

Waves and Communication

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Subject: General Science

Grade Level: Upper Elementary

Standards: *Next Generation Science Standards* (www.nextgenscience.org)

4-PS4-1. Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.

4-PS4-3. Generate and compare multiple solutions that use patterns to transfer information.

Schedule: 3-45 minute lessons



<p><u>Objectives:</u></p> <p>Students will learn about transverse waves and their properties. Students learn how to use sound to send coded information.</p>	<p><u>Vocabulary:</u></p> <table style="width: 100%; border: none;"> <tr> <td style="width: 50%;">Mechanical Wave</td> <td style="width: 50%;">Transverse Wave</td> </tr> <tr> <td>Amplitude</td> <td>Wavelength</td> </tr> <tr> <td>Frequency</td> <td></td> </tr> </table>	Mechanical Wave	Transverse Wave	Amplitude	Wavelength	Frequency	
Mechanical Wave	Transverse Wave						
Amplitude	Wavelength						
Frequency							
<p><u>Students Will:</u></p> <p>Use/view simulations to understand how waves travel.</p> <p>Measure waves to look at how amplitude and wavelength change.</p> <p>Develop a binary code to transfer information using sound.</p>	<p><u>Materials:</u></p> <p>For Each Group: Wave Generator Ruler</p> <p>For Each Pair: Code Sheet Drum</p> <p>For Each Student: Activity Sheet</p> <p>For Class: Colored Chips</p>						
<p>Safety</p>	<p>There are no safety concerns for this activity</p>						

Science Content for the Teacher:

Waves (General):

What is a wave?

When we think of the word "wave" we usually picture someone moving their hand back and forth to say hello or maybe we think of a tall curling wall of water moving in from the ocean to crash on the beach.

In physics, a wave is a traveling disturbance that travels through space and matter transferring energy from one place to another. When studying waves it's important to remember that they transfer energy, not matter.

Waves in Everyday Life

There are lots of waves all around us in everyday life. Sound is a type of wave that moves through matter and then vibrates our eardrums so we can hear. Light is a special kind of wave that is made up of photons that helps us to see. You can drop a rock into a pond and see waves form in the water. We even use waves (microwaves) to cook our food really fast.

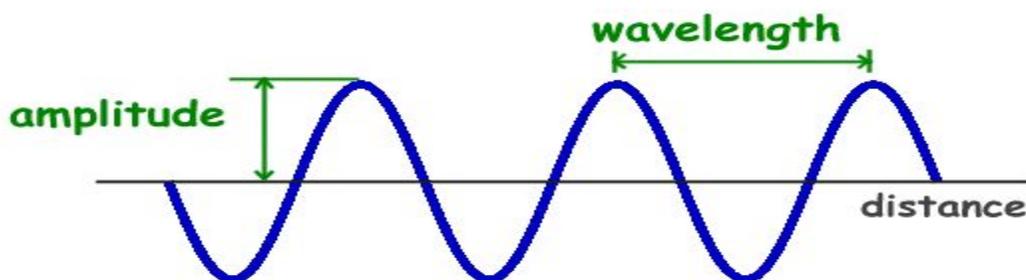


Mechanical waves are waves that require a medium. This means that they have to have some sort of matter to travel through. These waves travel when molecules in the medium collide with each other passing on energy. One example of a mechanical wave is sound. Sound can travel through air, water, or solids, but it can't travel through a vacuum. It needs the medium to help it travel. Other examples include water waves, seismic waves, and waves traveling through a spring.

Transverse waves are waves where the disturbance moves perpendicular to the direction of the wave. You can think of the wave moving left to right, while the disturbance moves up and down. One example of a transverse wave is a water wave where the water moves up and down as the wave passes through the ocean. Other examples include an oscillating string and a wave of fans in a stadium (the people move up and down while the wave moves around the stadium).

Amplitude

The amplitude of a wave is a measure of the distance of the wave from its rest position. The amplitude is shown on the graph below.



Amplitude is generally calculated by looking on a graph of a wave and measuring the height of the wave from the resting position.

The amplitude is a measure of the strength or intensity of the wave. For example, when looking at a sound wave, the amplitude will measure the loudness of the sound. The energy of the wave also varies in direct proportion to the amplitude of the wave.

Wavelength

The wavelength of a wave is the distance between two corresponding points on back-to-back cycles of a wave. This can be measured between two crests of a wave or two troughs of a wave. The wavelength is usually represented in physics by the Greek letter lambda (λ).

Taken from:

"Ducksters: Education Site for Kids and Teachers." 2006. 22 Apr. 2014 <<http://www.ducksters.com/>>

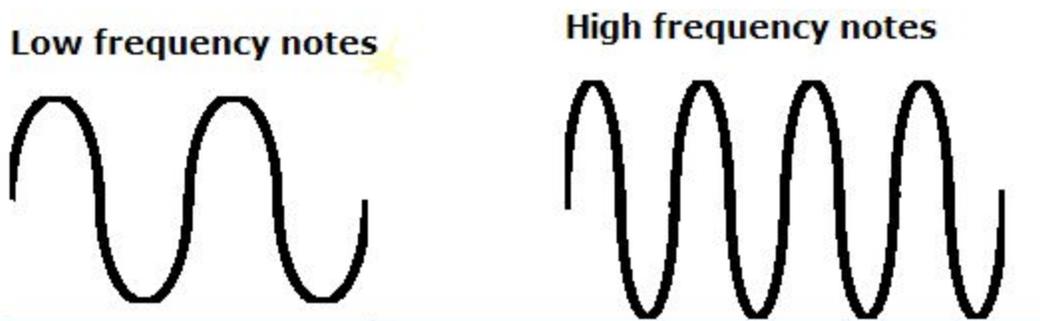


Sound:

Sound is a type of energy made by vibrations. When any object vibrates, it causes movement in the air particles. These particles bump into the particles close to them, which makes them vibrate too causing them to bump into more air particles. This movement, called sound waves, keeps going until they run out of energy. If your ear is within range of the vibrations, you hear the sound.

Picture a stone thrown into a still body of water. The rings of waves expand indefinitely. The same is true with sound. Irregular repeating sound waves create noise, while regular repeating waves produce musical notes.

When the vibrations are fast, you hear a high note. When the vibrations are slow, it creates a low note. The sound waves in the diagram show the different frequencies for high and low notes.

**Taken From:**

"Science Kids at Home - free ideas for childrens science ..." 2006. 22 Apr. 2014
<<http://www.sciencekidsathome.com/>>

Preparation:

Have materials ready to distribute to class

Classroom Procedure:

It is up to the teacher to decide whether you would want to start with the communication game first or the waves activity. Either way will work. We set it up to start with the waves activities.

Waves and Sound (Time: 40 minutes)

Discuss with students how sound moves. Show students how to set up the wave machine.

In groups of 4-5, they will get their own machine. Have students follow activity sheet 1 to measure and identify wave properties. Depending on the class, you can read each section together with the class, have them do the activity, then check-in with each group to make sure they understand.

Hand out activity sheet 2 and have students read and answer the questions. You can read this as a class, or have them work in small groups, pairs, or alone.

Use the website below to show the class some simulations on sound waves. Discuss sound with the class.

(<https://phet.colorado.edu/en/simulation/sound>)

Using Sound to Communicate (Time: 60 minutes)

Have students work in pairs to build an instrument. You can use the examples we provide or allow the kids other options (balloons, cups, rulers, nails)

Have students come up with a communication system with their instrument. It can be based on the number of beats, loudness of sound, or pitch.

Have students play the Sound game. They will have to communicate with their partner about the number of and/or color of the chips. Play each game and then stop to have kids reflect on some questions before moving onto the next game.

Explain (Time: 20 minutes)

Have groups explain how their communication system worked.

Assessment:



The following rubric can be used to assess students during each part of the activity. The term “expectations” here refers to the content, process and attitudinal goals for this activity. Evidence for understanding may be in the form of oral as well as written communication, both with the teacher as well as observed communication with other students. Specifics are listed in the table below.

- 1= exceeds expectations
- 2= meets expectations consistently
- 3= meets expectations occasionally
- 4= not meeting expectations

	Engage	Explore	Explain
1	Shows leadership in the discussion and offers creative ideas reflecting a good scientific understanding of waves and sound.	Completes work accurately and completely. Works well independently in creating a musical instrument.	Provides an in-depth explanation of findings, making good use of vocabulary terms.
2	Participates in the discussion and shows an understanding of the different parts of a wave.	Completes work accurately and completely. Works independently in creating a musical instrument.	Provides clear explanation of findings. Fills out worksheet clearly.
3	Contributes to the brainstorm, but shows little understanding of waves.	Works well independently, but does not complete their instrument.	Provides a limited explanation of findings.
4	Does not participate in brainstorm. Shows no understanding of waves.	Has trouble working independently. Does little to complete the instrument.	Is not clear in, or provides no explanation of findings.

Other Resources:

The Sound Site: www.smm.org/sound/nocss/top.html
 The Soundrum: www.wayback.archive-it.org/3635/20130919165031/http://library.thinkquest.org/19537/

