Sound Waves in Zero-G!

Introduction

Sound waves are created when an object vibrates, which causes particles in the medium (such as air) to vibrate, and these vibrations are transmitted as sound waves. However, in space or microgravity environments, there is no air or atmosphere, so sound waves cannot travel in the same way as they do on Earth.

Microgravity is a condition where objects appear weightless, such as on the International Space Station. In this environment, the properties of sound waves can behave differently than they do on Earth. Ask students to consider how this might be different, and how it could affect the study of sound waves in space.

Students will explore the concepts of sound waves, frequency, and motion using an assortment of instruments and materials. As an extension students will design and build an apparatus to move an object in microgravity.

Materials

Small, round cake sprinkles
Plastic wrap
Small bowl
Variety of musical instruments

Target grade level: K-8th grade

NGSS (Next Generation Science Standards)

HS-PS4-1: Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.
model, and that for some situations one model is more useful than the other.
MS-PS4-1: Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.
MS-PS4-2: Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.
MS-ETS1-2: Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

Engage

Ask students if they know your super power - You can make cupcake sprinkles dance without touching them!

- Stretch plastic wrap over a small bowl, so that it is tight with no wrinkles in the plastic
- Pour cupcake sprinkles over the top, pushing plastic down lightly in the center of the saran wrap. This dent will keep the sprinkles from running away!
- Play music, and instrument, sing, or strike a tuning fork near the Saran wrapped bowl.
- Discuss: what caused the sprinkles to move?
- Introduce the concept of soundwaves.

Purpose

To demonstrate the ability of sound energy to move objects. How does sound and pitch affect movement? How does the mass of the object affect movement?

Materials

Selection of “instruments”
- Band instruments (students can bring their own)
- Choir students can use their voices
- Tuning forks
- Recorded music

Selection of materials
- Paper or plastic Cups
- Paper plates
- Plastic wrap
- Styrofoam
- Cardboard
- Beads
- Iron filings
- Magnets
- Use your imagination!

Procedure

1. Create a device in which objects are moved by sound waves
2. Adjust the pitch of sound. Observe and record how movement changes
3. Adjust volume of sound. Observe and record how movement changes

Results

Describe and illustrate your design:

Effect of pitch and volume

		Observations
Pitch	Low	
Pitch	High	
Volume	Low	
Volume	High	

Assessment

1. How does changing pitch affect movement of your object? Explain.
2. How does changing volume affect movement of your object? Explain.
3. How does changing mass of the object affect its movement? Explain.
4. How would movement of the cupcake sprinkles change in lunar gravity? Explain.
5. How would movement of the cupcake sprinkles change in microgravity? Explain.
6. Reflect about real-world examples of resonance, such as musical instruments, bridges, and buildings. How can the knowledge of resonance be applied?
7. Look at the following videos taken on board G-Force One. Explain.
    - https://youtu.be/LImuNxcwGmE
    - https://youtu.be/jSDw5q1EDyk

Design and construct a device that will move a substance or object in microgravity using sound waves!

- Max volume 10 cm^3
- Max weight 2 kg
- No hazardous materials, including glass,sharp, or breakable objects
- No liquids
- All materials must be contained within the 10 cm^3 while weightless