Ronald McNair

Light & Sound Waves Exploration

MISSION SPECIALIST, PHYSICIST

Ronald held a Ph.D. in physics and was a pioneer in laser science. He was also an accomplished saxophonist and worked to inspire students from underrepresented backgrounds to pursue science.

OBJECTIVE

Explore properties of light and sound, linking to music and lasers.

HOW WILL STUDENTS ACHIEVE THE OBJECTIVE?

1. Learn about McNair's love for physics and music.
2. Explore pitch using rubber bands or water glasses.
3. Investigate light refraction or reflection.
4. Draw wave diagrams.

MATERIALS

- Tuning forks, rubber bands, glasses with water
- Flashlights, laser pointers (if available), mirrors
- Sound wave visualizer apps (optional)
- Student worksheet (data table, diagrams)

STEP BY STEP INSTRUCTIONS

1. **Introduction:** Introduce McNair and his background as a physicist and musician.
    a. On board the Challenger, one of his NASA assigned mission goals was to perform laser-based spectroscopy experiments. He was hoping to study how gases and particles perform in microgravity (in areas such as energy transfers, fluid behavior, and laser interactions).
    b. See Biographical Data Sheet for his work experience with NASA
    c. Notable works of McNair
        i. During his time at MIT he specialized in quantum electronics and laser physics. His work later influenced advancements in aerospace sensors and laser communication.
        ii. During his first space flight he worked to launch two satellites that sent messages and TV signals around the world.

STEP BY STEP INSTRUCTIONS (continued)

2. **Demonstration:** Show how different lengths of rubber bands or water glasses create different pitches.
    a. **Rubber Bands**
        i. Rubber bands that are longer or looser vibrate slowly and create a low pitch
        ii. Rubber bands that are shorter or tighter vibrate quickly and create a high pitch sound.
    b. **Water Glasses**
        i. Glasses that have a large amount of water in them will vibrate slow creating a low pitch.
        ii. Glasses that have a little amount of water in them will vibrate quickly creating a high pitch.
3. **Station Rotation:**
    a. **Sound Station:** Students stretch rubber bands over boxes and pluck to observe pitch change. Provide the students a variety of materials (different size boxes, different sized rubber bands, etc.)
    b. **Water Glasses:** Fill with various water levels, tap with pencils.
    c. **Laser/Mirror Station:** Use a laser pointer and mirror to bounce light.
        i. Remind students of the harmful effects lasers can have on the human body – so provide clear instructions on how to use a laser properly.
    d. **Refraction Station:** Shine flashlight through water and glass.
    e. ** Upon completion of the experiments - have students complete the front side of the Light and Sound Student Worksheet to review the data gathered during their experiments. **
4. **Wave Diagram:** Students draw sound and light waves with labeled amplitude and wavelengths.
    a. Explain to students that sound waves cannot only be heard, but they can also be seen. You can draw what a sound looks like by using the following vocabulary words – amplitude, wavelength, and frequency.
        i. Review the definition of each vocabulary word
            01. **Amplitude –** shows how big or strong the wave is (height)
            02. **Wavelength –** the distance between two waves
            03. **Frequency –** how often waves happen in one second
    b. Work with the students to draw one or both soundwaves (a low pitch sound wave and a high pitch sound wave) onto the Light and Sound Student Worksheet
        i. **Low pitch sound wave –** wave is spread out, not very tall, etc.
        ii. **High pitch sound waves –** waves are very close together, very tall, etc.
5. **Reflection:** Discuss how astronauts use sound and light sensors in space.
    a. Have students answer the last question on their Light and Sound Student Worksheet. Discuss answers.
    b. Possible answers include: flashlight, head/helmet lights, laser, radios, headsets, alarms, cameras, etc.

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Light & Sound Student Worksheet

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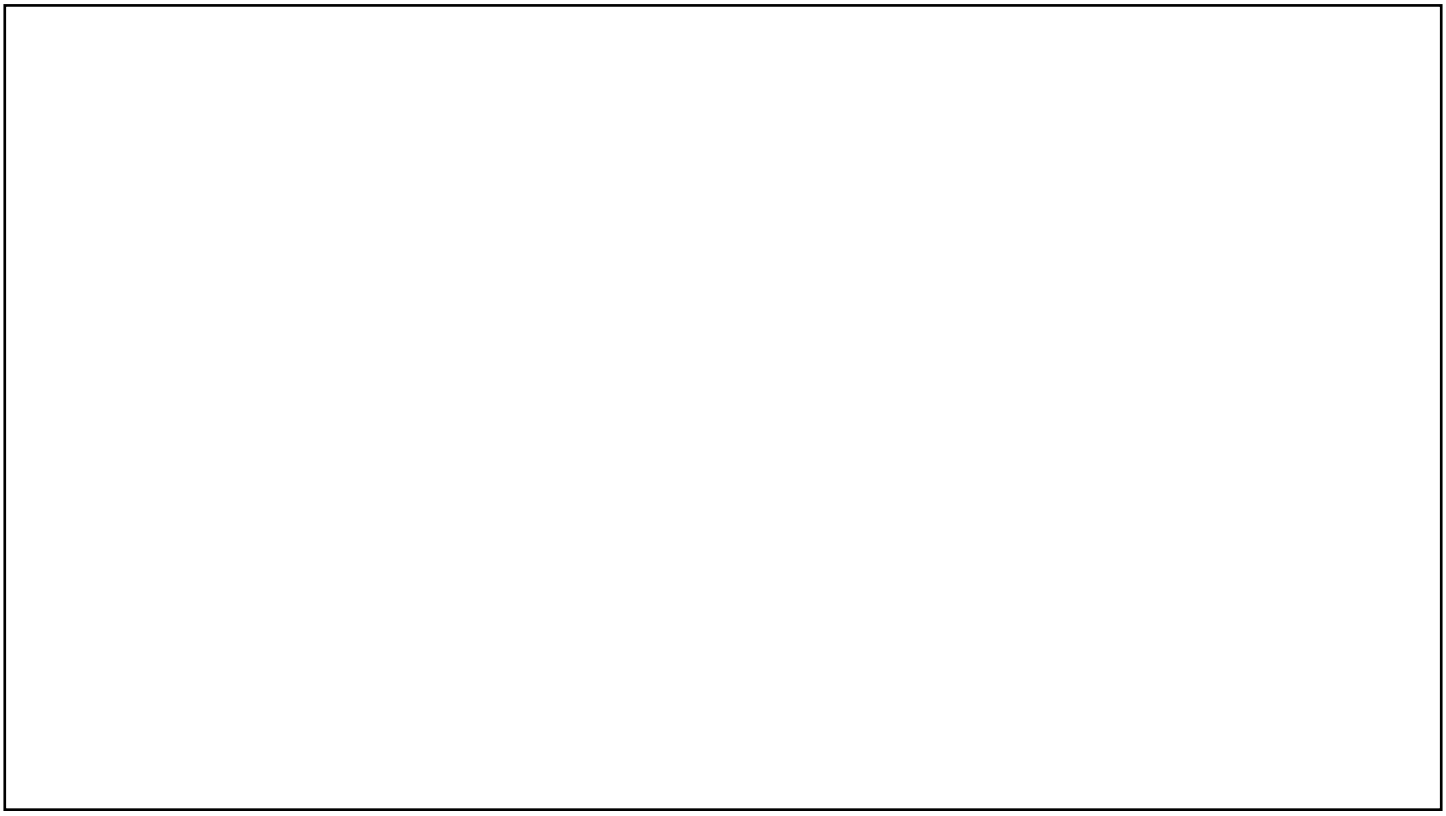
Describe how pitch or tone changed with your instruments:

How did the light behave when you used mirrors or glass?

Sketch one sound wave and one light wave below:
[Amplitude, wavelength, frequency]



Which tools do astronauts use that rely on sound or light?