AUDITION & AUDITORY REHABILITATION

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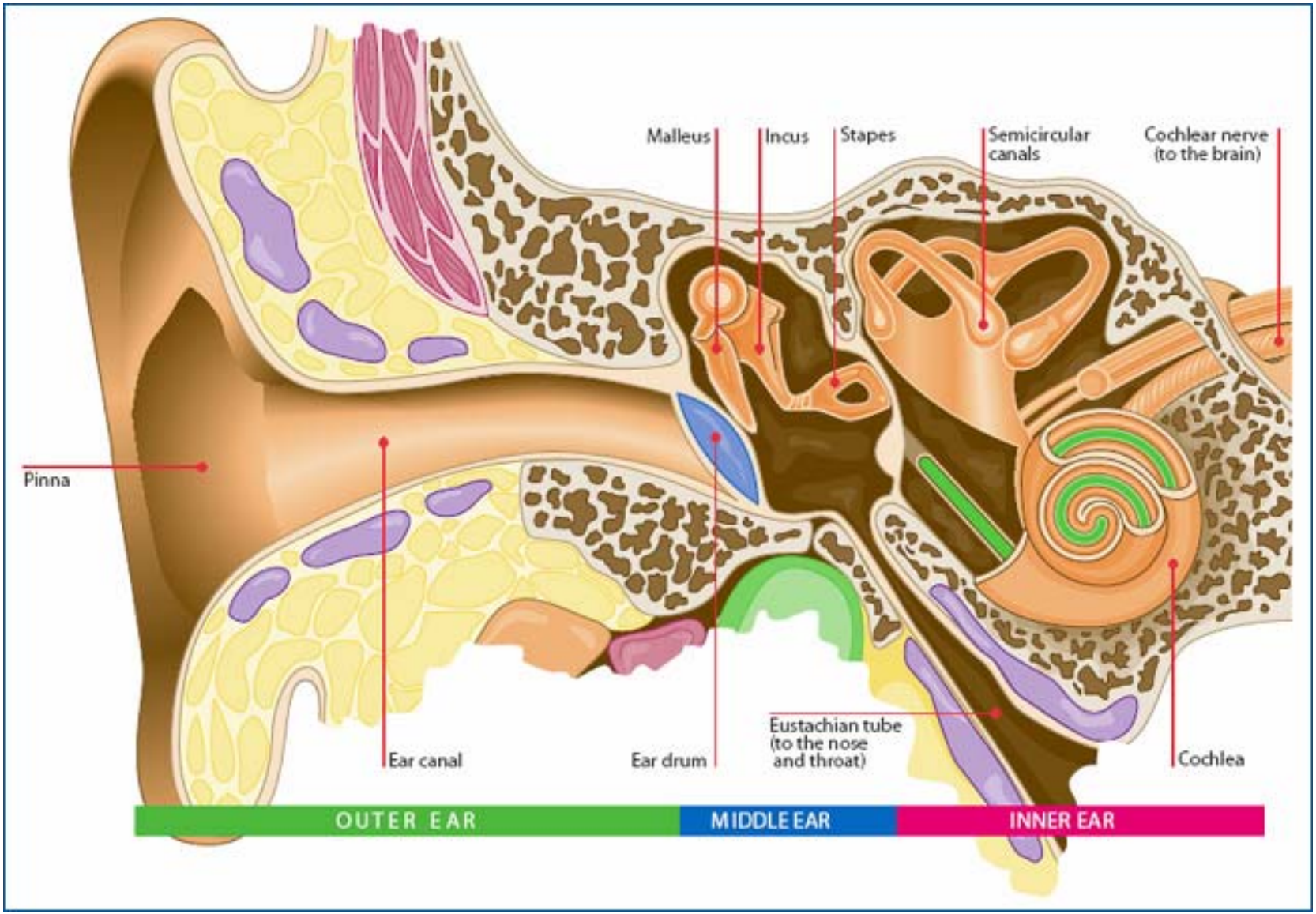
OUTLINE

- Tour of the ear
- Types and degrees of hearing loss
- Consequences of presbycusis (age-related hearing loss)
- Options for hearing loss

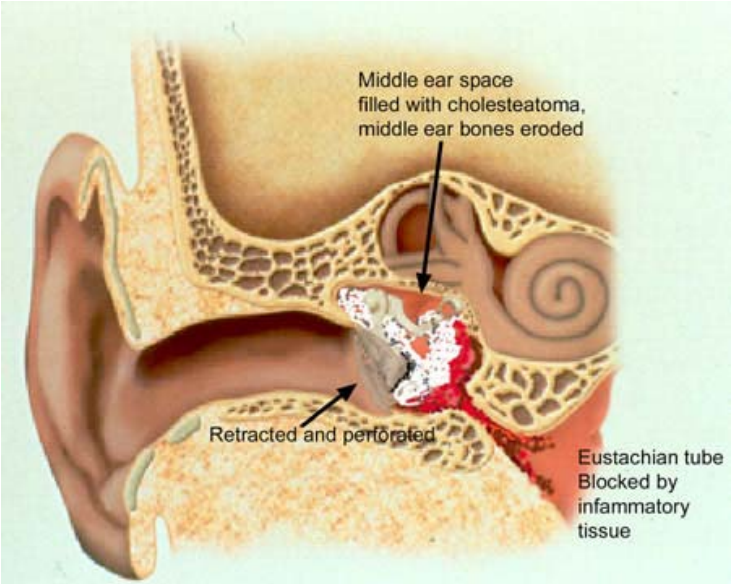


AUDITORY TRANSDUCTION

- This can explain it in a much more interesting way:
  - https://www.youtube.com/watch?v=PeTriGTENoc&list=PLF7AC7F995007EA6F

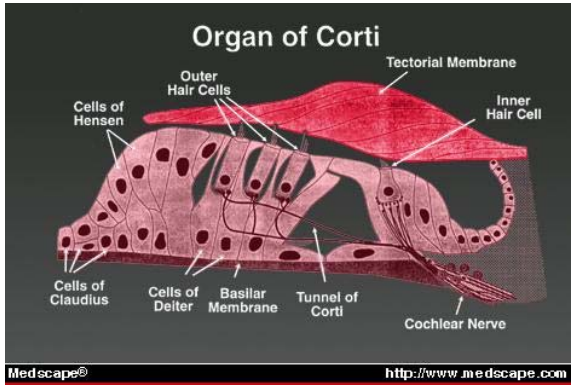
TYPES OF HEARING LOSS

- Conductive
  - Occurs in outer or middle ear system
  - Sound waves are not conducted properly to the inner ear
  - Often correctable by medical intervention
  - Sounds aren't loud enough



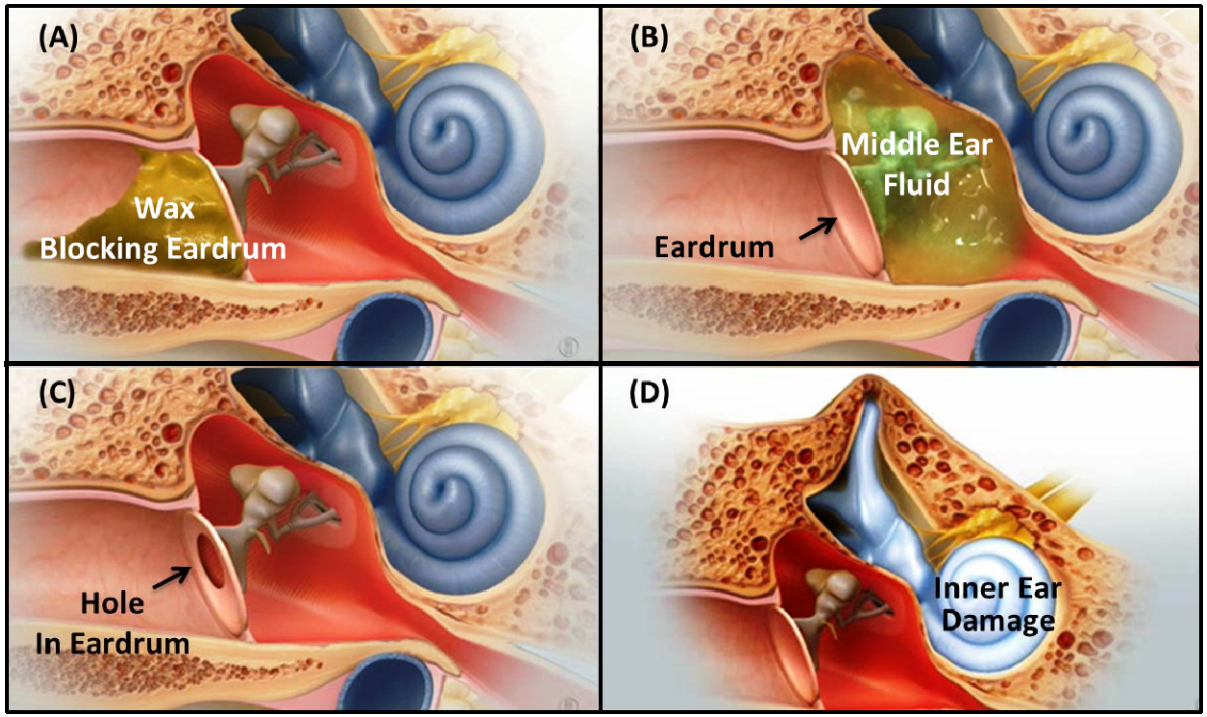
TYPES OF HEARING LOSS

- Sensorineural
  - Damage in the inner ear or to the nerve pathways from the inner ear to the brain
  - Cannot be medically or surgically corrected
  - Interferes with the ability to hear certain pitches and reduces the ability to hear faint sounds
  - Person with this type of loss often complains "I can hear, I just can't understand."



WHAT DOES HEARING LOSS "SOUND" LIKE?

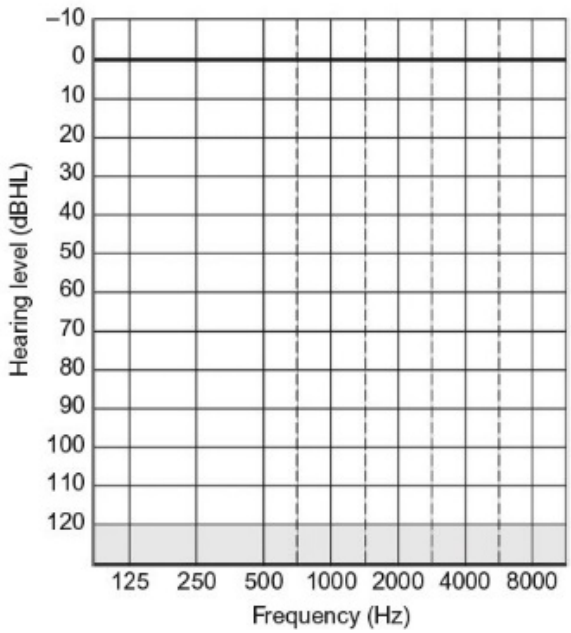
- http://www.hear-it.org/Impressions-of-hearing-loss-and-Tinnitus-

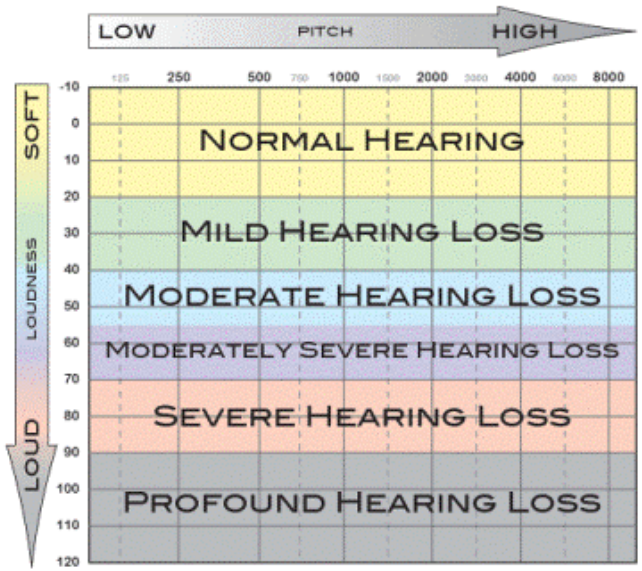


HAVE YOU HAD YOUR HEARING TESTED?

- http://www.audiocheck.net/testtones_hearingtestaudiogram.php

THE AUDIOGRAM

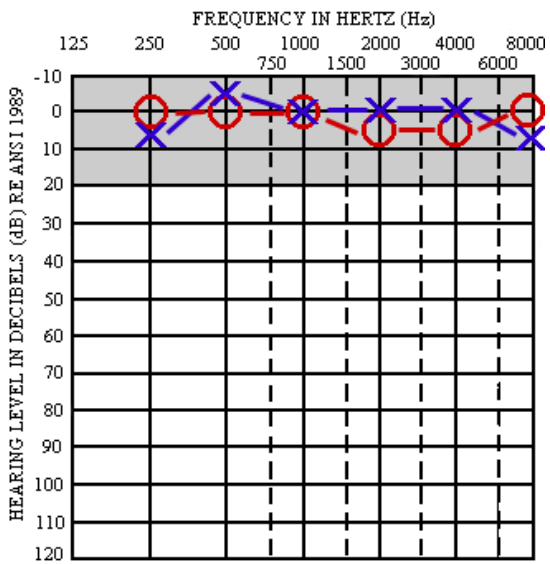




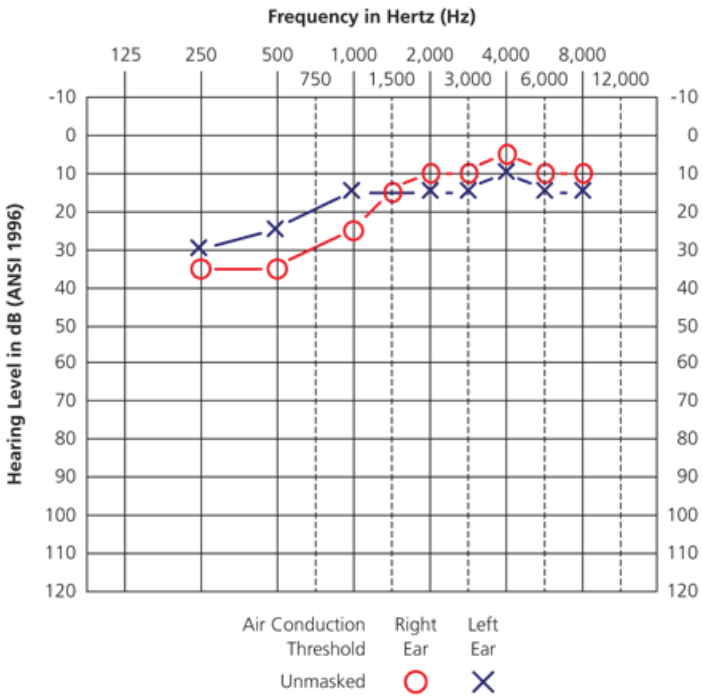
Blank audiogram showing frequencies & decibels

Different degrees of hearing loss

DIFFERENT RESULTS

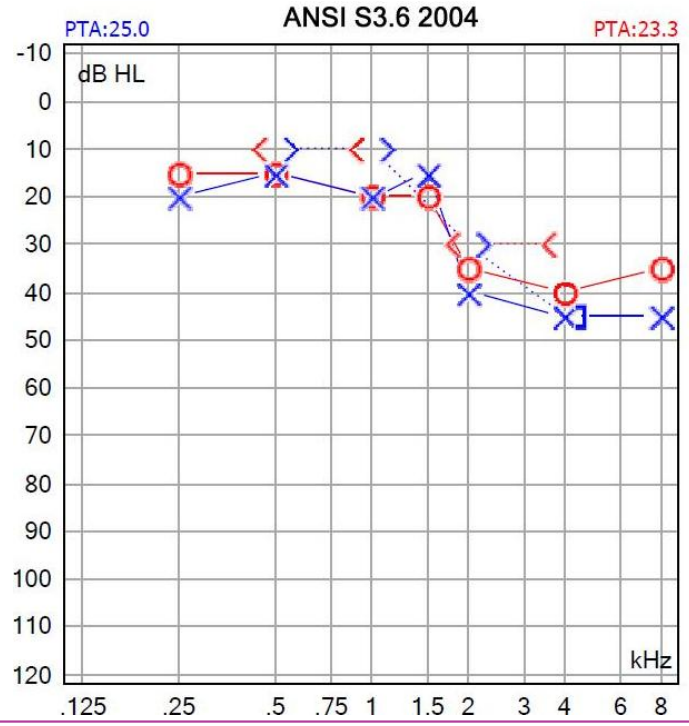


Hearing thresholds are within normal limits

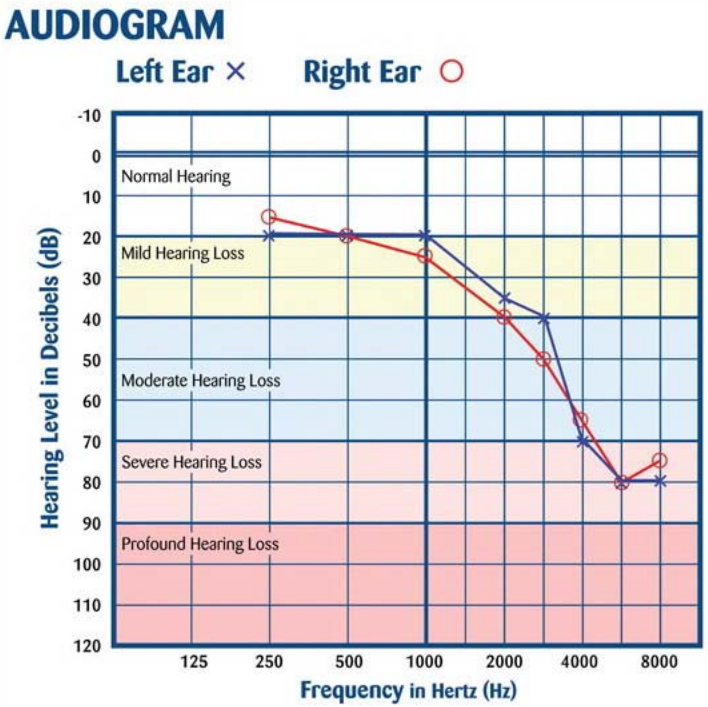


Hearing thresholds worse in the lower frequencies – conductive hearing loss

MORE RESULTS



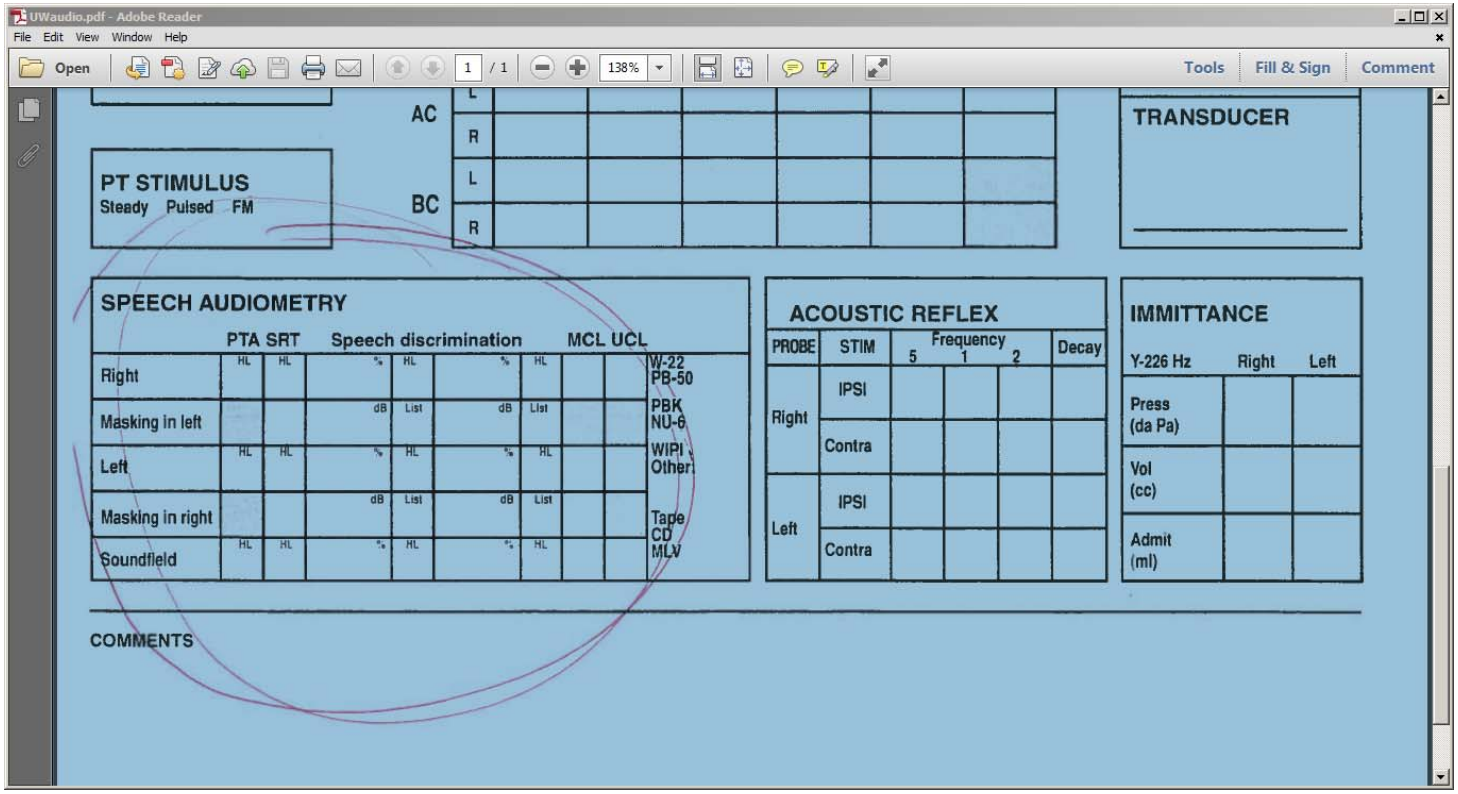
Hearing thresholds worse in the higher frequencies = starting to notice difficulty understanding in noisy envs.



Moderate to severe hearing loss in the high frequencies = difficulty understanding speech!

SPEECH RECOGNITION TESTING

- https://www.youtube.com/watch?v=GPRwA9BG-m4



WHAT DOES SPEECH SOUND LIKE WITH HEARING LOSS?

- https://www.youtube.com/watch?v=1EJ4g3J6cJM

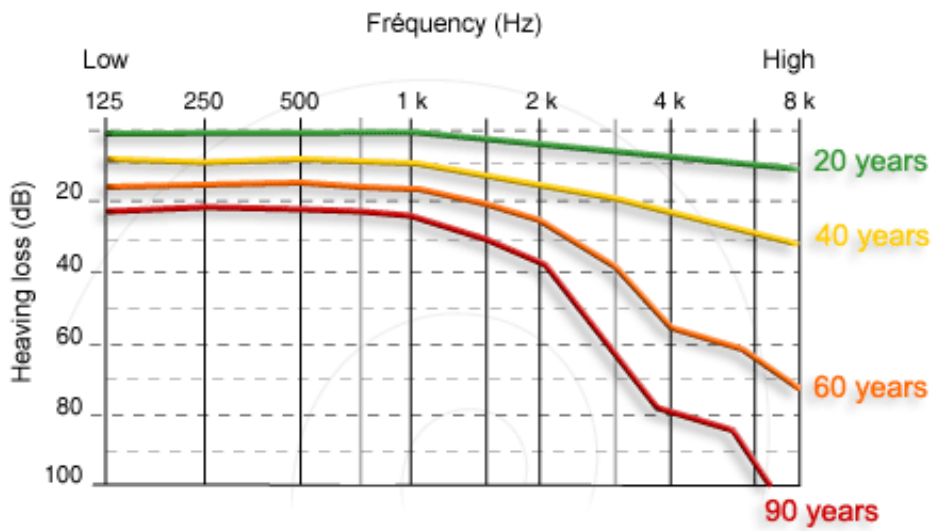
PRESBYCUSIS

- High frequency sensorineural hearing loss that occurs with the natural aging process
- A person will have greater difficulty hearing high pitched sounds versus lower pitched sounds, which contributes to greater difficulty understanding speech…..*"I can hear, I just can't understand."*

© Brian Crane.

HEARING LOSS WITH AGING

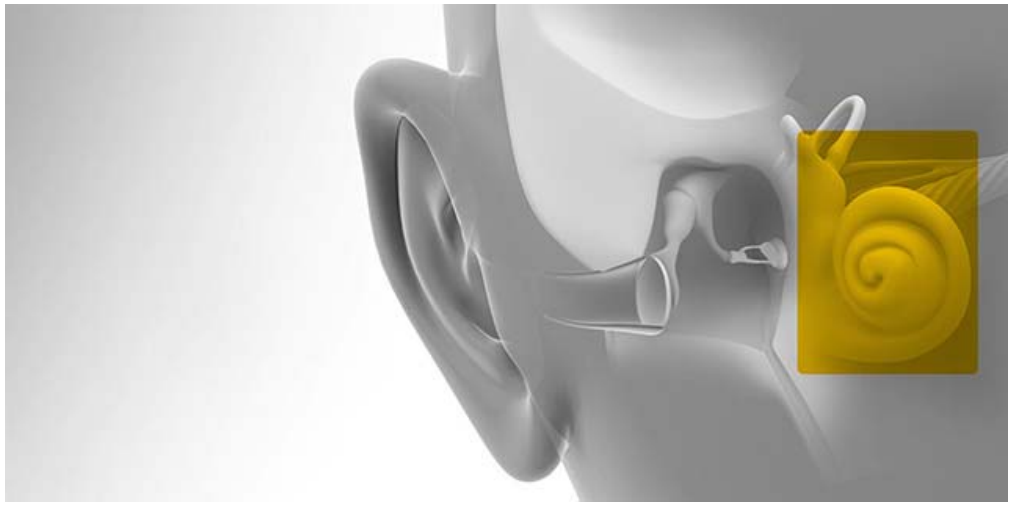
Pure tone audiograms recorded in a normally-hearing subject over the course of their life. Each curve represents the average hearing loss as a function of age.



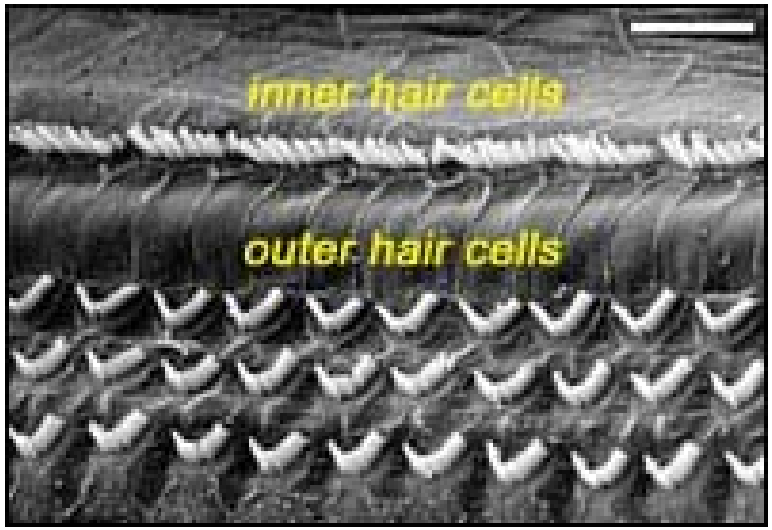
http://www.neuroreille.com/promenade/english/audiometry/faudiometry.htm

OTHER CAUSES OF SENSORINEURAL HEARING LOSS

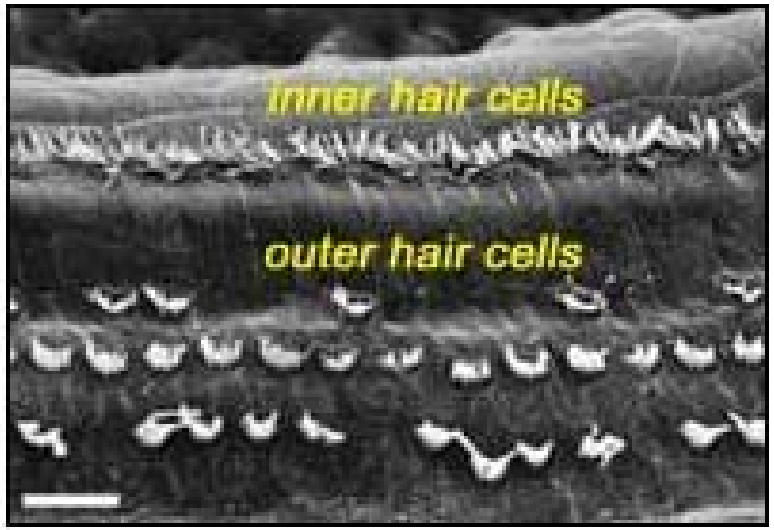
- Hereditary factors
- Noise exposure
- Head trauma
- Infections
- Diseases
- Ototoxic medications



NORMAL & DAMAGED INNER HAIR CELLS



Normal



Damaged

SIGNS OF HEARING LOSS

- Person may wear hearing aids or a cochlear implant
- Person may tell you they are hard-of-hearing
- Person may not answer when spoken to or may answer incorrectly
- Person may be speaking loudly
- Person may watch your face/mouth closely
- Person may complain that everyone mumbles
- Person may bluff – smile & nod as if they understood
- Person may avoid noisy environments or social situations
- Person may dominate conversation – if talking then they don't have to listen!

WHAT OPTIONS ARE AVAILABLE WHEN A HEARING LOSS IS DIAGNOSED?

- Medical intervention
- Cochlear implant
- Hearing aids
- Assistive listening devices
- Communication strategies
- Self-advocacy
- Counseling

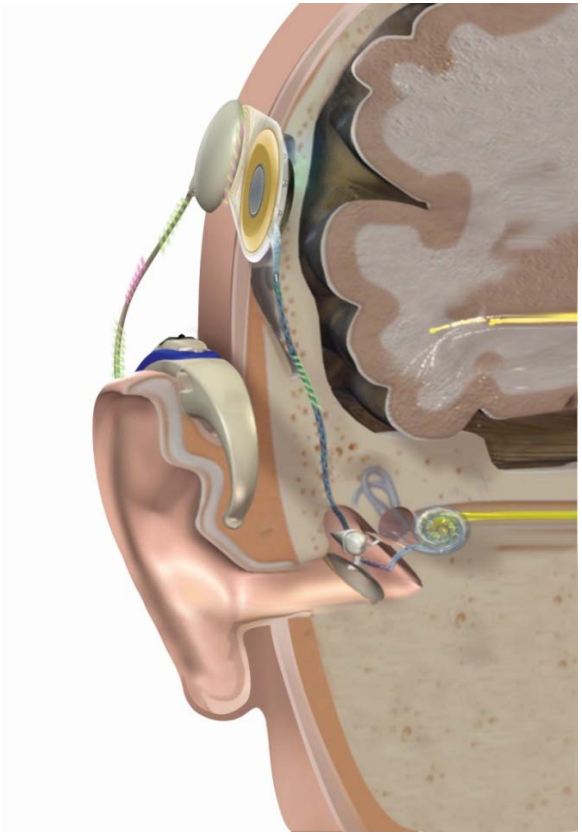
PROFESSIONALS IN HEARING

- **Otolaryngologist**: Also called an ENT, these medical doctors specialize in the treatment and diagnosis of diseases of the head and neck, including ears, nose, and throat. Important in the diagnosing and treating of underlying causes of hearing loss in full or part.
- **Audiologist**: trained professionals who diagnosis hearing and vestibular disorders, and measure ramifications. They are trained to fit hearing aids and provide aural rehabilitation to all ages. The entry level degree is a Doctor of Audiology (AuD).
- **Hearing aid dispenser**: authorized by the state to measure hearing and fit hearing aids. Typically they work as an apprentice, then take a test about hearing aids. No degree necessary. Focus is on selling hearing aids. Can only work with adults.

WHAT IS A COCHLEAR IMPLANT?

- Cochlear implants convert *acoustic signal* into an *electrical signal* which directly stimulates the auditory nerve
- Cochlear implants bypass damaged hair cells and stimulate auditory nerves directly through the application of external electrical current
- For individuals who are unable to receive enough communication benefit from hearing aids

RIGHT COCHLEAR IMPLANT



EXTERNAL COMPONENTS OF A CI

Microphone – picks up sound and sends to

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Speech processor – converts sound to digital signal and sends to

→

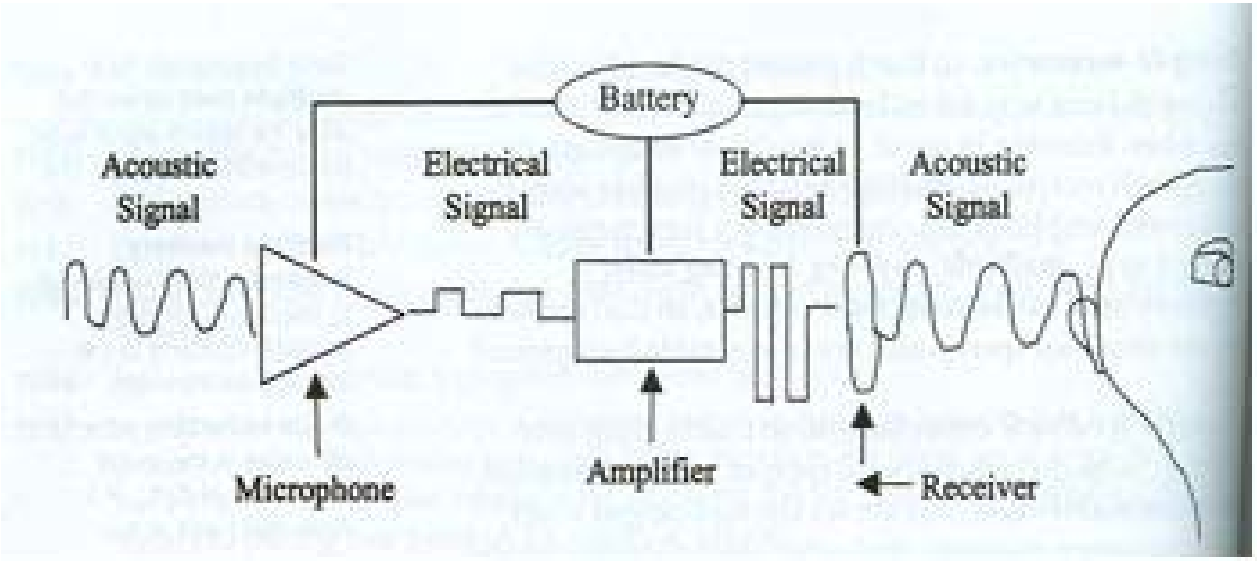
Transmitter – sends digitized signal to internal receiver under the skin

INTERNAL COMPONENTS OF A CI

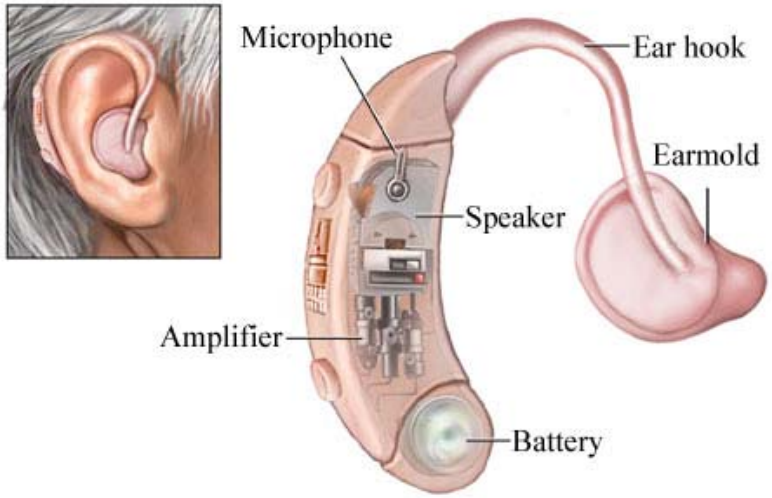
Receiver – takes the coded signals from the transmitter and delivers them to

Electrodes – surgically implanted in the cochlea. Provide stimulation to the fibers of the auditory nerve resulting in the perception of sound sensations

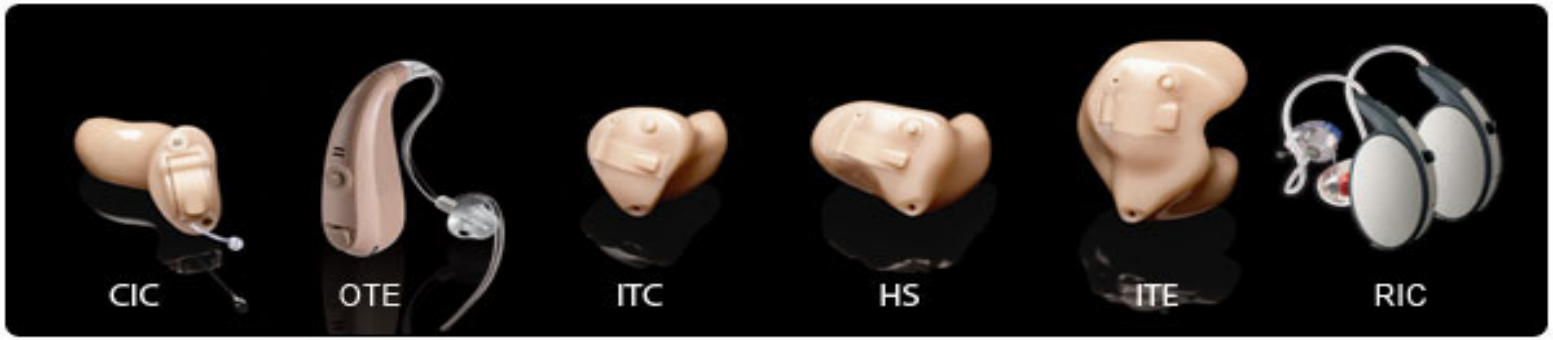
HOW DOES A HEARING AID WORK?



HEARING AID BASICS

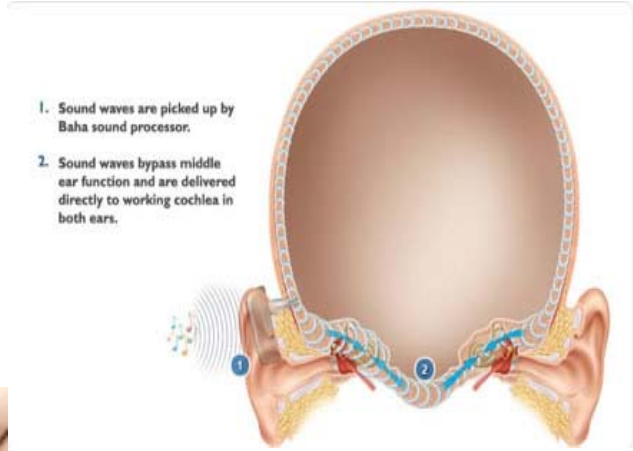


1. Microphone
2. Microchip
3. Amplifier
4. Battery
5. Receiver



BONE ANCHORED HEARING AID (BAHA)

- Sound is conducted through the bones of the skull, bypassing the outer and middle ear & directly stimulating the cochlea
- A bone anchored hearing aid is used when conventional hearing aids won't work:
  - Chronic middle ear fluid
  - Aural atresia (absence or closure of external auditory canal)
  - Microtia (spectrum of deformities of external ear)
  - Cholesteotoma
  - Middle ear dysfunction or disease



WHAT PROBLEMS DO HEARING AIDS SOLVE?

- Audibility
- Possibly social consequences from hearing loss

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- What do they not solve?
    - Everything else! (distortion from hearing loss; filtering out background noise; reverberation effects; speech-to-noise ratio; cognitive and central factors of hearing loss)
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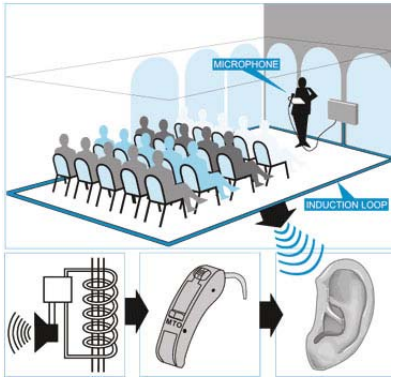
WHAT ABOUT ASSISTIVE LISTENING DEVICES (ALDs)?

- ALDs are devices that can be used with or without hearing aids/cochlear implants
- The hope is that ALDs can improve what's called the signal-to-noise ratio (S-N-R)
  - Listener can hear what they want to hear over any noise that is present
- When distance is a factor, an ALD can act to reduce it
- Emergency or routine signaling (smoke alarms, door bells, phone ringing, etc.)

WHERE CAN (ALDs) BE USED?

- Home environment

- Occupational/Educational environment



- Public/Social environment

OCCUPATIONAL ENVIRONMENT

- What is the goal?
  - Successful communication?
  - Safety/Alerting?
  - Hearing protection?
- How will the goal be achieved?
  - Hearing aids/CI/BAHA/Earplugs
  - ALDs – let's focus on this for now
  - Strategies
  - Combination? Hopefully!

COMMUNICATION

- Does the communication occur:
  - Over the phone?

  - During Meetings – small and large

  - During 1-1 interactions

DIFFERENT DEVICES FOR WORK ENVIRONMENT

SAFETY/ALERTING

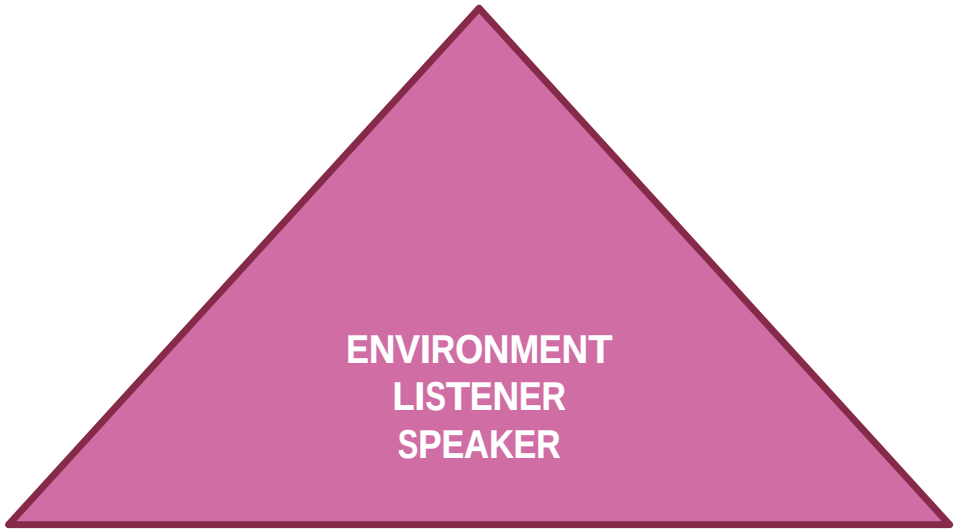
HEARING PROTECTION

CAN ANYTHING OTHER THAN TECHNOLOGY HELP?

- Absolutely! More often than not technology is looked upon as the only solution for people living with hearing loss. It is important to remember that communication strategies and self-advocacy can be taught to someone who is experiencing communication challenges due to hearing loss.
- Important to consider all treatment options that will allow the person with hearing loss to stay connected

DIFFERENT FACTORS INFLUENCE OUR ABILITY TO UNDERSTAND:

- Factors related to our environment
- Factors related to the listener
- Factors related to the speaker



ENVIRONMENTAL FACTORS

- Background Noise
- Lighting
- Interfering objects
- Angle of vision
- Room acoustics
- Distractions

SPEAKER FACTORS

- Visibility of lips
- Rate and clarity of speech
- Voice intensity and projection
- Facial expression
- Body language
- Facing the listener?
- Mannerisms
- Relationship to listener

LISTENER FACTORS

- Using amplification? Hearing aids or cochlear implant?
- Attention level/distracting thoughts
- Motivation to hear/understand
- Expectations
- Fatigue
- Emotional state
- Tension/stress level
- Pain/discomfort

STRATEGIES FOR IMPROVING COMMUNICATION

- Provide written and oral instructions
- Get the listener's attention before speaking to them
- Always face-to-face in a well-lit area: visual cues help tremendously
- Don't shout! (*It won't help)*
- Speak clearly and at a moderate pace – *Clear Speech*!
- Have appointments in the morning. Research shows that time of day effects speech perception with aging listeners, poorer speech understanding in the evening (Venemen et al., 2013)

STRATEGIES FOR IMPROVING COMMUNICATION

- Re-phrase rather than repeat
- Don't put objects in front of face or mouth while speaking
- Let them know if topic of conversation changes
- Use facial expressions and gestures
- Check understanding
- Remember the stress and fatigue that hearing loss puts on the listener: breaks may be helpful
- **Be patient with the listener!**

CONTACT INFORMATION

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