Sound

Physical Science | Lesson Guide

5th Grade

Photo Description

A group of musicians is playing brass instruments like trumpets and trombones together in what appears to be a band performance. The instruments are made of shiny metal and have different shapes and sizes. When the musicians blow air into their instruments, they create sound waves that travel through the air to our ears.

Scientific Phenomena

The anchoring phenomenon here is sound production and transmission through musical instruments. When musicians blow air into brass instruments, they cause their lips to vibrate against the mouthpiece. These vibrations create sound waves that travel through the metal tubes of the instruments. The length and shape of each instrument determines the pitch (how high or low the sound is), while the force of the air blown determines the volume (how loud or soft the sound is).

Core Science Concepts

1. Sound is produced by vibrations - The musicians' lips vibrate against the mouthpiece, creating the initial sound energy
2. Sound travels in waves through matter - The sound waves move through the air from the instruments to listeners' ears
3. Pitch depends on frequency - Longer instruments like trombones make lower sounds, while shorter instruments make higher sounds
4. Materials affect sound transmission - The metal construction of brass instruments amplifies and shapes the sound waves

Pedagogical Tip:

Have students place their hands on their throats while humming to feel vibrations firsthand. This concrete experience helps them understand that all sound starts with something moving back and forth.

UDL Suggestions:

Provide multiple ways for students to experience sound concepts: visual wave demonstrations with rope or springs, tactile experiences feeling vibrations on instruments or desks, and auditory examples with various pitched instruments.

Zoom In / Zoom Out

1. Zoom In: At the molecular level, sound waves are created when air molecules bump into each other in a chain reaction. When lips vibrate in the mouthpiece, they push and pull air molecules, creating areas of high pressure (compressions) and low pressure (rarefactions) that travel outward.

2. Zoom Out: This musical performance is part of a larger acoustic environment where multiple sound sources combine. The room's architecture, materials, and size all affect how the sound waves bounce around, creating echoes and resonance that influence what the audience hears.

Discussion Questions

1. "What would happen to the sound if the musicians played their instruments in outer space?" (Bloom's: Analyze | DOK: 3)
2. "How do you think the shape and length of different brass instruments affects the sounds they make?" (Bloom's: Evaluate | DOK: 2)
3. "Why might a trombone sound different from a trumpet even when playing the same note?" (Bloom's: Analyze | DOK: 2)
4. "What evidence can you observe that shows sound is being produced by these instruments?" (Bloom's: Apply | DOK: 2)

Potential Student Misconceptions

1. Misconception: "Sound travels faster than light" - Reality: Light travels much faster than sound, which is why you see lightning before hearing thunder
2. Misconception: "Louder sounds have higher pitch" - Reality: Volume (amplitude) and pitch (frequency) are separate properties of sound waves
3. Misconception: "Sound can travel through empty space" - Reality: Sound needs matter (like air, water, or solids) to travel through because it moves by vibrating particles

Cross-Curricular Ideas

1. Math - Measuring Wavelengths and Frequency: Have students measure the lengths of different brass instruments and create a graph showing how instrument length relates to pitch. They can use a xylophone or tone generator to test different frequencies and record data in a table, connecting math skills to sound science.

2. ELA - Descriptive Writing: Ask students to write a sensory poem or short story about attending a concert, using descriptive language to explain what they see, hear, and feel. They can research famous brass bands or musicians and write biographical paragraphs about them.

3. Social Studies - Music Around the World: Explore how different cultures use brass instruments in their traditional music (like French horns in European orchestras or didgeridoos in Aboriginal Australian music). Students can create a world map showing where different brass instruments originated and how they're used in various celebrations and ceremonies.

4. Art - Design and Construction: Have students sketch their own imaginary musical instrument, label its parts, and explain how they think it would produce sound. They can create a 3D model using paper towel tubes, straws, and other recyclable materials, then test it to see if it actually makes sound.

STEM Career Connection

1. Acoustical Engineer: These scientists study how sound works and design spaces where sound quality matters, like concert halls, recording studios, and movie theaters. They use math and physics to make sure sound travels and echoes the right way so audiences hear the best possible music or voices. Average Salary: $65,000–$85,000 per year

2. Musical Instrument Maker (Luthier): Luthiers are craftspeople who build and repair musical instruments like guitars, violins, and brass instruments. They use knowledge of materials, physics, and sound to create instruments that produce beautiful tones. They need to understand how different metals and wood affect the vibrations and sound quality. Average Salary: $40,000–$70,000 per year

3. Audio Technician/Sound Engineer: These professionals operate the equipment that records, mixes, and plays back music and sound for concerts, radio, television, and movies. They use technology and understanding of sound waves to make sure the audience hears everything clearly and at the right volume. Average Salary: $50,000–$75,000 per year

NGSS Connections

- Performance Expectation: 5-PS1-3: Make observations and measurements to identify materials based on their properties
- Disciplinary Core Ideas: PS4.A - Wave Properties, PS4.C - Information Technologies and Instrumentation
- Science and Engineering Practices: Planning and Carrying Out Investigations, Analyzing and Interpreting Data
- Crosscutting Concepts: Patterns, Cause and Effect

Science Vocabulary

* Vibration: A rapid back-and-forth movement that creates sound energy
* Sound wave: The invisible pattern that carries sound energy through air or other materials
* Pitch: How high or low a sound seems to our ears
* Amplitude: The strength of a sound wave that determines how loud or quiet it sounds
* Frequency: How many vibrations happen in one second, measured in hertz

External Resources

Children's Books:
- Sound: Loud, Soft, High, and Low by Natalie M. Rosinsky
- The Magic School Bus Explores the Senses by Joanna Cole
- Sounds All Around by Wendy Pfeffer