Seeing Sound

Summary

Students will understand important concepts of sound during this lesson, such as frequency and amplitude. Using recording programs such as GarageBand (free and standard on Macintosh computers) or Audacity (free download on the web), students can actually visualize amplitude and frequency of their own sounds, either by using their voice or some sort of sound they have experimented with in class to form their own test.

Time Frame

1 class periods of 60 minutes each

Group Size

Large Groups

Materials

-Recording program on a computer (GarageBand on mac or Audacity on mac or PC)
-Some way to project the computer screen to the smartboard or projector screen.
-A set of speakers for playing back sounds to the class -A microphone of some sort. Mac computers have built in microphones that work just fine. I'm not sure about any others.

Background for Teachers

Teachers should know the basic properties of sound, such as amplitude and frequency. Amplitude refers to how far the particles move from their original position as the wave passes. Sound waves with greater amplitude have greater energy, and the common word for amplitude is "volume". Frequency is the inverse of wavelength and is measured in hertz (cycles per second). Sounds with higher frequencies have a higher pitch, and those with lower frequencies result in lower pitches. Teachers should be familiar with use in GarageBand or Audacity. When recording into these programs, a sonogram is produced. This sonogram, when zoomed in very closely, can actually show individual waves, or frequency, depending on the type of noise being observed. Obviously, the lower the sound, the longer the wavelength, and the easier it will be to see on the sonogram. The sonograms show amplitude very nicely, because amplitude is the height of the wave. When zoomed out on the sonogram, this is the only sound characteristic visible. Sounds can be pre-recorded before class if you are unsure what the kids will come up with.
Many different types of animal sounds can be found at http://westernsoundscape.org/. These are fun to play around with, record, and see what they look like if you want to tie this into animal sound production.

Student Prior Knowledge

(none)

Intended Learning Outcomes

1. Use Science Process and Thinking Skills
    c. Given the appropriate instrument, measure length, temperature, volume, and mass in metric units as specified.
    f. Plan and conduct simple experiments.
    g. Formulate simple research questions.
    h. Predict results of investigations based on prior data.

i. Use data to construct a reasonable conclusion.
3. Understand Science Concepts and Principles
c. Solve problems appropriate to grade level by applying science principles and procedures.
4. Communicate Effectively Using Science Language and Reasoning
b. Describe or explain observations carefully and report with pictures, sentences, and models.

Instructional Procedures

It is good to start off with a vocabulary introduction, or overview depending on the background of the students. 'Frequency'/'Pitch' and 'Amplitude'/'Volume' are the obvious vocab words, though 'vibration', 'energy', etc., are also important. Tell them what you expect out of them for the day, and introduce them to the recording program.

To introduce them to the recording program, I closed the door, turned on the microphone, and let them get some energy out by making all the loud sounds they wanted. I could then play the sound for them and let them see the sonogram they produced. I then had them all make quiet and/or high sounds so they could see the difference.

Have the students, in small groups, develop an experiment with a hypothesis, test, procedure, and eventually conclusion for this question: Do the sonograms on the recording program record amplitude, frequency, or both? This will take about 10-15 minutes.

Pick a group or two with a particularly good experiment to perform in front of the class. The experiments should, of course, vary amplitude OR frequency, but never both (ex. maintaining the same volume while changing the pitch, or maintaining the pitch and changing the volume). My class did not have time to test all the groups' experiments, but after a few they mostly got the the idea with some encouragement. The important thing to understand is that amplitude affects the height of the wave, and that's the most prominent feature of the sonogram. Without zooming in, and after I had noted the sonogram definitely records amplitude, a few of the students noted that if we zoomed in far enough, we could see the frequency - which we did.

The students the wrote their conclusions in their science notebooks.

Extensions

I had originally intended to do this lesson with cricket sounds, using a Big Bad Booming Bugs electronic observation station purchased from Amazon (http://www.amazon.com/Booming-Bugs-Electronic-Observation-Station/dp/B000EUJKNE). Turns out, the crickets didn't like making sound when put under that much pressure, but others may have better luck than I! I also wanted to get into the mechanism for insect sound, such as a comb and file in a cricket. Using pocket combs and pencils, I was going to have the kids record onto the recording program to see how similar their sound was to cricket sound. I was then going to ask them to change the amplitude and frequency of their comb sounds, and let them figure out that more energy (harder you push the pencil across the comb), the louder and higher the wave, and the faster push the pencil across the comb, the higher the frequency. There was definitely not enough time for this, but it may work well for a review later in the year.

Assessment Plan

For an assessment, play for the class a couple prerecorded sounds of something you think they will be able to reproduce as a sonogram. I recorded myself whistling, and also played for them some animal sounds downloaded from the Western Soundscape Archive, at http://westernsoundscape.org/. Have them draw the sonograms in their notebooks, making sure they associate amplitude with wave height and frequency with wavelength.

The quality of their small experiment created in class - especially the conclusion - can also be assessed.

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