Bay Area Scientists in Schools Presentation Plan

Lesson Name Sound and Music
Presenter(s) EE Outreach @ Berkeley

Grade Level K—5 with CA standards connection at 2nd and NGSS 1st and 4th

Standards Connection(s):

California Science Content Standards: (1998)

(2nd Grade) PS-2) Sound is a vibration, describe pitch and volume.

Next Generation Science Standards:

(1st Grade) **1-PS4-1.** Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate.

(4th Grade) **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.

Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. • Plan and conduct investigations collaboratively to produce evidence to answer a question. (1-PS4-1),(1-PS4-3) **Developing and Using Models** Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Develop a model using an analogy, example, or abstract representation to describe a scientific principle. (4-PS4-1) **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. (4-PS4-3)	**PS4.A: Wave Properties** • Sound can make matter vibrate, and vibrating matter can make sound. (1-PS4-1) **PS4.A: Wave Properties** • Waves, which are regular patterns of motion, can be made in water by disturbing the surface. When waves move across the surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the water meets a beach. (Note: This grade band endpoint was moved from K–2.) (4-PS4-1) • Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks). (4-PS4-1) **PS4.C: Information Technologies and Instrumentation** • Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information—convert it from digitized form to voice—and vice versa. (4-PS4-3)	**Cause and Effect** • Simple tests can be designed to gather evidence to support or refute student ideas about causes. (1-PS4-1),(1-PS4-2),(1-PS4-3) **Patterns** • Similarities and differences in patterns can be used to sort, classify, and analyze simple rates of change for natural phenomena. (4-PS4-1) • Similarities and differences in patterns can be used to sort and classify designed products. (4-PS4-3)

Common Core State Standards Connections:

ELA/Literacy

W.1.8 With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question. (1-PS4-1),(1-PS4-2),(1-PS4-3)

SL.1.1 Participate in collaborative conversations with diverse partners about grade 1 topics and texts with peers and adults in small and larger groups. (1-PS4-1),(1-PS4-2),(1-PS4-3)

Mathematics

MP.5 Use appropriate tools strategically. (1-PS4-4)

1.MD.A.1 Order three objects by length; compare the lengths of two objects indirectly by using a third object. (1-PS4-4)

MP.4 Model with mathematics. (4-PS4-1)

Teaser:

Why does a guitar sound different than a trumpet? Why do things sound different when they're moving? Why can computers make pictures of sound and what do they look like? In this module we try to figure out the science of music and sound by using computers and demonstrations to visualize how sound moves around. Kids rotate around three stations conducting experiments with sound.

Objective: *As a result of your lesson, what will students learn? What will they be able to do?*

Students should have an introductory picture of how waves work with a particular emphasis on sound. They will also have an instinct for how sound waves can be represented both in time (as a pressure wave) and in frequency (as musical notes).

Vocabulary / Definitions: *3 – 6 important (new) words*

Frequency, amplitude, tone, volume, timbre, Doppler effect

Materials:

What will you bring with you?

Computers with visualization software. Instruments. Demonstration materials.

What should students have ready (pencils, paper, scissors)?

If note-taking is emphasized in class, there are some opportunities to take notes while other students are taking turns with the equipment. So a paper and pencil can be beneficial, but they're not necessary.

Classroom Set-up:

- Desks should be arranged into three groups, one of which needs to be near a chalk/white board. One experiment will be set up on each of these groups of desks and students will rotate between the three experiments.
- A laptop projector at the front of the class is very, very useful.

Classroom Visit

1. Personal Introduction: _____5___ Minutes

We'll introduce ourselves as engineers from Berkeley, talk about what we do as scientists and also talk a little bit about where we come from to help establish a more human connection.

Topic Introduction: _____10____ Minutes

This module starts with a quick introduction to waves and, in particular, sound waves. This consists of slides with animation of how sound moves, and a demonstration (using a few student volunteers) about waves in Slinkys.

2. Learning Experience(s): ___30-40_ Minutes

After this, the students start rotating among the sound stations.
Station #1 features a sound visualizer where students can play musical instruments and see how the sound looks as a wave and a music notes on a computer screen.
Station #2 features a sound building program, where students can design the notes they want in a sound and hear it played.
Station #3 is a lesson on the Doppler effect featuring drawings, videos and group participation. At each station one of our instructors will guide the students through a set of experiments that explore key ideas like frequency, amplitude and waves.

3. Wrap-up: Sharing Experiences ____5___ Minutes

Students reconvene. Instructors recap how vocabulary words relate to each station

4. Connections & Close: ____5____ Minutes

Point out that students can continue to experiment with sound just by listening carefully and explain how some these concepts connect directly to complex music like auto-tuning or guitar distortion. Talk about how we became scientists if time allows.

Total 50 – 60 Minutes

Follow-up – After Presentation

List or attach examples of activities, websites, connections for additional learning.
Our website (http://www.eecs.berkeley.edu/~eegsa/or) has all the sound related material we've produced available. The internet also has tons of sound information, start at howstuffworks.com.

Some other ideas:

Students are given a worksheet with pictures of low amplitude and high amplitude waves as well as low frequency and high frequency waves and asked to label them correctly.

Teacher plays various songs for the class and asks them to describe parts of the songs in terms of amplitude and frequency.

Students are asked to select their favorite song and find parts of the song that demonstrate high amplitude, low amplitude, high frequency and low frequency sounds.

Students are given a worksheet with pictures of everyday items and asked to number them in order of lowest amplitude to highest amplitude. Similarly with frequency.

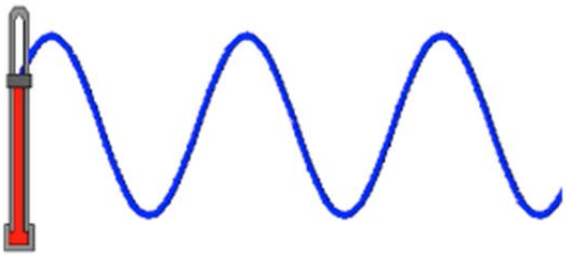
Some example worksheets are attached.

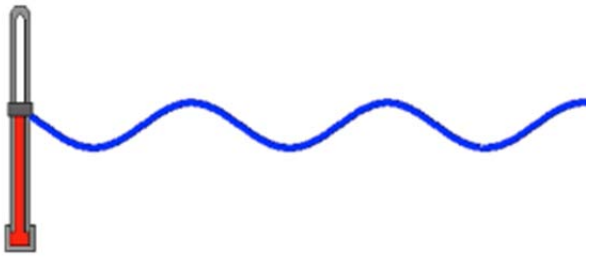
Follow Up Worksheet – Sound & Music Demo
Berkeley Engineering Outreach

Amplitude and Frequency Review

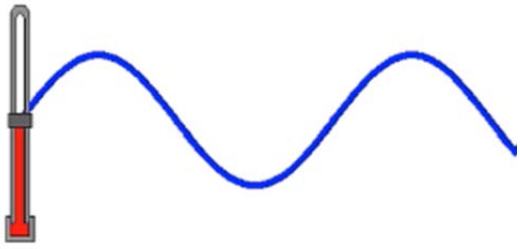
Instructions: Circle the picture that best matches each question.

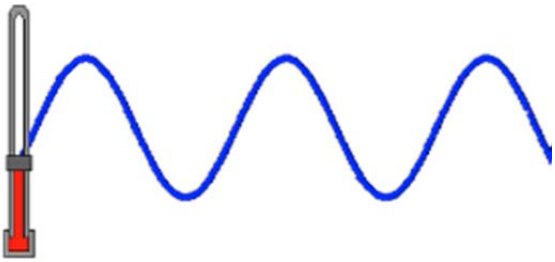
Which sound wave is louder (has a higher amplitude)?





Which sound wave is a higher pitch (has a higher frequency)?





Follow Up Worksheet – Sound & Music Demo
Berkeley Engineering Outreach

Amplitudes in Everyday Life

Instructions: Cut out the pictures along the dotted lines.
Rank the sounds in order of lowest to highest amplitude.
Remember that louder sounds have a higher amplitude.

Follow Up Worksheet – Sound & Music Demo
Berkeley Engineering Outreach

Frequencies in Everyday Life

Instructions: Cut out the pictures along the dotted lines. Rank the sounds in order of lowest to highest frequency. Remember that sounds with a higher pitch have a higher frequency.