

How to Read An Audiogram

Includes:
Understanding frequency and intensity
The Audiometer
The Audiogram and its interpretation



WROCC Outreach Site at Western Oregon University

The measurement of hearing consists of two parameters: the frequency or pitch of the sound and the intensity or loudness of a sound. The device used to measure responses to sound is called an audiometer. Responses to the tones presented through the audiometer are recorded on a graph called an audiogram.

Frequency

Frequency is a measurement of sound waves. It is determined by how many cycles per sound wave occur in one second. Another name for frequency is Hertz, abbreviated Hz. Frequency, Hertz, and Hz all refer to cycles per second; for example, 1000 Hz is the same as 1000 cycles per second.

The numbers across the top of the audiogram (*see next page*) represent frequency (pitch), going



Low Frequency Mid-Frequency High Frequency

F R E Q U E N C Y

from low pitch (250 Hz) to high pitch (8000 Hz) much like the strings on a harp or piano. The longer the string, the lower the frequency. Although the range of hearing in humans is 20 Hz to 20,000 Hz, the audiogram is used to record those frequencies most necessary for the detection and understanding of human speech.

I N T E N S I T Y



Intensity

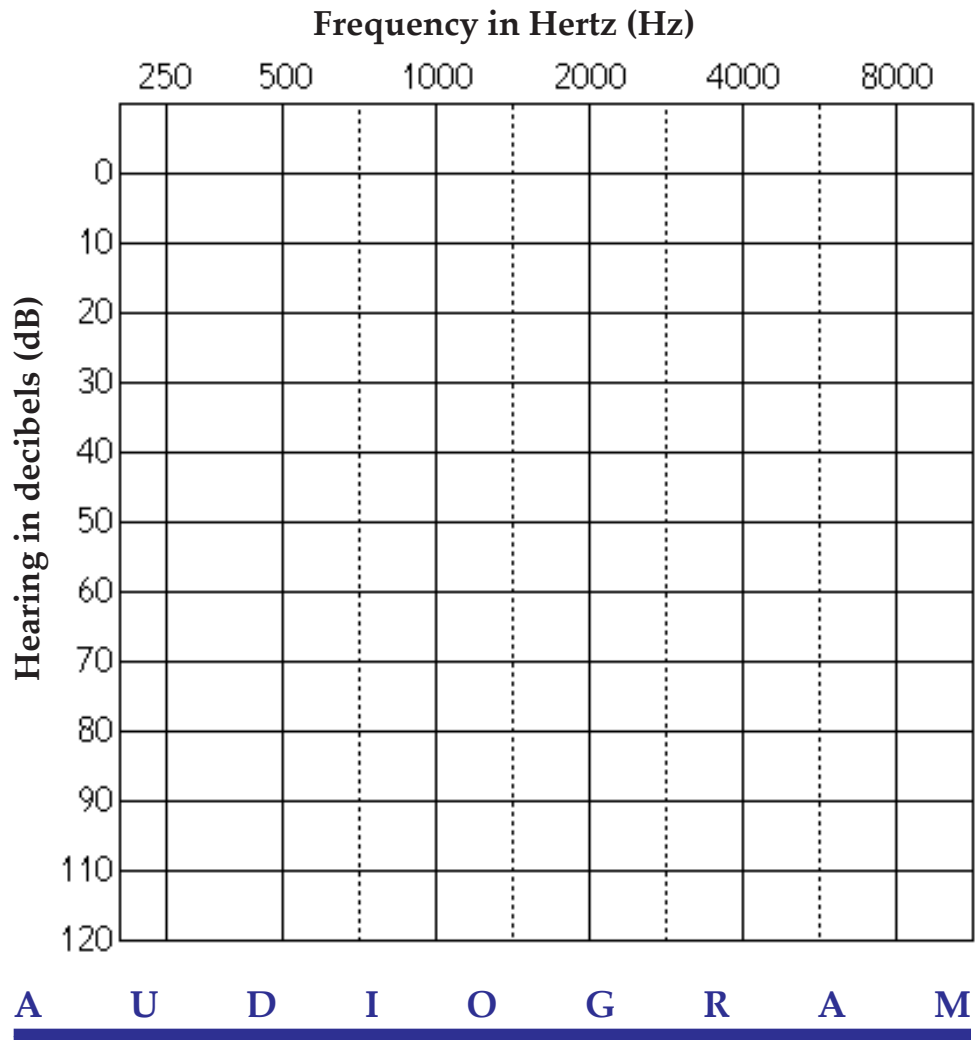
Intensity is also a measurement of soundwaves. Intensity is measured in decibels (dB). Decibel (dB) is a measurement of sound loudness (sound power) and grows more rapidly than a linear measurement. For example, 20 feet is 20 times longer than 1 foot but 20 decibels is 100 times more powerful than 1 decibel and 120 decibels is 1,000,000,000,000 more powerful than 1 decibel!

The numbers run along the left side of the audiogram (*see next page*) and represent the perception of loudness, ranging from

-10 dB to 120 dB. 0 dB represents the softest sound that individuals with the best hearing detect 50% of the time. 120 dB is painfully loud to most individuals with normal hearing.

The Audiometer

An audiometer may be portable or stationary. The most reliable evaluations are conducted with the client in one sound-proof room and the audiologist in another sound treated room using a stationary audiometer that has been calibrated yearly by a professional. Calibration assures validity of the evaluation. The audiologist presents tones through the audiometer either at ear-level or through speakers. When a tone is presented at ear-level, it comes through earphones (a headset with TDK earmuffs or earphones that insert into each ear canal) or a bone conduction oscillator. When tones are presented soundfield, speakers are placed approximately 3 feet from each ear to assure equal balance of the presentations.



The Audiogram

An audiogram is a graph that charts the way a person responds to specific sounds called *puretones*. It is designed to record the responses for the mechanical part of hearing. The audiologist measures a client's *hearing threshold* at each frequency. Auditory threshold is the intensity at which a puretone is barely detected 50% of the time, often in two out of three presentations.

All audiograms have an *audiogram key*, or *legend* at

A U D I O G R A M K E Y

Air Conduction ○ right ear × left ear With Masking: Δ right ear □ left ear	Bone Conduction < right ear > left ear With Masking: [right ear] left ear
* aided S unaided ↓ no response	

the bottom to remind the reader of the meaning of the symbols.

Earphones are used to evaluate hearing of the outer, middle, and inner ear. A response at any frequency is called the *air conduction response (AC)*. The type of earphone (TDK or insert) should be noted as part of the audiogram.

A bone conduction oscillator stimulates the inner ear directly and is placed by the audiologist on the mastoid bone. The use of the bone oscillator bypasses the outer ear and middle ear and stimulates the cochlea (inner ear) directly. A response at any frequency is called the *bone conduction response (BC)*.

When an individual cannot wear earphones, hearing levels are evaluated by presenting tones or noise through speakers in a soundproof room. This is called the *Soundfield Response*.

When there is suspicion or confirmation that one cochlea hears better than the other cochlea at a

given frequency, *masking* (narrow band or speech noise) is presented to the better ear to keep it “occupied.” Masking is generally presented through one earphone and a puretone or speech is presented through the opposite earphone or a bone oscillator.

The responses charted on the audiogram define levels of hearing for each ear. For adults, normal hearing and degree of hearing loss fall into the following categories:

- 0 dB - 20 dB normal hearing
- 20 dB - 40 dB mild hearing loss
- 40 dB - 55 dB moderate hearing loss
- 55 dB - 70 dB moderately severe hearing loss
- 70 dB - 90 dB severe hearing loss
- >90 dB..... profound hearing loss

Audiogram Interpretation

The audiogram indicates where along the auditory system hearing loss occurs. For most adults, hearing loss is confined to the inner ear and is called *sensorineural hearing loss*. The *sensory* part of the inner ear, tiny hair cells called cilia, are damaged. The configuration of responses on the audiogram indicate where the damaged hair cells are in the cochlea. It is not common for damage to occur to the *neural* part of the inner ear, those tiny nerve bundles that interact with both inner and outer hair cells.

Hearing loss that is the result of blockage, damage, or disease to the outer and/or middle ear, with the cochlea hearing normally, is called *conductive hearing*

loss. Conductive hearing loss means there is a difference of at least 10 dB between bone conduction responses and air conduction responses. Bone conduction responses must fall within the range of normal. The conductive mechanism consists of the outer ear, the ear canal, the eardrum, the Eustachian tube, and the tiny bones of the middle ear—the ossicles.

Hearing loss that includes diminished air conduction responses and both normal and diminished bone conduction responses is called *mixed* hearing loss. This means that a person has both conductive hearing loss and sensorineural hearing loss: that there is an air-bone gap of at least 10 dB, generally in the low to mid frequencies, but no air-bone gap at the mid to high frequencies.

While valuable, an audiogram only tells the way a person responds to basic sounds—or how loud a sound needs to be for an individual to be aware of it. The audiogram has value when determining financial compensation for handicap; however, it only *suggests* the way a person might function in a quiet environment and gives little valuable information about how one functions in the real world. Most people with hearing loss have hearing threshold levels that cross a range of categories; consequently, further word and speech testing must be conducted in order to determine function and amplification needs.

Carol J. Yetter, M.S., CCC-A, FAAA
Audiologist

WROCC is one of the four Regional Postsecondary Centers for Individuals Who Are Deaf and Hard of Hearing which make up PEPENet, the Postsecondary Education Programs Network. The centers combine their efforts to provide a biennial conference, online trainings, cross-regional training and consultation, distance learning opportunities, and transition services. For more information, visit the PEPNet website at www.pepnet.org.



**WROCC Outreach Site at
Western Oregon University**
345 N. Monmouth Ave.
Monmouth, OR 97361
wrocc@wou.edu
www.wou.edu/wrocc

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