

## SIEMENS STEM DAY ACTIVITY

# SOUND FOR VISION

## OBJECTIVES

Students will be able to:

- **Understand** the parts of a sound wave.
- **Classify** which frequencies are used for diagnostic ultrasound.
- **Analyze** the most useful type of ultrasound to human health and wellbeing.

## THIS LESSON FOCUSES ON

### Engineering Design Cycle

- Communicating Results

### 21st Century Skills

- Communication

## OVERVIEW

Students will explore the parts of a sound wave and learn about human reception of sound. Students will research and analyze the types of ultrasound before making a claim as to the most beneficial type to human health and well-being.

STEM incorporates Science, Technology, Engineering, and Mathematics to focus on real-world issues and problems guided by the engineering design process. This type of instruction supports students in developing critical thinking, collaboration, reasoning, and creative skills to be competitive in the 21st-century workforce.

Each Siemens STEM Day classroom activity highlights one or more components of the engineering design cycle and an essential 21st-century skill.

## MATERIALS

- **Parts of a Sound Wave** Handout—one per student or one displayed electronically
- **Frequency Chart**—one printed large or displayed electronically
- device with Internet Access—at least one for each of three groups
- **Jigsaw Note Taking Sheet Handout**—one per group

## HAVE YOU EVER WONDERED . . .

How is sound used to communicate distance or show us pictures inside our bodies?

## MAKE CONNECTIONS!

### How does this connect to students?

Ultrasound is usually the first diagnostic tool used when looking for internal injury. It has no radiation; it can capture real-time images. There are 2D ultrasounds that show flat images, 3D ultrasounds that show 3d pictures of inside the body, and 4d ultrasounds that show 3D video of what is going on inside the body. These modern 3D and 4D scans can be used to create sculptures of a baby about to be born.

### How does this connect to careers?

An **Ultrasound Technologist** is responsible for taking the ultrasound scan of a patient. The role involves positioning the sensor, so detailed pictures and measurements inside the body can be made. Ultrasound Technologists can be found in hospitals, clinics, and OB/GYN Dr. offices.

An **Ultrasound Systems Designer** is responsible for designing the software used in the Ultrasound computer. The role involved designing algorithms that enable the computer to render high-resolution images of inside the body. An Ultrasound Systems Designer can be found in medical technology companies.

### How does this connect to our world?

**Sound sight** is found in more than just Ultrasound." Bats use a variety of ultrasonic ranging (echolocation) techniques to detect their prey. They can detect frequencies beyond 100 kHz, possibly up to 200 kHz.<sup>1</sup>

Daniel Kish who is blind but can see like a bat using his version of echolocation.<sup>2</sup>

## BLUEPRINT FOR DISCOVERY

1. To engage students in what they will be learning, ask them what comes to mind when you ask them to describe what sound is. Many students might provide examples of sound (i.e., music notes, a dog barking, traffic noise, etc.) instead of describing sound with adjectives (i.e., dulcet, rich, loud, melodic, etc.) or defining terms (i.e., vibration that produces waves, transmits through medium, receiving waves by the brain, transmitted to the ear, etc.).
2. Confirm that sound is transmitted in waves. Distribute or display the **Parts of a Sound Wave** handout and discuss the elements shown.

<sup>1</sup> Popper A, Fay RR, eds. (1995). Hearing by Bats. Springer Handbook of Auditory Research. 5. Springer. ISBN 978-1-4612-2556-0

<sup>2</sup> On the internet <https://www.bbc.com/news/av/magazine-35545476/daniel-kish-man-who-is-blind-but-can-see-like-a-bat> (August 23, 2019)

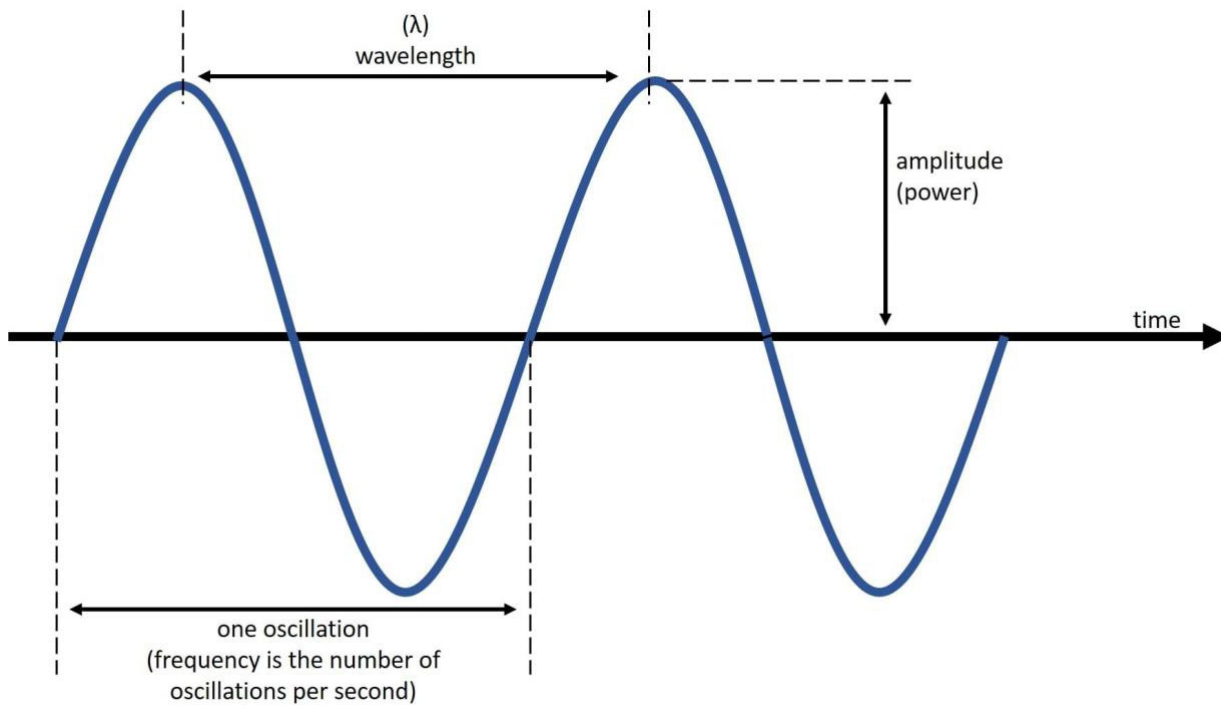
3. Inform students that there are several sounds that human ears are not able to perceive. One such wave, **ultrasound**, is undetectable because of the limitations of our ears. Display the **Frequency Chart** to show students the relatively small amount of sound waves that are detectable by humans. Reinforce the fact that humans can hear between 16 Hz–18 kHz, and diagnostic ultrasound occurs between 5 MHz–10 Mhz.
4. Split students into three groups. Assign each group one of the three types of ultrasound: **echolocation**, **sonar**, and **ultrasonography**. Give them time to work together to research online and complete their **Jigsaw Note Taking Sheet** Handout.
5. Give each group an opportunity to present their findings about their assigned type of ultrasound to the class.
6. As a group, work to answer the question, “Which type of ultrasound is most beneficial to human health and wellbeing?,” using their research as support for their position.

## TAKE ACTION!

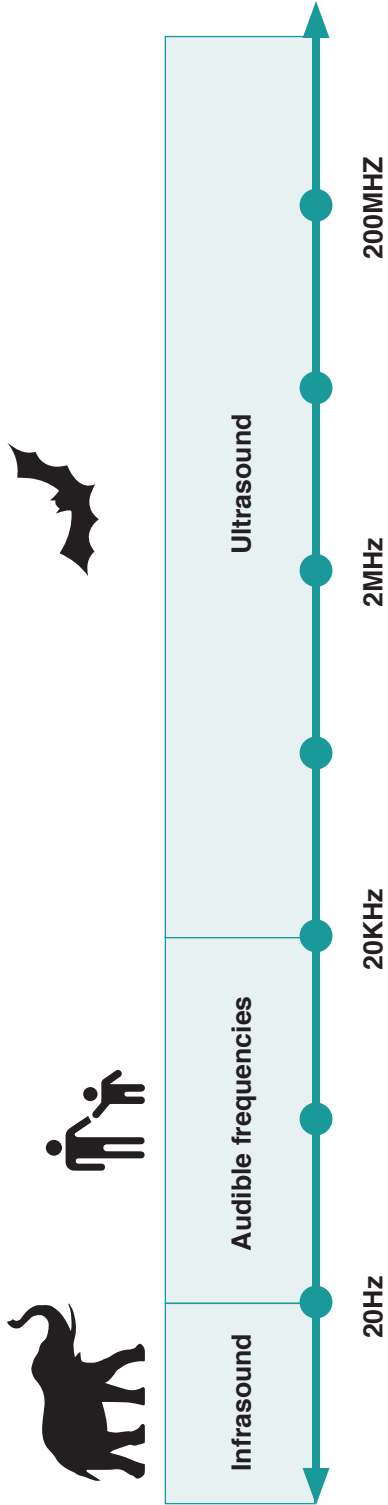
- Students can compare ultrasound images to that body part of which it represents to better understand the end product of sound representing a visual.
- Students can better learn how diagnostic 3D ultrasound work by exploring the idea of point clouds (<https://www.3deling.com/whta-is-a-point-cloud/>) and how some ultrasound devices use point clouds to make 3d images (<https://www.webmd.com/baby/3d-4d-ultrasound>).

## NATIONAL STANDARDS

<p>Science</p>	<p><a href="#">Next Generation Science Standards</a> HS-PS4-5. Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.</p>
<p>Technology Education</p>	<p><a href="#">International Technology and Engineering Educators Association</a> Standard 14: Students will develop an understanding of the designed world. This includes selecting and using medical technologies.</p>



- **Wavelength:** variation in air pressure and the distance over which the wave's shape repeats
- **Oscillation:** how long it takes for a wave to move from starting position, one position to the next, back to the start
- **Amplitude:** the intensity or power of a sound wave, regarding volume
- **Frequency:** the number of oscillations the wave completes in a certain amount of time (i.e., seconds)
- **Hertz (Hz):** the unit of measurement for sound, based on oscillations per second



# JIGSAW NOTE TAKING SHEET

Assigned Type of Ultrasound:

Description:

Examples:

Uses:

Diagram:

Most Useful To: