SCIENCE NORTH SCIENCE NORD
SUDBURY, ONTARIO, CANADA

Sound Waves **Grade 11 – Waves and Sound**

Lesson Plan

Assessment	AFL
Cross-curricular	

Big Ideas

- Mechanical waves have specific characteristics and predictable properties.
- Sound is a mechanical wave.

Learning Goals

- I can distinguish between longitudinal and transverse waves and provide examples of both types of waves.
- I know that sound is a longitudinal mechanical wave.
- I know the terms longitudinal wave, transverse wave, frequency, period, amplitude, wavelength, and velocity.
- I can demonstrate that the frequency of a wave affects its pitch, the amplitude of a wave affects its loudness, and the shape of the wave affects its tone.
- I can perform calculations relating the speed of a wave to its wavelength and frequency.

Specific Expectations:

E2. investigate, in qualitative and quantitative terms, the properties of mechanical waves and sound, and solve related problems;
E2.1 use appropriate terminology related to mechanical waves and sound, including, but not limited to: longitudinal wave, transverse wave, frequency, period, cycle, amplitude, phase, wavelength, velocity, superposition, constructive interference, destructive interference, standing waves, and resonance [C]
E2.4 investigate the relationship between the wavelength, frequency, and speed of a wave, and solve related problems [PR, AI]
E3. demonstrate an understanding of the properties of mechanical waves and sound and of the principles underlying their production, transmission, interaction, and reception.
E3.1 distinguish between longitudinal and transverse waves in different media, and provide examples of both types of waves

Description:

In this lesson students will use an oscilloscope to compare the wavelength and amplitude of sounds from various items and instruments. They will perform calculations relating the speed of a wave to its wavelength and frequency. **This lesson is intended for the university level**.

Materials

Know/Want to Know/Learn (KWL) chart
Sound Waves Visuals and Information
Mechanical Waves and Sound Student Worksheet
Amplitude Frequency and wavelength-Virtual Oscilloscope

Class Materials

4 Identical glass bottles (Jones Soda or other glass drink bottles), spoon, a stringed instrument such as a violin, guitar, ukulele, a violin bow, wind instrument such as a flute or pan flute, small drum, a cowbell, a simple tone generator such as http://onlinetonegenerator.com/

Sound Applications Rubric

Safety Notes

Students should dispose of broken glass in the appropriate glass disposal box/container.

Introduction

Students may already have been introduced to mechanical waves, both transverse and longitudinal, prior to this class. They will review these subjects, as well as terminology for characterizing a wave and using the universal wave equation.

The class starts off with K/W/L chart (See Link) about sound. Students complete a Know/Want to Know/Learn chart with a partner. They write down everything they already know about sound and a few things they want to know. Make sure each partner has a copy of the chart.

Students close their eyes and listen carefully for 20 seconds. Teacher asks the following questions: What do you hear? How does that sound get made (for example, if you hear a chair scraping, the leg is moving against the ground causing a vibration.

The teacher may wish to have students demonstrate the difference in transverse and longitudinal waves using slinky or other props.

A mechanical wave is the transfer of energy through a medium without transfer of the medium itself. In the Mechanical Waves visuals students will explore sound as a mechanical wave. Students take notes during the presentation using **"**Mechanical Waves and Sound**"** worksheet (See Link).

The demo/Investigation below takes place after slide 8 in the presentation.
Demo/Investigation: Teachers may use an oscilloscope to demonstrate. Have students use a tablet with an app listed below, or simply demonstrate how the pitch and volume affect frequency and amplitude using:

Amplitude Frequency and wavelength
http://www.educationscotland.gov.uk/resources/s/sound/oscilloscope.asp
Education Scotland
© Crown 2012
Retrieved January 31, 2016

Note: Teachers may wish to download an app called Oscium (it's free) or FreqCounter ($2.79) to explore sound further.

After the demo, the class should discuss their investigation and proceed with the rest of the presentation.

Action

Sound Stations Activity
At each station, students attempt to sketch the shapes of the waveform and compare the wavelength and amplitude for each sound.

Class Materials

- 4 Identical glass bottles (Jones Soda or other glass drink bottles)
- spoon
- a stringed instrument such as a violin, guitar, ukulele
- a violin bow
- a wind instrument such as a flute or pan flute
- a small drum
- a cowbell
- a simple tone generator such as http://onlinetonegenerator.com/

Instructions for stations

Station 1 (Pitch and frequency)

- There should be 4-5 glass bottles with varying amounts of water in them. Students can either hit the glasses with a spoon, or blow across the top of the bottles to make different noises.

Station 2 (Volume and Amplitude)

- Using the tone generator (http://onlinetonegenerator.com/ or other) students can adjust the volume of the tone to see the difference in the oscilloscope trace. They may also experiment with the wave shapes.

Station 3 (Wave shape)

- Make a stringed instrument, a wind instrument, and percussion instrument available. Students should try these instruments out to make different sounds and compare the wave shapes.

Method

1. At each station, play each sound in front of the microphone on the tablet or phone and look at the shape of the oscilloscope trace displayed.
2. Look especially at the maximum height (the amplitude) of the trace and relate that to how loud the sound is or how close the sound source is to the computer microphone. Compare it to the trace of the other sounds at that station.
3. Look at how close together the variations in the trace are horizontally and relate that to the pitch (frequency) of the sound that is heard. Compare it to the trace of the other sounds at that station.
4. Look at the shape of the trace and relate that to the type of sound that is heard.
5. Speak into the microphone and see the resulting trace. It is easier to see patterns on the oscilloscope when the sounds are sustained. Slowly say the five vowels and then other sounds such as a hiss and a gentle whistle.

Discussion Questions

1. How does the display change when a sound is made louder?
2. How does the display change when sounds of a higher frequency are played?
3. What differences are there between the traces of the spoken sounds ‘ahh’ and ‘shh’?
4. How common are pure sounds in what we hear in our daily lives?

Consolidation/Extension

Take 4-5 minutes to complete your KWL chart. Are there still things in your “W” section that you would like to know?

Teachers should assign the Sound Applications paragraph as outlined in the Mechanical Waves visuals on slide 16 (Sound Applications Rubric see Link).