Hearing Is Believing — Audiologist

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Application

"You'll be amazed how much math audiologists use," says audiologist Pam Phelps.

Mathematics can determine the frequencies that a person can't hear, the volume of the ear canal and how much hearing a person has lost. Computers do a lot of the calculations now, but audiologists still need to interpret and assess the mathematical data.

Hearing is one of the least understood senses. Still, there has been a lot of research and development in the last five to 10 years. "When I graduated there were at least four theories on how sound is transmitted through the ear to the brain, but now we have a pretty good solid theory," says Phelps. Understanding this theory is, of course, critical in diagnosing hearing loss.

There are a number of ways a person can be hard of hearing. "One person's loss of hearing can be quite different than someone else's," says Phelps.

Audiologists use an audiogram to chart the results of tests on a patient's hearing. The audiogram has frequency (or pitch) across the horizontal axis and decibels (or loudness) across the vertical axis.

Frequency ranges from the extremely low frequencies on the very left of the graph to the very high frequencies on the far right. Frequencies of 125 or 250 Hz are low tones like the bass notes on a piano. High frequencies of 8,000 Hz are high tones, like the treble notes on a piano.

Decibels describe the loudness of the sound. Zero decibels is very soft while 110 dB is very loud. Normal speech is around 45 dB. The softest sounds that a person can hear 50 percent of the time is considered their hearing threshold. These thresholds are measured and marked by an audiologist on the audiogram.

Practice

Get into groups of four or five. Complete the Student Activity Sheet with the following:

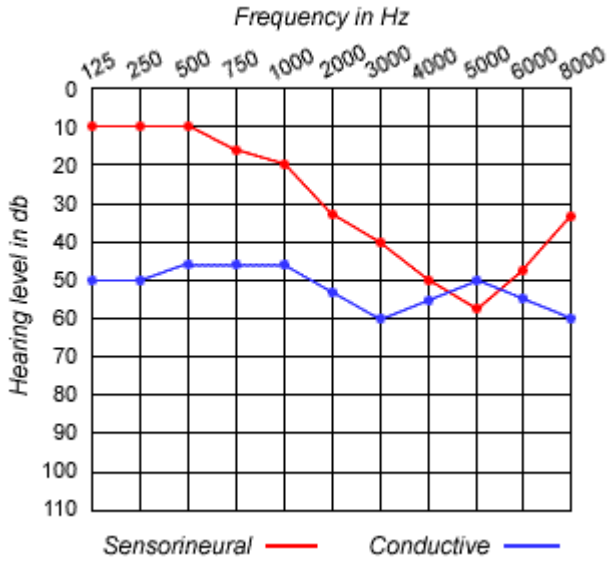
- Brainstorm five things that you believe would have an extremely low frequency and another five things that would have an extremely high frequency. Estimate how many Hz each would be.
- Brainstorm five things that would be very low in decibels and another five things that would be high in decibels. Estimate how many decibels each would be.

(Hint: One example for a low frequency sound might be a foghorn at 175 Hz. One example of a loud sound would be a fire alarm at 135 dB.)

Principles

From reading the results of an audiogram, audiologists can also determine what type of hearing loss has occurred. There are two main types -- conductive and sensorineural. Conductive hearing loss occurs when the outer or middle ear doesn't work properly. Sounds are "blocked" and don't make it all the way into the inner ear. Common causes are too much fluid in the middle ear or too much earwax. Conductive hearing loss is usually treatable. Sensorineural hearing loss occurs when the inner ear or hearing nerve becomes damaged. This happens with aging or damage from loud noises.

The audiogram shown in Diagram A represents the charts of typical conductive and sensorineural hearing losses. The areas above the lines are sounds that the person would not hear.



Ranges have been established to standardize descriptions of hearing loss:

- 10 dB to 25 dB -- normal range
- 26 dB to 40 dB -- mild hearing loss
- 41 dB to 55 dB -- moderate hearing loss
- 56 dB to 70 dB -- moderately severe hearing loss
- 71 dB to 90 dB -- severe hearing loss
- over 90 dB -- profound hearing loss

Learn

You're an audiologist and you've just finished evaluating an elderly gentleman's hearing. He's apprehensive that he's lost his hearing for good. These are his results:

- 125 Hz -- 55 dB
- 250 Hz -- 60 dB
- 500 Hz -- 60 dB
- 750 Hz -- 50 dB
- 1000 Hz -- 50 dB
- 1500 Hz -- 65 dB
- 2000 Hz -- 65 dB
- 3000 Hz -- 57 dB
- 4000 Hz -- 55 dB
- 6000 Hz -- 60 dB
- 8000 Hz -- 65 dB

Graph his audiogram with frequency (Hz) on the horizontal axis and loudness (dB) on the vertical axis. Based on your interpretation of this graph, answer the following questions:

1. Do you notice any patterns or trends in the graph?
2. Does this man have conductive or sensorineural hearing loss?
3. Do you expect his hearing loss to be treatable?
4. At what level would you describe his hearing loss?

Yes, you can do it

Ask a local audiologist to come into your classroom to show you the technology used to measure hearing loss. Return to your groups and test your own hearing level. Based on the interpretation of your own graph, answer the following questions:

1. Is your hearing within normal range for all frequencies?
2. At what frequency were you unable to hear?