Class: Grade 4 Science

Lesson Title: Sound Kinulation

Class Size: **24**
Time: **50 mins**

Curriculum Outcomes:
303-10 relate vibrations to sound production
303-11 compare how vibrations travel differently through air and a variety of solids and liquids
301-3 demonstrate and describe how the pitch and loudness of sounds can be modified

Learning Objectives:
1. Students will gain an understanding of how sound is produced and travels through different states of matter.
2. Students will be able to demonstrate and understanding of echoes and a primitive understanding of the Doppler Effect.

Materials:
- A buzzer attached to a piece of string (fire alarm works as well)
- A cart or moveable platforms that students can be pulled on

Preparation beforehand:
- Make sure a large space is cleared for the activity (enough space to roll a cart as well)

Introduction:
1. Introduce the topic. Possible prompt questions include:
    a. What is sound? How do we know it exists?
    b. Are all sounds the same or are there differing levels (pitch, frequency, etc.)?
    c. How do sound waves travel? What do they travel through (air, water, etc.)? Difficulty level in each medium?

2. Explain what a kinulation is (broken up into kinesthetic and simulation). Tell them that these are used to help students learn difficult concepts that are otherwise difficult to picture. It allows students to become part of the demonstration, and therefore easier to remember and learn. Ask students if they would like to try one.

Activity #1: Sound Travelling Through Gases, Liquids, and Solids

Gases:
1. Tell each student that they will represent one air molecule. Ask them how they might distribute themselves in the room to represent a gas (spread out, not touching each other).
2. The teacher will act as the source of the sound, and the students must represent how sound travels through them. When the sound reaches the student, they should either jump, or raise their hands in the air (like the wave at a sports game).
3. Ask the students where the sound will reach first and last, and how will they know when the sound is about to reach them (when they see the person in front of them jump/raise their arms).
4. Students should understand that if you are the source of the sound, the students closest to you will get the sound wave energy first, and then it will travel back like a domino effect.
5. Go through the activity a few times until they get the idea that they have to wait until the sound has reached the student closest to them.
6. *Optional:* You may wish to ask students what would happen if a wall was behind them (an echo might happen) and how they would change their representation to incorporate this wall (they may wish to bounce the sound back, so it would travel from front students → back students → front students again.

Liquids:
7. Ask how they would change themselves to instead represent molecules in a liquid (more closely packed together, perhaps they want to form a pair of lines).
8. This time, as the sound source reaches them, they can simply lean back (not too far), and the sound will

travel through them similar to a domino effect. This time they are more closely packed together.

Solids:

9. Again, ask students how they might represent a solid. How would sound travelling through the solid differ? It might be more difficult for sound to travel through a solid since the molecules of a solid don't move much, so the sound energy might be lost or not transferred completely.

Activity #2: The Doppler Effect

1. Complete a demonstration of a buzzer/alarm on the end of the string that is spun around your head. Ask them to listen closely to the sound as the buzzer is moving toward them, and then away from them (they should hear a distinct difference of high vs. low pitch).
2. Have 3-4 students stand on a stationary cart. Let them know that they each represent a part of the sound wave (air particles, etc.).
3. Get the students marching in place, and have them walk off the cart, keeping an equal space between each student as they walk off. This represents what a sound wave would look like when it is produced by an object that is not moving.
4. Repeat this marching of the students in place on the cart, but this time, as students are marching off the cart, pull the cart (carefully) backwards. Ask students to give their observations of the distances between students this time (the students will be further apart than in the stationary run, representing a different pitch/frequency of the sound wave).
5. Again repeat the activity, this time push the cart in the direction the students will be marching (carefully as to not run them over). Have students give their observations again (they will notice that the sound wave students got a lot closer together because the path of the sound wave was the same direction as the moving object producing the sound).
6. This activity is meant to simulate the Doppler Effect (something they might be familiar with as sirens from ambulance, police, or fire trucks sound as they are moving).
7. You may wish to repeat the activity with different groups of students.

Conclusion – Possible wrap-up questions:

1. How do we know that sound waves actually exist?
2. Why can we still hear sound underwater?
3. What types of objects do you think might be hard to hear sound through?