

Do all drums make the exact same sound? ______________________________________________________________________

How long have drums been around? ______________________________________________________________________

Are all drums used just to make music? ______________________________________________________________________
TRY THIS: Drum Observation

1. Place a piece of plastic wrap tightly over the top of the cup.
2. Add a small pinch of sprinkles or small plastic beads to the center of the plastic wrap.
3. Clap near the cup, but do not touch the cup.
   a. What happened to the sprinkles or small plastic beads?
      ________________________________________________________________
      ________________________________________________________________
      ________________________________________________________________
      ________________________________________________________________
      ________________________________________________________________
   b. Why do you think this happened?
      ________________________________________________________________
      ________________________________________________________________
      ________________________________________________________________
      ________________________________________________________________
      ________________________________________________________________
5. Try singing a low note then a high note near the cup and observe what happens.
    ________________________________________________________________
    ________________________________________________________________
    ________________________________________________________________
    ________________________________________________________________
    ________________________________________________________________
    ________________________________________________________________
Now that you have watched how the sound affected the sprinkles or small beads, use this link to research how sound travels.

- **Designmate, "Science - Transmission of Sound"**
  [https://www.youtube.com/watch?v=GkNJuZINSEY](https://www.youtube.com/watch?v=GkNJuZINSEY)

What are **vibrations**? 

Sound waves are made up of vibrations. What did these vibrations cause the sprinkles or plastic beads to do in the above observation?

In the box below, sketch a model showing how **energy** is transferred from you clapping to the cup to the sprinkles or beads.
Using Technology to Produce Sound

In this activity, you will program the micro:bit to produce sound.

With new advances in technology, you can use the micro:bit instead of a drum to send messages using sound.

First, you will look at how to program the micro:bit to produce sound.

Create the Code

- Open Microsoft MakeCode Editor [https://makecode.microbit.org/](https://makecode.microbit.org/)
- Create a New Project and Name the Project Sound
- Drag and drop the [On Button A Pressed] Input block. The [On Button A Pressed] block will run the program one time when the A button is pressed.
- Click on the red Music blocks in the library, and scroll down to "Melody Advanced" options.
- Drag and drop the [Start Melody] Music block into the Input block.

- The [Start Melody] block will play the tune that you select from the drop down menu. Change the melody from "dadadum" to any choice.
- To play the melody that you have choosen in the simulator, remember this code is inside of an [On Button A Pressed] Input block. You will have to press button A on the simulator to hear the sound come from your computer.
- Notice that the simulator has wires attached to the micro:bit. These wires are needed to play music because the micro:bit does not have any speakers. We will need to attach ear buds to the micro:bit to hear the musical code play. You will learn how to do that once your code is downloaded.
Download the Code

- Connect the micro:bit to your computer with a USB cable. The microUSB port is on the top of the micro:bit.

- On the purple **Download** button at the bottom, click on the three dots to the right. Choose "Connect to Device" and make sure your micro:bit is connected to the program.

- Next, click the purple Download button. The file will automatically be sent to your micro:bit.

Think about how the micro:bit is able to produce sound.

Where is the energy coming from?

In this activity, the micro:bit converted electrical energy into what other type of energy?
Connect the Earbuds

In order to allow the energy to flow from the battery through the micro:bit to your ears, gather two alligator clips and a pair of earbuds/headphones to do the following:

- Connect one alligator clip to pin 0 on the micro:bit.
- Connect the same alligator clip to the tip of the metal part of the earbud.
- Connect the other alligator clip to GND on the micro:bit.
- Connect the same alligator clip to the base of the metal part of the earbud.

Listen to the Sound

Press the A Button to hear your secret coded message.

- Caution! The tone that is produced might be loud! Play it once without the earbud in your ear. If you can’t hear it, then place the earbud in your ear (or near).

Encryption

What is encryption?

- Encryption is the process of creating a secret code. A code replaces words with groups of letters, numbers, or sounds. A scientist that studies secret codes is called a cryptographer.

You can decide to allow a sound to mean something. What are some sounds that you hear everyday that have certain meanings?
What melody would you choose to represent different messages and why?

<table>
<thead>
<tr>
<th>Melody</th>
<th>Meaning/Represents</th>
<th>Why?</th>
</tr>
</thead>
<tbody>
<tr>
<td>dadadum</td>
<td>Example: Danger</td>
<td>Example: It sounds suspenseful.</td>
</tr>
<tr>
<td></td>
<td>Coming</td>
<td></td>
</tr>
</tbody>
</table>

What are some pros and cons to using melodies for encryption?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
Connect Back to the Discovery Phenomenon

Think back to the picture of the person playing a drum.

Watch the following video to find out how drums can be used to communicate.
- WorldMusic, "Talking Drum Demonstration"
  https://www.youtube.com/watch?v=CbMMw-88eT4

Are the drums only used for short distances? Why or why not?

What are some ways people can use sound to communicate?

Return to your Research Log and fill in the Learn section for Discovery 1: How can we use sound to send messages?
Career Connection

A cryptographer tries to figure out secret codes and determine what messages actually say. By understanding how things are encrypted, they can also help keep their companies information safe. They are constantly learning about new types of encryption.

Do you think that you could help encrypt messages?

What are the parts of this job that you find interesting?
Discovery 2
How do we use electricity to send messages?

What do you think is happening in this picture?

How many cables do you see?

Where do you think the power lines are going?

What questions do you have about this phenomenon?

Go back to your OWL Tracker and fill in the Learn section for Discovery 2: How do we use electricity to send messages?
Use the following video to research electricity
• EnergyNowNews, "Energy 202: Electricity Generation"
  https://www.youtube.com/watch?v=20Vb6hILO5g

Where does the energy needed to generate electricity come from?

The majority of America’s electricity comes from

Can large amounts of electricity be stored?

How is electricity transferred across long distances?

Once the electrical currents reach your house, what types of things do they help power?
The electrical energy from the power lines is transferred into different types of energy in our homes.

Circle the items below that use electrical energy.

The washing machine takes electrical energy and transfers it into what other type of energy?

____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
Now that you know how electricity gets to your house, how do batteries work?

- TED-Ed, "How batteries work - Adam Jacobson"
  [https://www.youtube.com/watch?v=9OVtk6G2TrQ](https://www.youtube.com/watch?v=9OVtk6G2TrQ)
- EXPLAINTHATSTUFF!, "Batteries"
  [https://www.explainthatstuff.com/batteries.html](https://www.explainthatstuff.com/batteries.html)

What materials were used in the first battery?

__________________________________________________________________________

What is the benefit of having a battery?

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

Without the discovery of batteries, what are some items would not be able to exist today?

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________
Batteries store electric energy. A battery was needed to develop a new type of long-distance communication called Morse code.

• University of Cambridge, "History of Morse by NRICH Team"
  [https://nrich.maths.org/2198](https://nrich.maths.org/2198)
• Concerning Reality, "How Does Morse Code Work?"
  [https://www.youtube.com/watch?v=iv8BaMsJU](https://www.youtube.com/watch?v=iv8BaMsJU)

What type of energy is needed to use a Morse code machine?

__________________________________________________________________________

__________________________________________________________________________

Why did Morse represent the letter "e" with only one dot?

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

How did Morse code improve communication over long distances?

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________
Make Your Own Morse Code Device:
In this activity, you will program the micro:bit to send a radio message to a partner in Morse code.

What is Morse code?
- Morse code is a type of electronic communication that uses dots and dashes to represent letters and numbers.

<table>
<thead>
<tr>
<th>Morse Code</th>
<th>Code the micro:bit</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Open Microsoft MakeCode Editor: <a href="https://makecode.microbit.org/">https://makecode.microbit.org/</a></td>
</tr>
<tr>
<td>B</td>
<td>Create a new project.</td>
</tr>
<tr>
<td>D</td>
<td>Set the radio group to 1.</td>
</tr>
<tr>
<td>E</td>
<td>Add a [Show String] Basic block to the [On Start] block.</td>
</tr>
<tr>
<td>F</td>
<td>Change “Hello” to say “Morse Code.”</td>
</tr>
<tr>
<td>G</td>
<td></td>
</tr>
<tr>
<td>H</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td></td>
</tr>
<tr>
<td>J</td>
<td></td>
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<tr>
<td>K</td>
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<td>M</td>
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<tr>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>Z</td>
<td></td>
</tr>
</tbody>
</table>
• Drag two [On Button Pressed] Input blocks to the coding workspace.
• Leave one block as value A and change the value in the second block to B.
• Drag a [Radio Send Number] Radio block and drop into the [On Button A Pressed] Input block.
• Drag another [Radio Send Number] Radio block and drop into the [On Button B Pressed] Input block.
• Leave the number value of the [Radio Send Number] block as 0 in the [On Button A Pressed] block.
• In the [On Button B Pressed] block, change the number value of the [Radio Send Number] block to the value 1.

![Diagram of coding workspace with blocks for On Button A Pressed and On Button B Pressed with Radio Send Number blocks set to 0 and 1 respectively.]

• Drag an [On Radio Received (receivedNumber)] Radio block to the coding workspace.
• Drag an [If...Else] Logic block to the coding workspace and place it in the [On Radio Received (receivedNumber)] Radio block.

![Diagram of If...Else Logic block triggered by On Radio Received (receivedNumber) with conditional logic set to true or false based on receivedNumber value.]
• Drag a [0=0 Comparison] Logic block into the coding workspace.
• Replace the value ‘true’ of the [If...Else] Logic block with the Comparison block.
• From the [On Radio Received (receivedNumber)] Radio block, pull down the [‘receivedNumber’] variable block and drop it into the first slot of the [If...Else] Comparison block. The yellow outline shows where your block will be dropped. in yellow and drop to replace.
  ° Note: You are not going to be getting this from the block library.
• Leave the right hand side value of zero in the 0=0 block.

![Diagram of Comparison block](image)

• Drag and drop a [Show LEDS] Basic block in the space after the “if. . .then” of the [If...Else] Logic block.
• Click on the blue squares to turn them white and create an image to represent a dot.

![Diagram of LEDS](image)

• Drag another [Show LEDS] Basic block and drop in the space after the “else” of the [If...Else] Logic block.
• Click on the blue squares to turn them white and create an image to represent a dash.

![Diagram of LEDS](image)
- Add a [Pause] Basic block below each [Show LEDs] blocks. To make the pause longer, click on the drop down arrow near the 100 to change the value to 500.
- Click on Basic and then select more to choose a [Clear Screen] block. Place one [Clear Screen] block after each [Pause] block.
Check Your Code:

- Test your code in the simulator. The words “Morse Code” will scroll across.
- When you press A on the top micro:bit, the second virtual micro:bit should display a dot. When you press B on the top micro:bit, the second micro:bit should display a dash.
Download Your Code:

- If your file still says Untitled at the bottom, rename the file to "Morse Code." Save the File.

- Click “Show File in Folder” or go to your Downloads folder. The file will display in your folder as a hex file.
Download Your Code:

- Connect the micro:bit to your computer with a USB cable. The microUSB port is on the top of the micro:bit.

- On the purple Download button, click on the three dots to the right. Choose "Connect to Device" and make sure your micro:bit is connected to the program.
- Next, click the purple Download button. The file will automatically be sent to your micro:bit.

Your teacher will send you a message using Morse code.

<table>
<thead>
<tr>
<th>Letter</th>
<th>Morse Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>⏯-</td>
</tr>
<tr>
<td>B</td>
<td>⏯-----</td>
</tr>
<tr>
<td>C</td>
<td>⏯-----</td>
</tr>
<tr>
<td>D</td>
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<td>⏯-</td>
</tr>
<tr>
<td>Y</td>
<td>⏯-</td>
</tr>
<tr>
<td>Z</td>
<td>⏯-----</td>
</tr>
</tbody>
</table>
Analyze the Code:

How did your micro:bit receive the message that your teacher sent?

Hint:

How can you and a partner send and receive messages that no one else can see?

Hint:

Challenge: What message did your teacher send you?

DID YOU KNOW

The Morse code signal for “Help” is “SOS”. This does not stand for any particular words. It was just a very easy to recognize group of letters that do not naturally mean anything.


In this activity, how does energy change forms?
Optional Morse Code Challenge

Work with a partner to send and receive a secret message in Morse code. Refer to the Morse code alphabet and press the A button to represent a dot and the B button to represent a dash.

Think:

How can you “listen in” on another group’s Morse code message?

Hint:

Go back to your Research Log and fill in the Learn section for Discovery 2: How do we use electricity to send messages?

CYBER POP OUT: Sensors

Electricity needs wires to travel through to reach your home. However, once the energy leaves a power plant, it is difficult to control how it is used, where it is sent, or problems along the way, such as a downed power line. Integrating sensors and monitoring devices throughout the network can greatly increase the efficiency of power distribution. This is called the smart grid. Watch the video below to learn more. Do you think there are any risks or problems with this type of system?

- Scientific American, “What is a smart grid”
  https://www.youtube.com/watch?v=-8cM4WfZ_Wg
Name: ______________________________

**Discovery 3**

What do you observe in the investigative picture above?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

What questions do you have about this situation?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

Go back to your OWL Tracker and fill in the Learn section for **Discovery 3: What is heat?**
TRY THIS: Friction Observation

1. Rub your hands together quickly.
2. What did you observe?

3. Why do you think this happened?
Use the following resources to answer the questions below.

- **Rader's Physics 4Kids.com, "Friction Basics"**

- **Merriam Webster Dictionary, "Friction Definition"**

- **Don't Memorise, "What is Friction?"**
  [https://youtube.com/watch?v=n2gQs1mcZHA](https://youtube.com/watch?v=n2gQs1mcZHA)

Friction is a force that does what? __________________________________________________________________________

How do you think this relates to machines?
________________________________________________________________________
________________________________________________________________________

How does friction affect a race car?

- **National Science Foundation, "Friction and Heat - Science of Speed"**
  [https://www.youtube.com/watch?v=T0mVBeYGco0](https://www.youtube.com/watch?v=T0mVBeYGco0)

What positive effect does friction have on a race car?
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

What negative effect does friction have on a race car?
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
Make Your Own Temperature Sensor

In this activity, you will program the micro:bit to detect heat produced by electricity using the internal micro:bit temperature sensor.

What is temperature?

- Temperature is a measurement of hot or cold. A thermometer is a device used to measure temperature.
- Temperature can be measured in Celsius, Fahrenheit, or Kelvin scales.
- The micro:bit can detect the current temperature of the micro:bit device in the Celsius temperature scale.

Code the micro:bit

Program the micro:bit to read the temperature of the micro:bit computer chip in Celsius after the micro:bit is shaken.

- Open Microsoft MakeCode Editor: https://makecode.microbit.org/
- Create a “New Project.”
- Drag the [On Shake] Input block to the workspace.

DID YOU KNOW

Only 10% of energy in a conventional light bulb is used to create light. Ninety percent of the bulb's energy creates heat.

• In the block library, select **Variables** and click “Make a Variable.”
• Name it ‘Temperature” and click Ok.

A variable is something that changes, in this case temperature. When you make a new variable, your code is telling the micro:bit to look for that change and remember it when you use that variable block.

• Drag the **set temperature to 0** Variable block and drop it inside the **On Shake** block.
• Select the **Temperature** Input block and drag it over the 0 until it is outlined in yellow and drop to replace.

• Select a **Show Number** Basic block and connect below **set temperature**.
• Find the rounded **Temperature** Variable block in the library and drag it on top of the 0 inside the **Show Number** block until outlined in yellow and drop.

**Analyze the Code**

• **[On Shake]** Input block – program will not run until the micro:bit is shaken.
• **[Set (temp)]** Variable block – sets the variable “Temperature” to read the temperature of the micro:bit processor chip in **Celsius** degrees
• **[Show Number (temp)]** Basic block – displays the current value of the Temperature variable of the micro:bit processor in Celsius degrees
**Test the Code in the Simulator**

- When you press "Shake" on the virtual micro:bit, the temperature will scroll across.

![Image of micro:bit simulator with code blocks and a shake icon](image1)

**Rename and Download the Code**

- In the box that says “Untitled,” rename the file to “Temperature.”

![Image of code renaming in the micro:bit simulator](image2)

- Connect the micro:bit to your computer with a USB cable. The microUSB port is on the top of the micro:bit.

- On the purple Download button, click on the three dots to the right. Choose "Connect to Device" and make sure your micro:bit is connected to the program.

- Next, click the purple Download button. The file will automatically be sent to your micro:bit.

![Image of downloading the code to the micro:bit](image3)
Test the Code:

- Test your program on your micro:bit by shaking the device. The micro:bit computer chip does not get that hot, so the temperature of the micro:bit will be close to the room temperature.

  Record the current reading on the micro:bit:

  Room Temperature: ______________________________

- Using a lot of energy, rub your hands together to create friction. Keep rubbing your hands together until you’ve created heat.
- Then, hold the micro:bit tightly closed in between your hands.
- Shake the micro:bit to see if the temperature increases.

  Temperature: ______________________________

°Note: The thermometer is in the processor on the back of the micro:bit.
Career Connections

Your coding skills used on the micro:bit will help you develop the skills needed to become a software developer.

What are the parts of this job that you find interesting?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
**Investigate**

Use your programmed micro:bit to measure the temperature of the room and the temperature of items that are using electricity. Then compare the temperatures and determine a reason for the results.

- Note: Let the micro:bit return to room temperature between different objects.

Object #1: 

Temperature of Room: __________________________

Temperature of Object: __________________________

Potential Reason: ________________________________

Object #2: 

Temperature of Room: __________________________

Temperature of Object: __________________________

Potential Reason: ________________________________

What did you notice about devices that use electricity and their temperature?

Complete the flow chart below to represent your learning from this activity:

Go back to your Research Log and fill in the Learn section for **Discovery 3: What is heat?**
What do you notice about the investigative picture above?

__________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________

What questions do you have picture?

__________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________

Go back to your OWL Tracker and fill in the Learn section for Discovery 4: How do digital devices send and receive messages?
Computers talk in a computer code called binary.

- Code.org, "How Computers Work: Binary & Data
  https://www.youtube.com/watch?v=USBCmwmCDMA

What does the number 1 mean to a computer? ________________________________

What does the 0 mean to a computer? ________________________________

How does a computer represent the letter A in binary code?

_____________________________

_____________________________

Use the website to find the binary code for the letters in the word “Hello.”

- Science Friday, "Write Your Name In Binary Code"
  https://www.sciencefriday.com/educational-resources/write-your-name-in-binary-code/

H ____________________________

E ____________________________

L ____________________________

L ____________________________

O ____________________________
Make Your Own Binary Message:
In this activity, you will program the micro:bit to blink an LED light to send a message in Binary.

What is binary code?
• Binary code is an encryption system that uses the digits 0 and 1 to represent letters, numbers, or characters in a computer.
• The micro:bit can use the LEDs to show 0 for off and 1 for on.

What is an LED?
• LED (Light Emitting Diode) is a light source that emits light when electric current flows through it.
• The BBC micro:bit has 25 built-in LEDs.
• An external LED can also be connected to the micro:bit.

Code the micro:bit
Program the micro:bit to blink a red LED light ON when the A Button is pressed and OFF when the B Button is pressed.

• Open Microsoft MakeCode Editor: https://makecode.microbit.org/
• Create a “New Project.”
• Click on [Input] then drag two [On Button A Pressed] Input blocks to the coding workspace. Note: You will leave the two blue blocks on your workspace.
• Leave one block as value A and change the second block to B.

• In the block library, click on the [Advanced] tab and click on [Pins].
• Place one [digital write pin] block into each of the [On Button Pressed] Input blocks.
• In the [On Button A Pressed] block, change the number value of the [digital write pin] block to the value 1.
• Verify that number in the [digital write pin] on the [On Button B Pressed] block shows the value 0.
Analyze the Code:

- **[On Button A Pressed]** and **[On Button B Pressed]** Input block – the program will not run until button A or B the micro:bit is pressed.
- **[digital write pin (P0) to 1]** Variable block – turns on the LED when A is pressed
- **[digital write pin (P0) to 0]** Variable block – turns off the LED when B is pressed

Download the Code:

- Connect the micro:bit to your computer with a USB cable. The microUSB port is on the top of the micro:bit.

- On the purple Download button, click on the three dots to the right. Choose “Connect to Device” and make sure your micro:bit is connected to the program.
- Next, click the purple Download button. The file will automatically be sent to your micro:bit.
Use two alligator clips and one LED to do the following:

- Connect one alligator clip to pin 0 on the micro:bit.
- Connect the same alligator clip to the tip of the long leg of the LED.
- Connect the other alligator clip to GND on the micro:bit.
- Connect the same alligator clip to the short leg of the LED.

**Test the Code:**

- Test the code on your micro:bit.
- Press the A Button. The LED should light up.
- Press the B Button. The LED should turn off.
Send the Code:
Choose a very short message to send to a partner.

What is the message you will try to send?

Was the task easy or difficult? _____________________

Why do you think this was so? ________________________________

It is important for engineers to understand the science of electricity when designing new digital devices.

Think:
Draw a model of the energy flow from the battery to the light. Label the types of energy.

Go back to your Research Log and fill in the Learn section for

Discovery 4: How do digital devices send and receive messages?
Go back to your OWL Tracker and fill in the Learn section for "Discovery 5: What is the future of long-distance communication?"
What changes or improvements in technology have you heard about?

Take a look at how much communication has changed over time in these videos:

- **What's the Big Deal?, "From Brick Phones to Phablets: 40 Years of Cell Phones"**
  https://www.youtube.com/watch?v=rgWRdldVAzQ

- **National Geographic, "History of the Telephone I I Didn't Know That"**
  https://www.youtube.com/watch?v=qWUP9EigdjY

What changes do you think you will see in the future?

Use this article to find out how internet speeds have changed over time.

- **NCTA The Internet & Television Association**

Based on the article, what was the average broadband speed in 2007?

In 2015, what was the average broadband speed?
Sending Data Over the Internet

- Code.org, "The Internet: Wires, Cables & WiFi"
  https://www.youtube.com/watch?v=ZhEf7e4kopM

What are the pros and cons of using electricity to send information?

What are the pros and cons of using light to send information?

What are the pros and cons of using radio waves to send information?

Everything sent over the internet all comes down to

Map of Fiber Internet Lines from CenturyLink Global Networks:

- Century Link, "Global Network Maps"

How Fiber-Optic Cables Bend Light

- Science Channel, "This Brilliant Experiment Shows How Fiber Optic Cables Bend Light"
  https://www.youtube.com/watch?v=aFRnXB8DUm8

How can light travel thousands of miles through a fiber optic cable?
With the micro:bit you will change electrical energy into light energy as you learn how to send your own binary message just like a computer.

Watch this video about what and LED is and how they work
- Microsoft MakeCode, "Behind the MakeCode Hardware - LEDs on micro:bit"
  https://www.youtube.com/watch?v=qqBmvHD5bGw

What does it tell you when the light turns on? __________________________________________

What type of energy does the micro:bit use? ______________________________________________

What type of energy does the LED produce? _____________________________________________

DID YOU KNOW
Just like the micro:bit, there are several cars that run on battery power. These cars convert electrical energy to energy of motion. Find out more about electric cars that are for sale right now
https://www.digitaltrends.com/cars/best-electric-cars/
Compare and Contrast

What kinds of patterns are used in Morse code and binary? Choose one of the graphic organizers to show the similarities and differences between Morse code and binary.

Option 1

What do you realize about using Morse code versus binary?

__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
**Compare and Contrast**

What kinds of patterns are used in Morse code and binary?

Choose this graphic organizers or the previous one to show the similarities and differences between Morse code and binary.

**Option 2**

<table>
<thead>
<tr>
<th>Morse code</th>
<th>binary</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
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<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

What does Morse code and binary have in common?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

What do you realize about using Morse code versus binary?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
Computers use algorithms to know what to do. Check out this video to learn more:

- **BBC Learning, "What Is An Algorithm?"**
  [https://www.youtube.com/watch?v=Da5TOXCwLSg](https://www.youtube.com/watch?v=Da5TOXCwLSg)
- **Khan Academy, "What is an algorithm?"**
  [https://www.khanacademy.org/computing/computer-science/algorithms/intro-to-algorithms/v/what-are-algorithms](https://www.khanacademy.org/computing/computer-science/algorithms/intro-to-algorithms/v/what-are-algorithms)

What is an algorithm?

Give an example of an algorithm.

In computer science what is an algorithm?

Give an example of an algorithm used by computers.

---

**CYBER POP OUT: NASA Challenge**

A few years ago NASA released a challenge, asking people to develop a more efficient algorithm to help power the International Space Station using solar panels. Anyone able to write the needed computer code could submit their work for a chance to win $30,000. Check out this link to find out more:

[https://obamawhitehouse.archives.gov/blog/2013/01/25/help-nasa-power-international-space-station](https://obamawhitehouse.archives.gov/blog/2013/01/25/help-nasa-power-international-space-station)

NASA still releases new challenges every year.

[https://www.nasa.gov/coeci/ntl](https://www.nasa.gov/coeci/ntl)

---

Go back to your Research Log and fill in the Learn section for **Discovery 5: What is the future of long-distance communication?**
Technology Carrying Case

Most people take their technology with them everywhere. Our portable devices need to be protected in transport and when being stored.

Using what you have learned from this module, design a secure carrying case for your micro:bit that will provide housing with ventilation in order to protect the components and prevent overheating.

The Engineering Design Process

Step 1: Identify the Problem

With your team, you will design a carrying case for your micro:bit. Remember to include security, protection, and ventilation.

Each team may only use straws, cardstock, tape, hole punchers, and one micro:bit.

What are your constraints?

Available Materials: _______________________________________________________________

Safety Considerations: __________________________________________________________________
Criteria for Success:
- The team is able to create a secure carrying case.
- The micro:bit is completely covered and encased.
- The micro:bit has some type of ventilation.
- Constraints were followed.
- All team members contributed in some way to the design.

Step 2: Research the Problem
What did you learn about technology that will help you design your housing?

Find out more about what causes technology to overheat:
- Dell Support, "What happens when a Laptop overheats?"
  https://www.youtube.com/watch?v=MkuZF9P2wO0
- Motorola India, "How to prevent overheat on your phone"
  https://www.youtube.com/watch?v=Wk_xOD-IEgs

What do you need to consider in your design?

When might your phone overheat?

What can you do to prevent your micro:bit overheating?

Step 3: Brainstorm Solutions
First think for yourself: What do you want your design to look like?
1 Design 1: Original Prototype Blueprint

Use the graph paper below to draw your design. Be sure to label your materials. List all materials in the margin.

Materials Used:

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

Describe your design of this stand.
What are the benefits of this design and what are the limitations?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
Step 4: Choose a Solution

Now it is time to choose your best design as a team. Discuss the strengths of each individual design, and explain your reasoning to your teammates. Combine the best ideas for different parts to make a final group design.

Which brainstorming design idea did you choose? (Keep in mind it is okay to combine multiple designs into one for your final choice.)

Materials Used:

Use the graph paper below to draw your design. Be sure to label your materials. List all materials in the margin.

2 Design 2: Group Design Blueprint

Use the graph paper below to draw your design. Be sure to label your materials. List all materials in the margin.
Working with your team gave you new ideas and made your product a little better than it was before.

How did working with your team help you identify the failure points in your own individual design?

Step 5: Create and Develop a Prototype
After your teacher approves your blueprint, collect your supplies and build your design.

Class Presentation:
When it is your team’s turn, you will present your design to the class. A highlight of the presentation should be to discuss the creativity of how your carrying case looks and the cosmetic appeal of the architectural design. Consider sharing the following:

1. **Ease of Construction** – How easy will it be to assemble the different components of your design? A rating of 1 is difficult and 5 is extremely easy.

2. **Meets Design Requirements** – Does your design meet all of the constraints?

3. **Ability to Maximize Efficiency** – How successful do you think your design will be in protecting your micro:bit and preventing overheating?

4. **Uniqueness of Design** – How interesting is the design? Will this design leave a positive impression on others? Is your design unique?

After all the different presentations, which design was your favorite? Why?
Developing Models

Draw four ways that information can be sent. Remember to label the parts of your picture. If you need help, look back through the module for reminders.

Energy transferred by: __________

Energy transferred by: __________

Energy transferred by: __________

Energy transferred by: __________
# Rubric for Scientific Model

Name: ____________________________

Date: ____________________________

<table>
<thead>
<tr>
<th>Category</th>
<th>Excellent (4 points)</th>
<th>Good (3 points)</th>
<th>Fair (2 points)</th>
<th>Weak (1 point)</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Accuracy</strong></td>
<td>Clearly explains the concept correctly and completely with details.</td>
<td>Explains the science concept correctly and completely.</td>
<td>Partially explains the science concept correctly but not completely.</td>
<td>Does not explain the science concept correctly.</td>
<td></td>
</tr>
<tr>
<td><strong>Labels/Explanation</strong></td>
<td>All parts are labeled and explained clearly and correctly.</td>
<td>All parts are labeled but a few labels or explanations are unclear.</td>
<td>Most parts are labeled but some labels or explanations are unclear.</td>
<td>Labels are incorrect or missing and/or explanations are incorrect or missing.</td>
<td></td>
</tr>
<tr>
<td><strong>Organization/Neatness</strong></td>
<td>Sketch is very neat and completely legible.</td>
<td>Sketch is mostly neat and legible.</td>
<td>Sketch is somewhat messy or illegible but can still be understood.</td>
<td>Sketch is too messy or illegible to understand.</td>
<td></td>
</tr>
<tr>
<td><strong>Relevant Details</strong></td>
<td>Many relevant details are given to strengthen the explanation. (Ex: measurement, color, etc.)</td>
<td>Some relevant details are given to strengthen the model’s explanation.</td>
<td>Few details are given or some details are irrelevant.</td>
<td>Does not include any details or details given are incorrect.</td>
<td></td>
</tr>
</tbody>
</table>

Total Points /13

Use this rubric with the models on page 56.
Claim-Evidence-Reasoning

Use your OWL Tracker to complete the following questions.

Phenomenon:
What was the focus question you attempted to answer in this module?

Claim:
In your own words, explain how we are able to send long-distance messages.

Evidence:
What did you learn from your research and investigations?

Reasoning:
Explain how your evidence supports the claim you have made about the phenomenon.
Rubric for Claim-Evidence-Reasoning

<table>
<thead>
<tr>
<th>Category</th>
<th>Excellent (4 points)</th>
<th>Good (3 points)</th>
<th>Fair (2 points)</th>
<th>Weak (1 point)</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Claim</td>
<td>Claim is stated accurately and completely; includes points from the question to demonstrate advanced understanding</td>
<td>Claim is stated accurately and completely; demonstrates general understanding of the science topic</td>
<td>Claim is stated accurately but vague or incomplete</td>
<td>Claim is implausible or stated incorrectly</td>
<td></td>
</tr>
<tr>
<td>Evidence</td>
<td>Provides all or multiple pieces of evidence provided from research, videos, explorations, etc.</td>
<td>Provides some pieces of evidence but leaves out an important part</td>
<td>Makes a general statement but not specific details</td>
<td>Does not provide evidence or evidence is inappropriate</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Uses many applicable scientific terms in correct context and scientific terms to support evidence</td>
<td>Uses some scientific terms or vocabulary in correct context</td>
<td>Uses very few scientific terms; Most are used correctly but there may be 1 or 2 errors</td>
<td>Does not use scientific terms and/or uses terms incorrectly</td>
<td></td>
</tr>
<tr>
<td>Reasoning</td>
<td>Supports/extends by providing reasoning for all or most evidence and explains how it supports the claim</td>
<td>Provides reasoning for some evidence and links it to the claim to show how it supports the claim</td>
<td>Repeats evidence or restates facts but does not explain how it supports the claim</td>
<td>Does not provide reasoning or reasoning is illogical or inaccurate</td>
<td></td>
</tr>
</tbody>
</table>

Total Points

Use this rubric with the Claim-Evidence-Reasoning writing task on page 58.