Sound and Waves: 4.D.1A

Introduction to Sound and Waves

<table>
<thead>
<tr>
<th>Grade Level</th>
<th>4</th>
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<tbody>
<tr>
<td>Sessions</td>
<td>90-120 minutes</td>
</tr>
<tr>
<td>Seasonality</td>
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<td>Instructional Mode(s)</td>
<td>Whole Class</td>
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<td>Team Size</td>
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| WPS Benchmarks | 04.SC.IS.01  
                 | 04.SC.IS.04  
                 | 04.SC.PS.01  
                 | 04.SC.TE.01  |
| MA Frameworks | 3-5.IS.1  
                 | 3-5.IS.4  
                 | 3-5.PS.11  
                 | 3-5.TE.1.1  |
| Key Words   | Sound waves, sound, reflection, pitch, volume |

Summary
The students will learn about mechanical waves from a demonstration and then translate what they learn about mechanical waves to sound waves. The students will then build a device to investigate how you can detect sound waves.

Learning Objectives
2002 Worcester Public Schools (WPS) Benchmarks for Grade 4

04.SC.IS.01 Ask questions and make predictions that can be tested.

04.SC.IS.04 Conduct multiple trials to test a prediction. Compare the results of an investigation or experiment with the prediction.

04.SC.PS.01 Design and construct a simple sound-producing device to predict, demonstrate, and describe the properties of loudness and pitch of sound.

04.SC.TE.01 Identify materials used to accomplish a design task based on specific property (e.g., weight, strength, hardness, and flexibility).

Additional Learning Objectives

1. 3-5.IS.1 Ask questions and make predictions that can be tested.
2. 3-5.IS.4 Conduct multiple trials to test a prediction. Compare the results of an investigation or experiment with the prediction.
3. **3-5.PS.11** Recognize that sound is produced by vibrating objects and requires a medium through which to travel. Relate the rate of vibration to the pitch of the sound.

4. **3.5.TE.1.1** Identify materials used to accomplish a design task based on specific property i.e., weight, strength, hardness, and flexibility.

### Required Background Knowledge
None

### Essential Questions
1. How does sound travel?
2. What is the difference between loudness and pitch?

### Introduction / Motivation
Ask the students the following questions:
- How does sound travel?
  - You should get the following responses (or lead the students to the following answers):
    - Air, Water, Solid things like wood, metal, and the ground
    - You can’t hear things in outer space since it is a vacuum. (This is optional information – could confuse the students depending on their understanding of what a vacuum is.)

What do you think sound waves look like?
- You can’t see them, but they travel is waves. (Slinky demonstration)

### Procedure
The instructor will:
1. Slinky Demonstration – Have a volunteer hold one end of a slinky and you create waves. Create waves of different sizes and ask the students to identify which type of wave they think has more energy. Rephrase the question or define what energy is if the students are unclear about what the question means.
2. Tuning fork demonstration – Demonstrate with different pitch tuning forks. Point out that you produce sound by striking the turning fork causing it to vibrate and
produce sound waves. Just like the slinky with faster waves had more energy; the sound waves with higher pitch (more vibration) has more energy.

3. Point out that pitch and loudness are not the same. Strike the higher note more softly and the lower note harder to compare the loudness and the pitch.

4. If we can’t see sound waves how can we tell they are there? They cause the air to vibrate and that is how we hear. The vibrating air enters our ear and causes three very small bones to vibrate.

(http://www.entnet.org/healthinfo/ears/ear.cfm)

5. We can build a device that will help us to see sound.

* Prior to the lesson, the teacher should cut out the tops and bottoms of the can / containers and either remove the sharp edges or cover them with tape.
Distribute the construction handout and materials.
- There are many alternate sources that give instructions for building this sound wave detection device.  http://www.teachervision.fen.com/page/380.html

8.) Have the students test their sound measurement devices and fill out their prediction handouts.

<table>
<thead>
<tr>
<th>materials per class</th>
<th>amount</th>
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<tbody>
<tr>
<td>Tuning Forks</td>
<td>2 of different pitches</td>
<td>Hardware Store</td>
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<tr>
<th>Materials per class</th>
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<td>Flashlight</td>
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<td>Hardware Store</td>
</tr>
<tr>
<td>Slinky</td>
<td>1</td>
<td>Toy Store</td>
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Materials List
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<thead>
<tr>
<th>Materials per student</th>
<th>Amount</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper cups (without bottom), cylindrical containers with no top or bottom</td>
<td>1</td>
<td>Grocery Store</td>
</tr>
<tr>
<td>Balloon or plastic wrap</td>
<td>1</td>
<td>Grocery Store</td>
</tr>
<tr>
<td>Rubber bands or masking tape</td>
<td>1, 12 in.</td>
<td>Office Supply Store</td>
</tr>
<tr>
<td>Mirror (circular - 1-15 inch diameter)</td>
<td>1</td>
<td>Office Supply Store</td>
</tr>
<tr>
<td>Double sided tape</td>
<td>2 inches</td>
<td>Hardware Store</td>
</tr>
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</table>

**Vocabulary with Definitions** (in alphabetical order)

1. **Energy** – The capacity for work. There are many different forms of energy such as thermal energy, mechanical energy, electrical energy, and sound energy.
2. **Pitch** – The pitch of the sound is synonymous to the frequency of the vibration. Frequency or pitch can be measured on a scale in units of Hertz or Hz. It is more commonly associated with note names assigned to each pitch. For example, the note “A” is a pitch which can also be referred to as 440 Hz.
3. **Sound** – Vibrations transmitted through liquid, gases, and some solids capable of being detected by hearing organs.
4. **Volume** – The amplitude or loudness of a sound.

**Assessment / Evaluation of Students**

The instructor may assess the students in any/all of the following manners

1. Prediction handout

**Lesson Extensions**

Have the students design and build their own musical instruments.

**Attachments**

1. **Sound Wave Detector**
2. **Sound Worksheet**
**Troubleshooting Tips**

If there is too much light in the classroom for the light from the flashlight to be seen, create a large box on top of the desks to make the flashlight beam visible. Cut the front of the box out and a hole in the back or side to position the flashlight.

**Safety Issues**

None

**Additional Resources**

None

**Key Words**

Sound waves, sound, reflection, pitch, volume
Sound Wave Detector

Instructions

1. Stretch the balloon over the end of the container and secure with a rubber band.

2. Attach the mirror to the center of the balloon with double-sided tape.

3. After your device has been approved by your teacher, test it with a flashlight. Speak into the open end of the container while shining the flashlight on the mirror. The vibrations from sound waves will cause the light move.
Sound Worksheet

1. How do sound waves travel?
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

2. What did you observe when you used the sound wave detector?
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

3. Answer the following question by circling Yes or No.

Can sound waves travel through the air?   YES   NO
Can sound waves travel through water?     YES   NO
Can sound waves travel through wood?      YES   NO
Is the pitch different than the loudness of a sound?   YES   NO

4. What is pitch (of a sound)?
________________________________________________________________________
________________________________________________________________________