AUDIOLOGY LESSON

Subject: Math & Science

Grade Level:11th (Junior)

CCSS Math: F-BF.5, F-LE.4, F-LE.5
NGSS Science: PS4.A, ETS.2.B, Using mathematics and Computational Thinking, Analyzing and interpreting data.

Topics: Logarithms and decibels

Concepts:
- decibels are a logarithmic scale
- Sound is a mechanical wave
- Mathematics is coupled with physics to solve problems in our everyday world

Knowledge and Skills Needed for the Project:
- Knowledge of logarithmic functions
- Ability to use a scientific calculator

Materials:

- pen / pencil and paper
- The handout for this lesson

Lesson: This lesson provides a real-life model of a situation and career where algebra and physics, specifically logarithmic functions, can be used to solve problems.

Procedure:

1. Watch The Futures Channel - Audiology video with the class.
2. Discuss with students which math concepts (particularly Algebra 2) and physics (electromagnetic and mechanical waves) might be used within the work Dr. Camacho has described in the video.

3. Remind students that decibels are on a logarithmic scale. Do any review examples as needed for the class to warm up with logarithm before beginning the exercise below.

NOTE: This lesson can be done individually or in teams. When working in teams, allow students to discuss and document their theories about how the equations should be set up based on the information below. When a team has decided what equations should be carried out, one of the team members should be assigned to the job of quality control for the group to check the math of the other teammates before the work is presented to the teacher for grading.

AUDIOLOGY LESSON - HAND OUT

Today, students will test their knowledge to help Dr. Camacho while she is performing tests on a patient to see if he has received middle ear damage. As you may remember from the video, sound is measured in units called decibels (dB), which work on a logarithmic scale. During tests, Dr. Camacho must gradually increase decibel levels in the patient's good ear, to see what the other ear is actually receiving. However, you could not simply turn the volume knob on the sound all the way up without serious risk of injuring the patient's good ear. We will need to see which loudness intensities can be used safely on a patient without damaging their ear drums.

A whisper is about 30 dB, normal conversation is about 60 dB, a motorcycle engine running is about 95 dB. Prolonged exposure to noises above 70 dB can start to damage hearing and loud noises above 120 dB can cause immediate ear damage.

The equation for sound intensity in decibels is L = 10 log (i/m) where *i* is the intensity of the sound and *m* is the minimum intensity of sound detectible by the human ear. For our lesson we will set m = 1.

The lowest setting on the noise machine is 1dB. The highest setting is 120 dB. Dr. Camacho has given you 5 loudness intensity settings to program into the noise machine for the scale to be tested on the patient.

1. What are the decibel levels of the following intensities, and which of the below can be used with a normal hearing patient without doing damage to their ears?

A) I = 1,000
B) I = 1,100,000
C) I = 398,107
D) I = 63,095,734
E) I = 39,810,717,055

2. Dr. Camacho believes she has zeroed in on the patient's level of damage but, wishes to further test between 22 dB and 27 dB. What is the sound intensity difference between these two decibel levels?

ANSWER KEY

QUESTION 1

A) 30 dB

B) 60 dB

C) 56 dB

D) 78 dB

E) 106 dB

A, B, C can be used safely on the patient. D can be used if only for a short period of time and E should not be used at all.

QUESTION 2

22 dB = 158.49 sound intensity
27 dB = 501.19 sound intensity

A difference of 5 decibels is equivalent to (501.19 - 158.49 = 342.7).

27 dB is 342.7 times greater intensity than 22dB.