

Introduction to Audiology

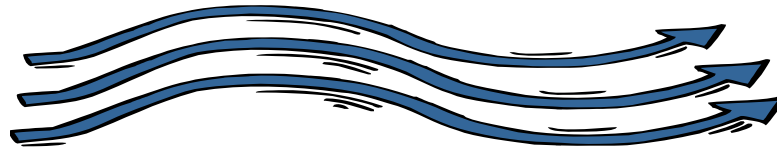


- How to Read an Audiogram
 - Degrees of Hearing Loss
 - Types, Causes and Prevalence of Hearing Loss
 - Types of Tests

How to Read an Audiogram

- Terminology Used

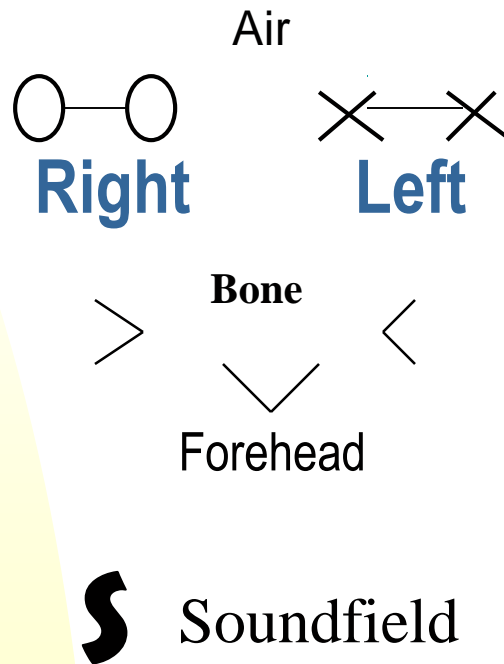
- ◆ Hertz (Hz) is used to describe frequency or pitch, cycles per second



- ◆ Decibel (dB) is the unit that describes the intensity, or loudness, of the sound

Audiometric Symbols⁽¹⁾

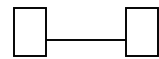
Look for the Key on Chart



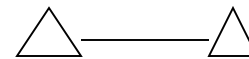
Masked Audiometric Symbols⁽¹⁾

Masked Left Ear

Masked Right Ear



Air



Bone

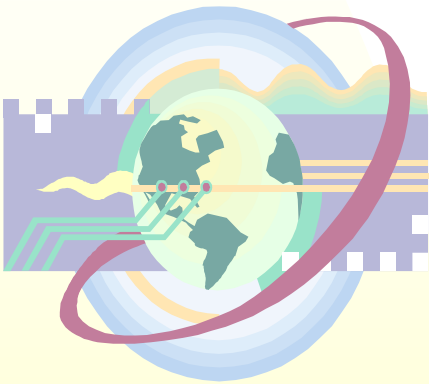


The idea behind masking is to keep one ear “*busy*” while testing the opposite side

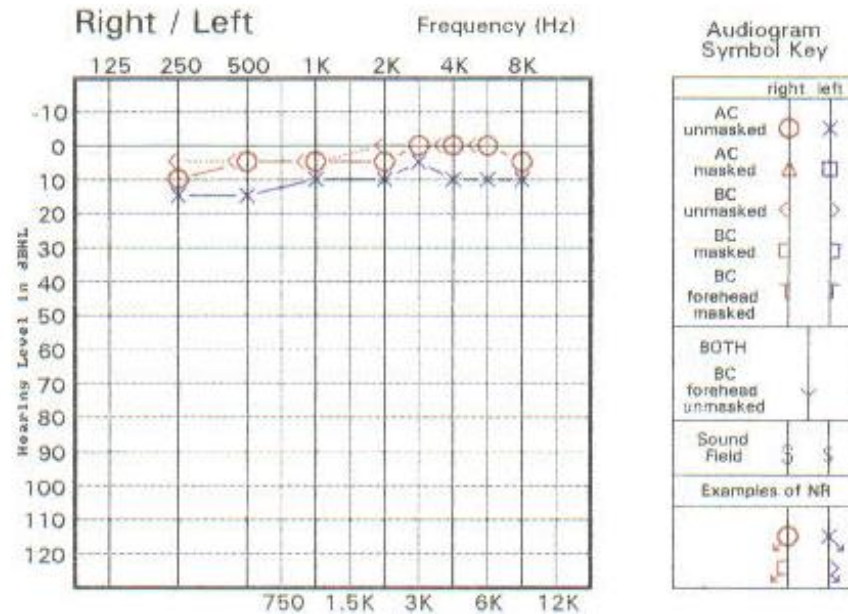
Audiometric Symbols

Universally Used

- Pure Tone Air Conduction
- Pure Tone Bone Conduction
- May be Masked or Unmasked
- Tests in Soundfield (Narrow Band Noises, Warble Tones, or Speech)
- May obtain responses to Speech via Air and/or Bone Conduction pathways



Normal Hearing⁽²⁾



Determine Hearing Level



- Establish Hearing Threshold Level (HTL or simply HL)
- What is *threshold*?
 - ◆ With earphones or via bone, softest sound detected 50% of time
 - ◆ In the soundfield, tests reveal response of *better ear*
- Speech Reception Threshold (SRT) is softest level possible to hear closed set of bi-syllabic words
- Thresholds are measured in decibels (dB) at various frequencies, reported in Hertz

Speech Reception Threshold

- Softest level of speech that can be understood 50% of the time
- Bi-syllabic vocabulary may include words tailored for pediatric patients
- Ear specific, if earphones used
- Obtained via air and/or bone conduction
- Correlates closely with pure tone average at 500 Hz, 1000 Hz and 2000 Hz
- ⊗ Provides estimate of hearing for speech

Determine Amount of Loss ⁽³⁾

- Hearing impairment is documented unilateral or bilateral sensorineural, mixed, or conductive hearing levels greater than 20dB HL



Determine Amount of Loss

- Minimal, or mild, hearing loss is from 25dB - 40dB HL_(4,5)
- Moderate loss is from 40dB - 70dB HL
- Severe loss is from 70dB - 90dB HL
- Profound loss is greater than 90dB HL

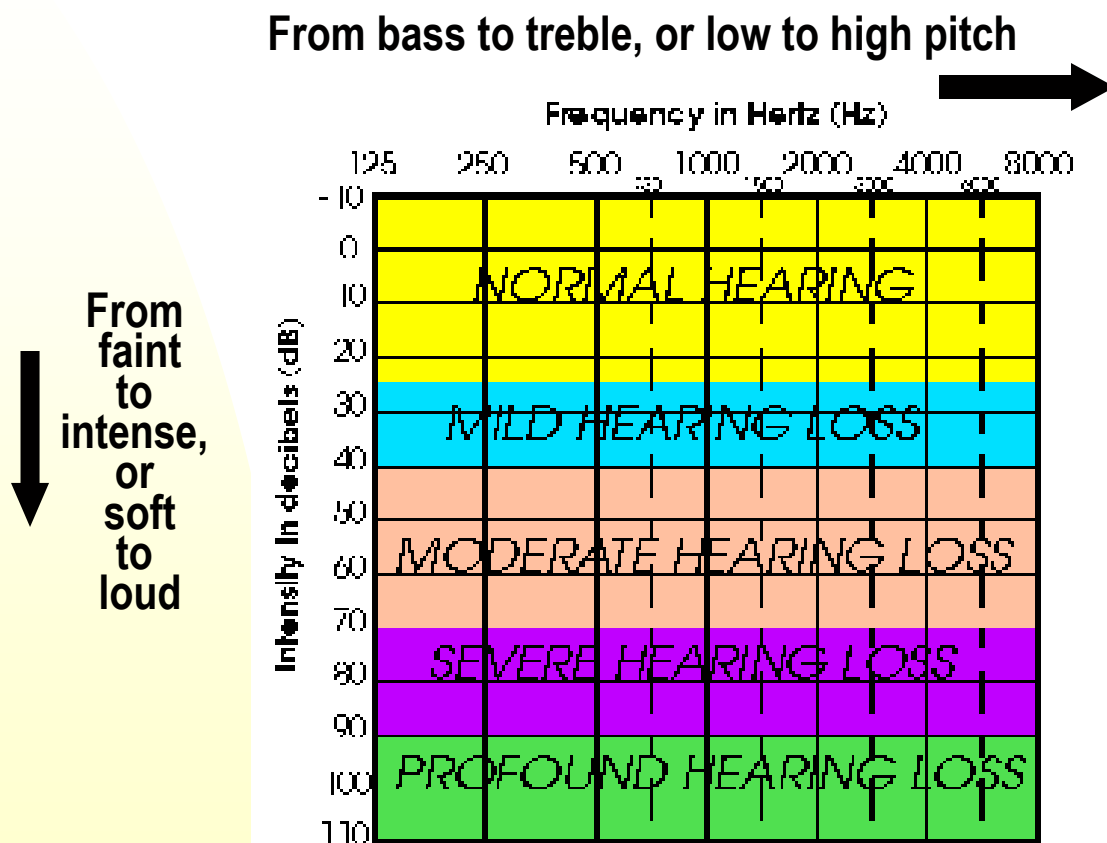


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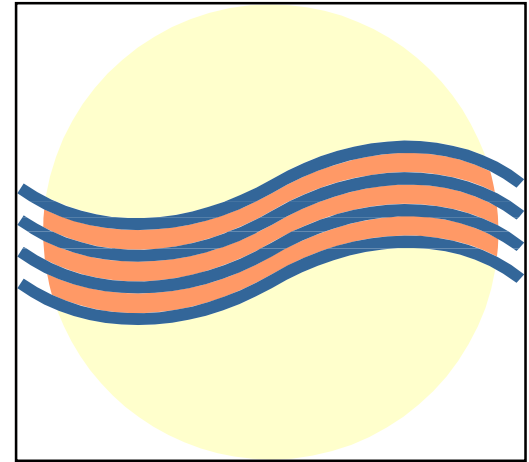


Determine Amount of Loss



Types of Hearing Loss

- Conductive
 - ◆ Bone Conduction better than Air Conduction
- Sensorineural
 - ◆ Bone Conduction equal to Air Conduction
- Mixed
 - ◆ Some amount of Air and Bone Conduction loss



Prevalence of Hearing Loss



- Prevalence data vary by study and by age range, but hearing loss is more prevalent than *any* other condition(5)
 - ◆ 6:1000 infants(6)
 - ◆ 25-40% > 65 years(7)
 - ◆ 70-80% > 80 years(7)

Causes of Hearing Loss

- This forum doesn't allow adequate discussion of this topic(8)
- Presbycusis (aging) is #1 cause of hearing loss(7)
- Hazardous noise exposure is #2
- Just a few other causes include genetics, teratogens, otitis media, idiopathic hearing loss, fistula, congenital anomaly, prenatal or perinatal exposures (syphilis, CMV, rubella), syndromes, head injury, among hundreds of others!
- **Only one type of hearing loss is preventable**
- **AVOID NOISE**
Hazardous noise damages hearing
12.5% of children aged 6-19 have some amount of noise induced hearing loss(9)

Tests Frequently Used



- Speech Reception Threshold
 - Tests in Soundfield
 - Air Conduction
 - Bone Conduction
- Immittance or Tympanometry
 - Various Screening Tests
 - ◆ OAE, AABR, Hand-held audiometer

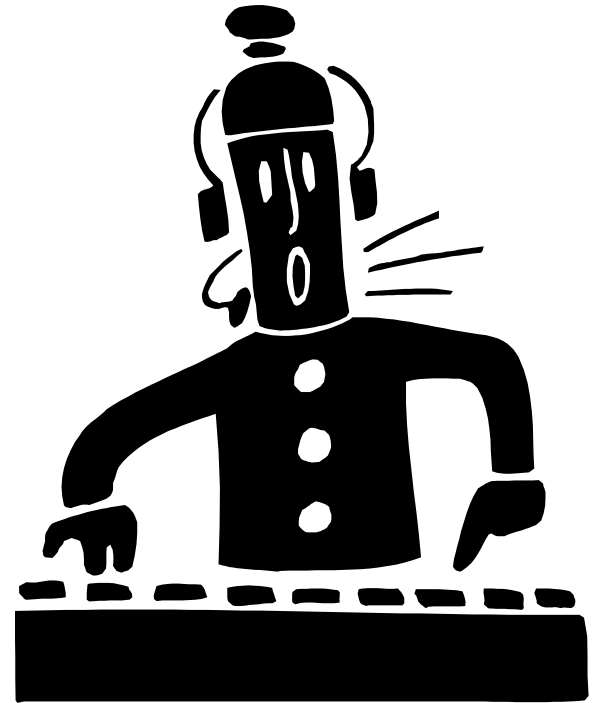
Tests in the Soundfield



- Test infants as young as 6 months
- Assess Localization Skills(10)
- Assess Auditory Ability(11)
 - ◆ VRA
 - ◆ COR
 - ◆ TROCA
 - ◆ VROCA
 - ◆ BOA

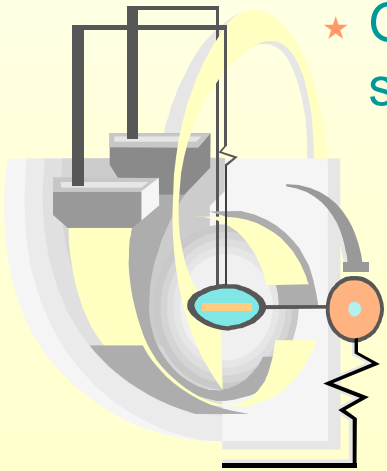
More Soundfield Tests⁽¹²⁾

- Tests may be performed while patients wear hearing aids to determine word recognition in quiet or noisy backgrounds
- Tests may be useful to determine amount of noise reduction provided by Hearing Protection Devices (HPD)
 - ◆ Estimation only, not formal assessment



Tests Via Air Conduction

- May be as simple as a tuning fork
- Most precise is with earphones
 - ◆ Audiologists can obtain results with earphones in children as young as 6 months
 - ★ With children, thresholds obtained at a high frequency in each ear, a low frequency in each ear, then additional frequencies as attention permits
 - ★ Goal is to obtain as much information as quickly as possible, short attention of child limiting factor



What is Conditioned Play Audiometry? ⁽¹¹⁾



- Term covers a lot of ground!
- Tactics used to engage the child to respond to a sound stimulus by putting block in bucket, placing peg in board, clapping their hands, etc
- Maintains the interest, seems like fun, allows more information to be obtained

Tests Via Bone Conduction

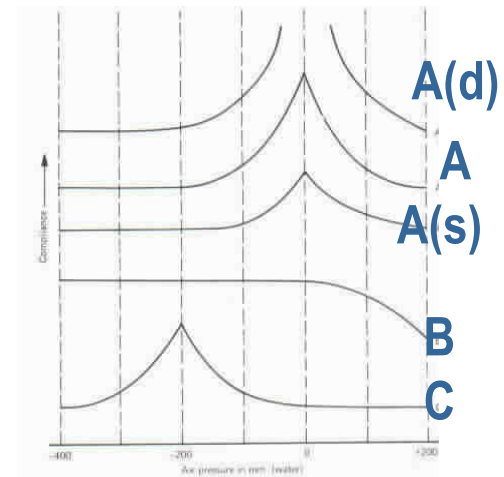


- Obtain speech awareness and/or speech reception threshold, pure tone thresholds
- Vital to determine middle ear status
- Infants as young as 6 months can be tested behaviorally, even younger if assessment involves physiologic tests (evoked potentials)



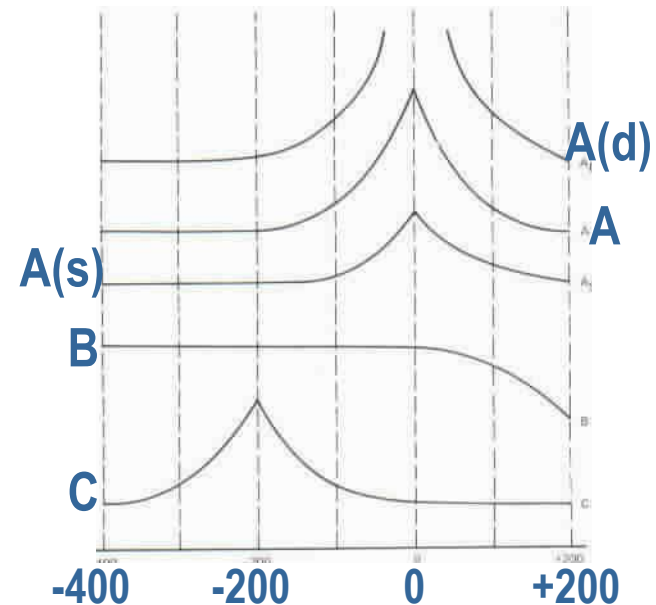
Tympanometry/Immittance Measures⁽¹³⁾

- Tympanometry provides objective results to determine status of middle ear
- Acoustic reflexes are part of the test, add diagnostic information
 - ◆ May be obtained ipsilaterally and/or contralaterally



Immittance Tests₍₁₂₎

- Five classifications of results, referred to as Modified Jerger Classification System
- Type A(d), A, A(s), B and C



Otoacoustic Emissions⁽¹⁴⁾

- Evoked OAE (EOAE) are sounds that come out of the cochlea upon stimulation
- Spontaneous emissions (SOAE) are found in 60% of ears, 2:1 females to males
 - ◆ OAEs should not be confused with TINNITUS
- EOAE indicate movement of Outer Hair Cells
- Corresponds to thresholds <40dB HL
- ***Presently used to screen newborns***, monitor patients on ototoxic medication
- Shows potential as tool to monitor noise exposure damage in cochlea

Audiology Screening Tests^(3, 15)

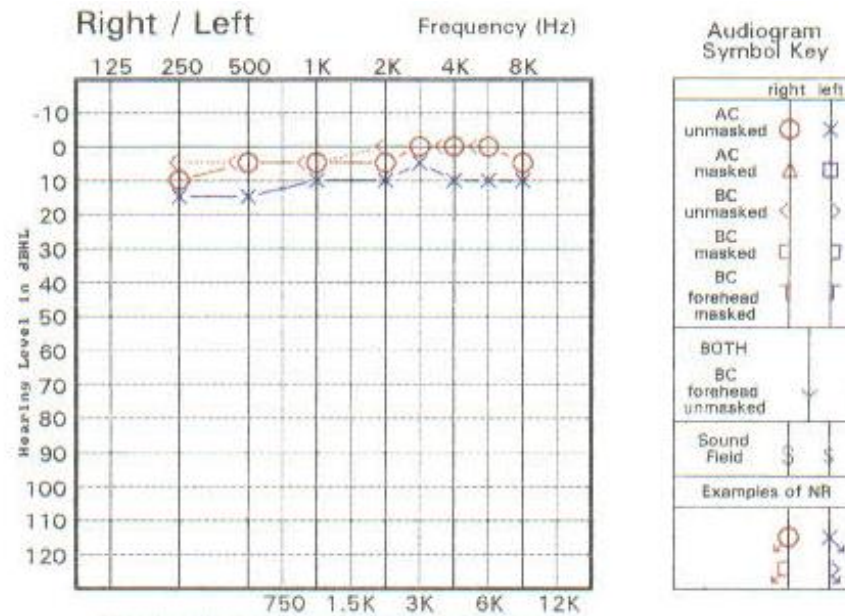
- Several **screening** applications exist that are totally microprocessor driven and are applicable for use in a newborn nursery or physician's office
 - ◆ OAE - Otoacoustic Emissions (Transient Evoked or Distortion Product Evoked)
 - ◆ AABR - Automatic Auditory Brainstem Response
 - ◆ Hand-held audiometer, presents sounds across frequencies, patient indicates number detected
- Provide "Pass" or "Refer" results

Results Reveal the Story⁽¹⁵⁾

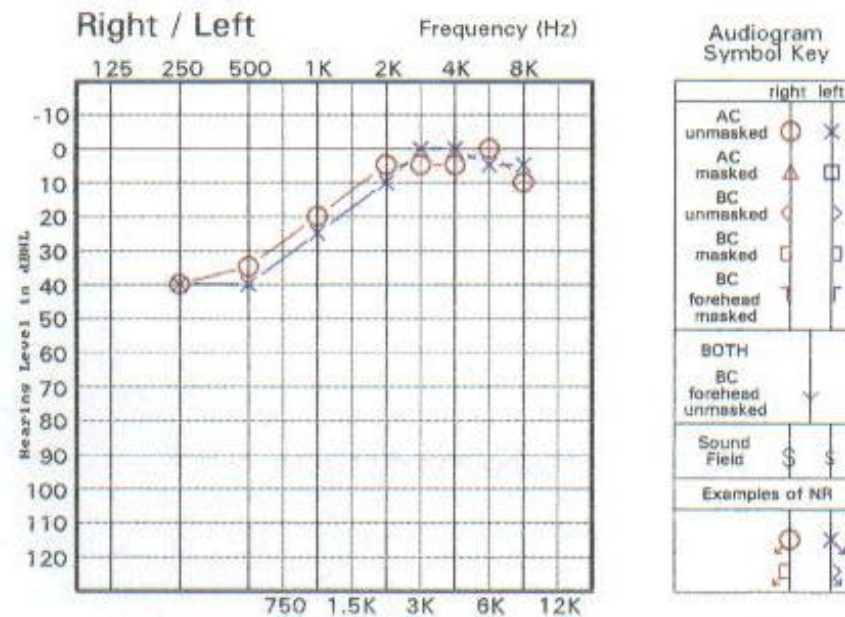
- Child/Family History
- Speech Reception Threshold (SRT)
- Soundfield
- Tympanogram
- Air Conduction
- Bone Conduction
- Otoacoustic Emissions
- Evoked Potentials
- Test battery may be accomplished over several visits
- Results may fluctuate over time, check for history of serous effusion in children



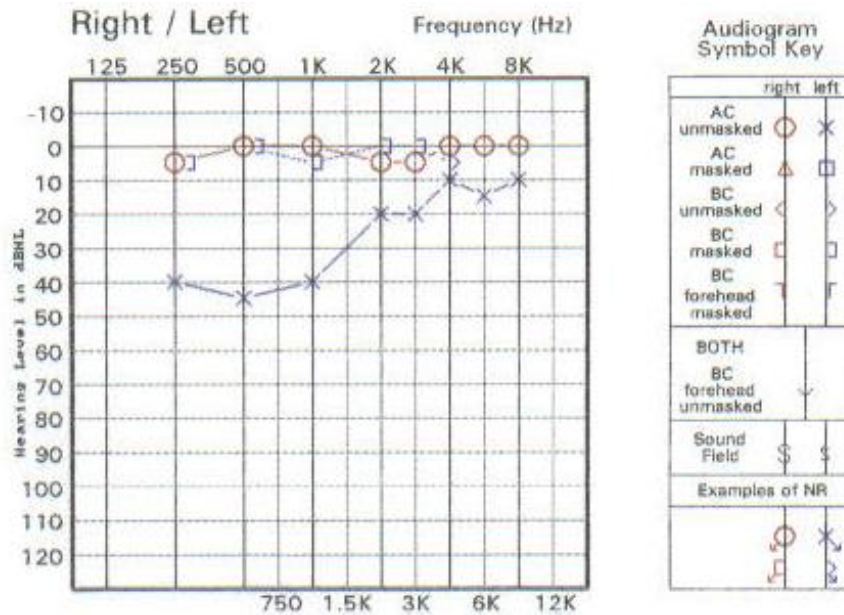
Normal Hearing



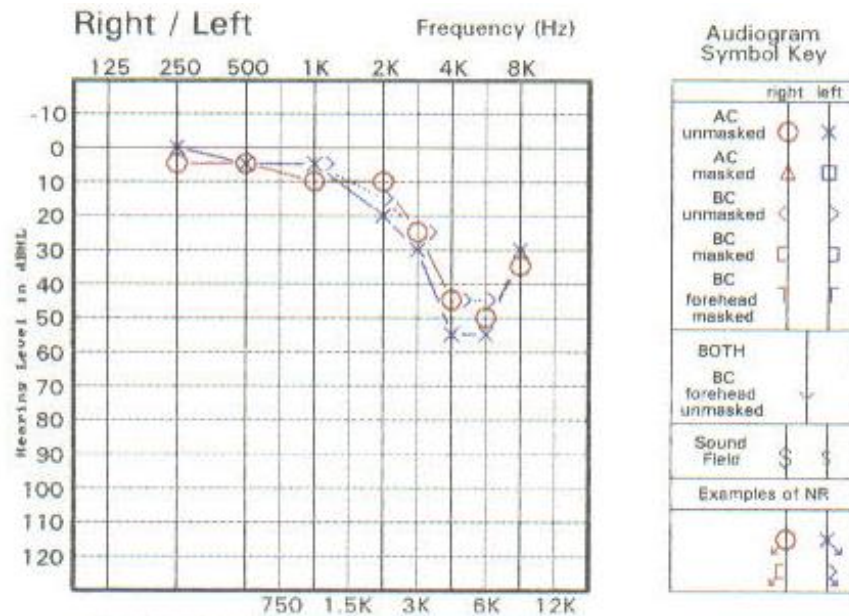
Low Frequency Loss



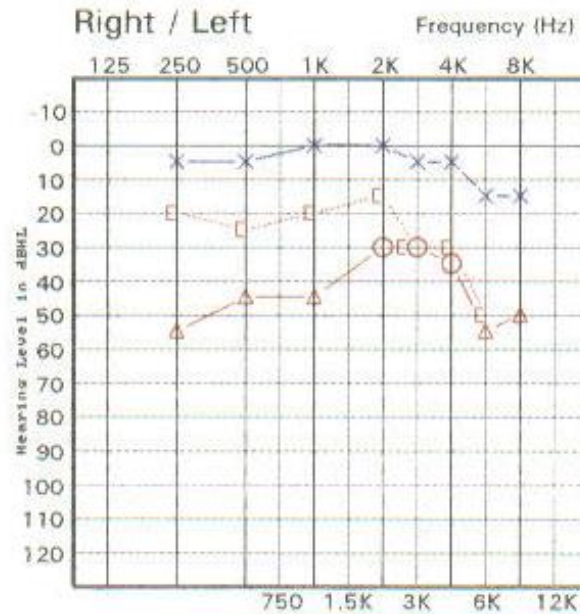
Conductive Hearing Loss



High Frequency Sensorineural Hearing Loss



Mixed Hearing Loss



Audiogram Symbol Key

	right	left
AC unmasked	○	×
AC masked	△	□
BC unmasked	<	>
BC masked	◻	◻
BC forehead masked	⊥	⊥
BOTH		
BC forehead unmasked		∨
Sound Field	Ⓢ	Ⓢ
Examples of NR		
	○	×
	◻	◻

Some Closing Thoughts

- Components of Sound
 - ◆ Hertz
 - ◆ Decibel
- Audiometric Symbols
 - ◆ Unmasked and Masked
- Determine Amount of Loss
 - ◆ Normal, Mild, Moderate, Severe, Profound
- Types of Hearing Loss
 - ◆ Conductive
 - ◆ Sensorineural
 - ◆ Mixed

More Closing Thoughts

- Tests Used
 - ◆ SRT
 - ◆ Soundfield
 - ◆ Air, Bone
 - ◆ Play Audiometry
 - ◆ Immittance
 - ◆ Screening audiometry, AABR, OAE

