

Sound



Course Overview

This course will teach students how sound works. With a teacher's guidance, students will combine their conceptual knowledge with hands-on experimentation using the Tokymaker.

Core Objective: (1) Understand the concepts behind sound
(2) Understand how sound is generated



Course Requirements

Age Restrictions	Subject	Objective	Duration
7 years or older	STEM / STEAM	Understanding the features of sound	70 Minutes
Prerequisite Skills	Hardware Requirement	Evaluation	Additional Resources
<p>"Hello World" program: Understand Tokymaker coding basics (how to drag and drop code blocks/ download templates from the internet). Tutorial: Tokymaker basic tutorial, course one.</p>	<p>Starter kit (1 kit per group of 2-3 students) MacBook OSX, Chromebook, Android Tablet or Android Smartphone with version 6.0 and up, Internet</p>	<p>Use the guide in this document to evaluate students' understanding of the course.</p>	<p>Tokymaker Workbook</p>



Important Course Vocabulary

- Sound
- Tone
- Vibration
- Notes
- Frequency

Instructions



Step One: Pre-Class Preparation

Duration: 5 Minutes

This course can be completed by an individual or group.

Required

Before starting the next part of the course, students must complete the basic language course. This will give them the foundation necessary to understand future lessons.

Optional

The code and walkthrough for the “Rhythm Master” and “Little Pianist” sections can be printed (see Appendix for details)

Materials

- Tokymaker
- Computer/ Laptop
- Tokymaker Workbook
- Paper
- 1.5m String
- Scissors
- 2 Paper cups
- Rotation sensor
- Speaker
- Adapter Pin
- Five button sensor

Precautions

The video on sound generation has audio. If the school is unable to provide audio support, the students can watch the video on laptops or personal electronic devices.



Step Two: Physics – What is sound? How is sound transmitted?

Duration: 70 Minutes

Main Objectives

- Learning about sound generation
- Understanding sound transmission
- Learning what sound is

Next is the teaching guide. We recommend teaching the content in this order.

Sound Generation

(1) Experiment:

- The teacher instructs the students to place their fingers on their throats and sing different tones. They should be able to feel the difference between low pitched tones and high pitched tones.
- The teacher will hand out blank sheets of paper to the class. The students will be asked to come up with ways to make sound using the paper.

(2) Thoughts:

- The teacher will ask the students:

If the world were to suddenly become silent, what would happen to our lives?

The students will then be allowed to think and discuss.

- The teacher will ask the students:

What happens to both your throats and the paper when they make sounds?

Students will be given time to think and respond. They should be led to the conclusion that vibrations create sound.

(3) Summary:

- Sound is generated by vibrations.

Sound Transmission

(1) Construction:

Let the students take turns participating

- 1) Cut a hole into the bottom of two paper cups and attach one end of the 1.5m string to each cup.
- 2) Take two children to the front of the class, have them stand 1.5m apart, and then have them speak to each other.
- 3) Give the students the paper cups. Have one student speak into a cup and the other one listen.
- 4) Let the students compare the sounds they hear with the cup and without the cup.

(2) Thoughts:

- Have the teacher ask the students:

How was the sound transmitted between the two cups? Which way of communicating is better, with or without the cups?

Give the students time to think and discuss.

- Have the teacher ask the students:

Can sound also be transmitted through water?

Give the students time to think and discuss.

(3) Video:

- Play a video about sounds
<https://www.youtube.com/watch?v=AGjxfx8sy6s>

(4) Summary:

- Sound can travel through solids, liquids, and gases because vibrations can travel through those mediums.

What is sound

(1) Thoughts:

- Have the teacher ask the students: Compare and contrast sound waves and water ripples. Give the students time to think and discuss.

(2) Summary:

- Vibrations are waves and sound is a specific type of vibration. We call this vibration a sound wave.
- When waves encounter obstacles they reflect. Echoes are created when sound waves are reflected.



Step 3: Practice – Using new knowledge to complete a Tokymaker experiment

Duration: 30 Minutes

Experiment 1 - Rhythm Master

(1) Introduction

- Let's recreate a man's deep voice and a woman's higher voice using the Tokymaker.

(2) Preparation

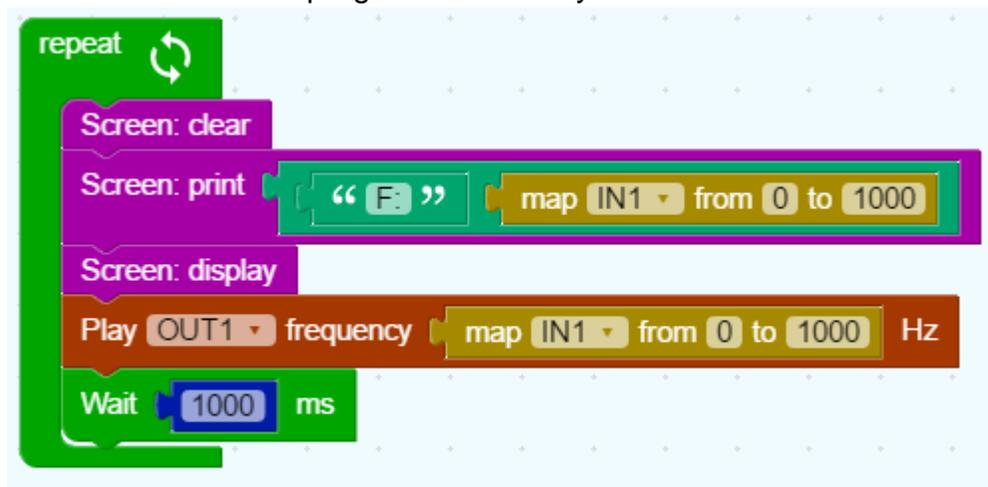
- Connect the Tokymaker to a power supply and connect your computer to the online coding environment.

(3) Required components

- Input: Rotation Sensor
- Output: Speaker
- Additional: Adapter pin

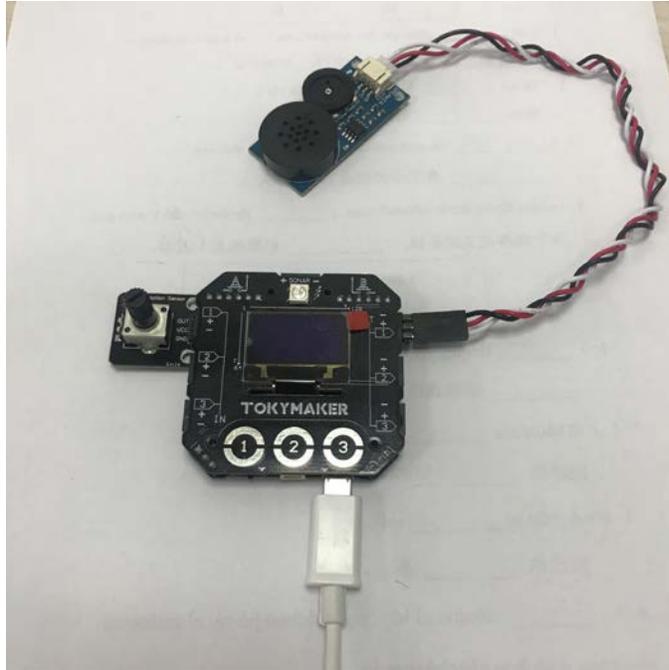
(4) Experiment

- Download the program to the Tokymaker



- Connect the sensors
 - 1) Connect the rotation sensor to input 1.
 - 2) Connect the speaker to the adapter pin.
 - 3) Connect the speaker with adapter pin to output 1.Note: Make sure the black speaker wire is aligned with the '-' on the Tokymaker.

Diagram



- Question
How does the rotation sensor relate to the pitch of the sound?
[Optional] Try changing the mapped ranges in the code to get a different set of frequencies.
- Conclusion
As we've observed in the previous experiment: The higher the frequency, the higher the pitch and vice versa.

Experiment 2 - Rhythm Master

(1) Introduction

- Music is one of the most beautiful things in the world. Over time, we've developed many different ways of creating it. The ancient Chinese created instruments based off of a five note scale. Today, we will simulate this scale.

(2) Preparation

- Connect the Tokymaker to a power supply and connect a computer to the online coding environment

(3) Required Components

- Input: Five-button sensor
- Output: Speaker
- Additional: Adapter pin

(4) Experiment

Step 1: Download the program to the Tokymaker

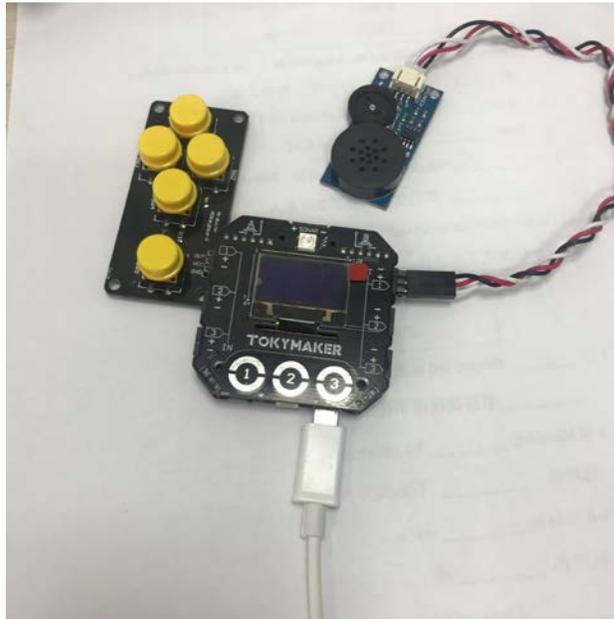
```

repeat
  if (29 <= Read IN1 and 31 >= Read IN1)
  do Play OUT1 octave 5 note C
  else if (0 = Read IN1)
  do Play OUT1 octave 5 note D
  else if (10 <= Read IN1 and 12 >= Read IN1)
  do Play OUT1 octave 5 note E
  else if (47 <= Read IN1 and 49 >= Read IN1)
  do Play OUT1 octave 5 note G
  else if (71 <= Read IN1 and 73 >= Read IN1)
  do Play OUT1 octave 5 note A
  else if (100 = Read IN1)
  do Mute OUT1
  Screen: clear
  Screen: print "Music!"
  Screen: display
  
```

Step 2: Connect the sensors

- 1) Connect the speaker to the adapter pins.
- 2) Connect the speaker to output 1.
Note: Make sure the black wire is aligned with the '-' on the Tokymaker
- 3) Connect the five-button sensor to input 1.
Note: Make sure GND is aligned with the '-' on the Tokymaker

Diagram



Step 3: Try playing through the scale and creating your own music!
[Optional] Try changing the notes in the code to create your own instrument.



Step 4: Discussion – What did you learn in this course? What else are you curious about?

Duration: 15 Minutes

(1) Class questions

- How is sound made?/ What creates sound?
- How is sound transmitted?
- What is sound?

(2) Programming Reflection

- Invite a few students to answer: What did they gain from programming the Tokymaker?
- [Optional] On sticky notes, have students write about what they think sound can be used for in real life. Have them post these on a wall in order to share their ideas with the rest of the class. This provides reinforcement and encourages peer to peer support.



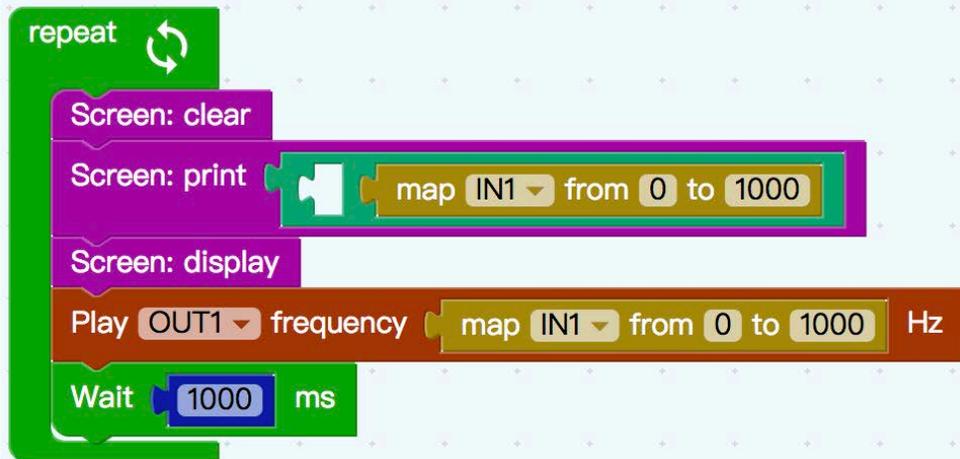
Step 5: The End

Duration: 5 Minutes

Have the students shut down their computers and Tokymakers. Put all of the sensors and equipment back into the box and clear their workspace.

2.1 Rhythm Master

Code



Understanding the Code

In green [repeat]: The statement represents that the program inside will be executed again and again.

In purple [Screen: clear]: Indicates that the display is cleared to avoid previous images on the last screen.

In purple [Screen: print]: Indicates that the following content is input to the Tokymaker. The orange [map] statement indicates that the data is read from input 1 and the range is adjusted from 0 to 1000.

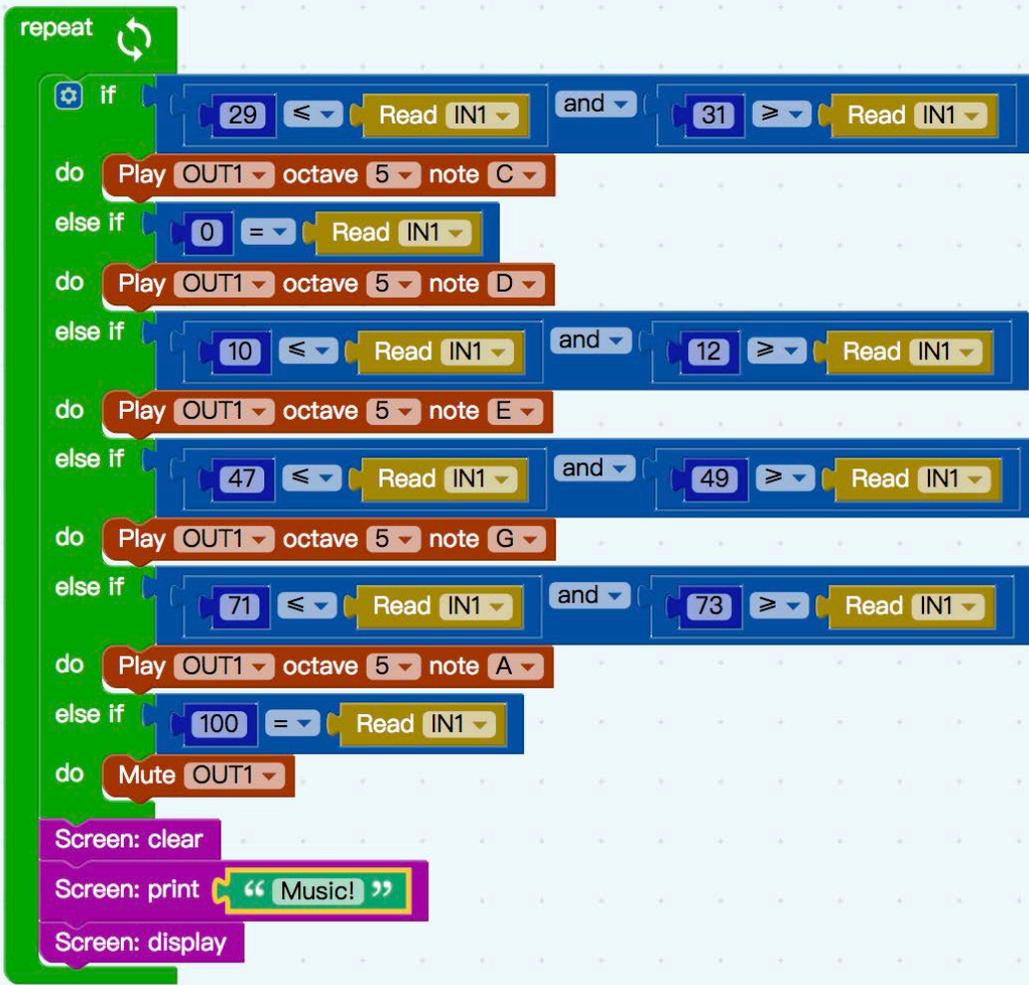
In purple [Screen: display]: Indicates the print content to be displayed on the screen.

In red [Play]: Indicates that a frequency will play out of output 1. The orange [map] statement indicates that the frequency value will be taken from input 1 and adjusted to the range 0 to 1000. This indicates the speaker will output a frequency range of 0 to 1000.

In green [Wait]: The statement indicates a waiting period, 1000ms = 1s. This wait statement is here in order to extend the speaker playing time.

2.2 Little Pianist

Code



```
repeat
  if (29 <= Read IN1) and (31 >= Read IN1)
  do Play OUT1 octave 5 note C
  else if (0 = Read IN1)
  do Play OUT1 octave 5 note D
  else if (10 <= Read IN1) and (12 >= Read IN1)
  do Play OUT1 octave 5 note E
  else if (47 <= Read IN1) and (49 >= Read IN1)
  do Play OUT1 octave 5 note G
  else if (71 <= Read IN1) and (73 >= Read IN1)
  do Play OUT1 octave 5 note A
  else if (100 = Read IN1)
  do Mute OUT1
  Screen: clear
  Screen: print "Music!"
  Screen: display
```

Understanding the Code

In green [repeat]: The statement represents that the program inside will be executed again and again.

In green [if] [else if] [do]: It is a conditional sentence. When the condition contained in the [if] statement is satisfied, the program will run the command in the [do] statement. The [if] statement condition here is the blue statement. It judges whether the orange [input] value satisfies the set key value.

In green [Play]: The statement indicates that the speaker at Output1 will play the note indicated at the specified octave.

In purple [Screen: clear]: Clears whatever is on the screen.

In purple [Screen: print]: Sends the text "Music!" to the Tokymaker

In purple [Screen: display]: Tells the Tokymaker to display any text it was sent to the screen.