Hear and now: The latest Advancements in hearing

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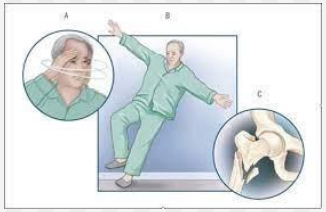
Importance of Managing hearing loss

- Healthy hearing is important for **communication** and **socialization**
- Loss of hearing impacts the quality of life
- Hearing loss is risk factor for:
  - **Depression**
  - **Dementia**
  - **Fall**
  - **Tinnitus**

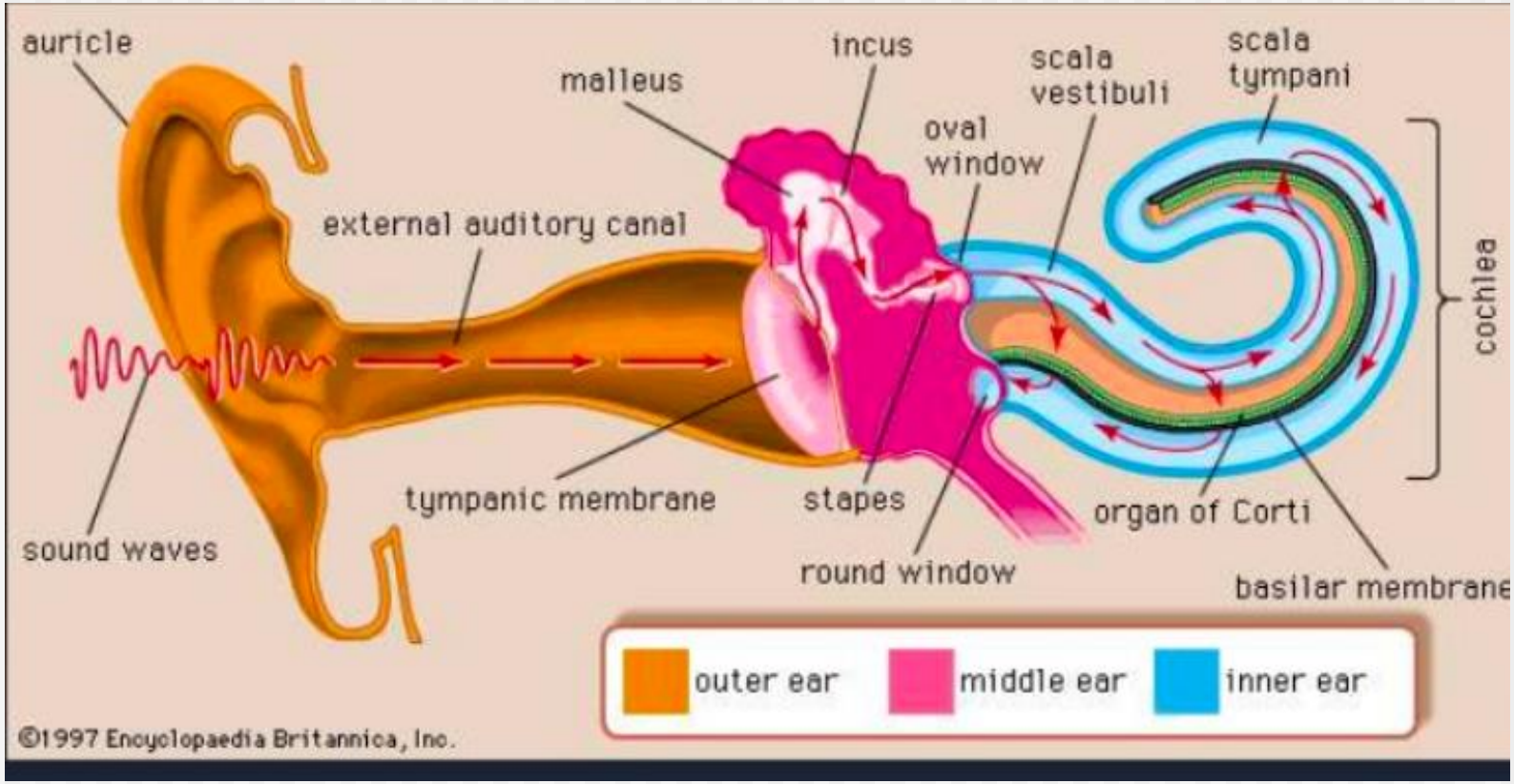


- Community feels sorry about blind people while many people joke about deafness

Can you hear me now?

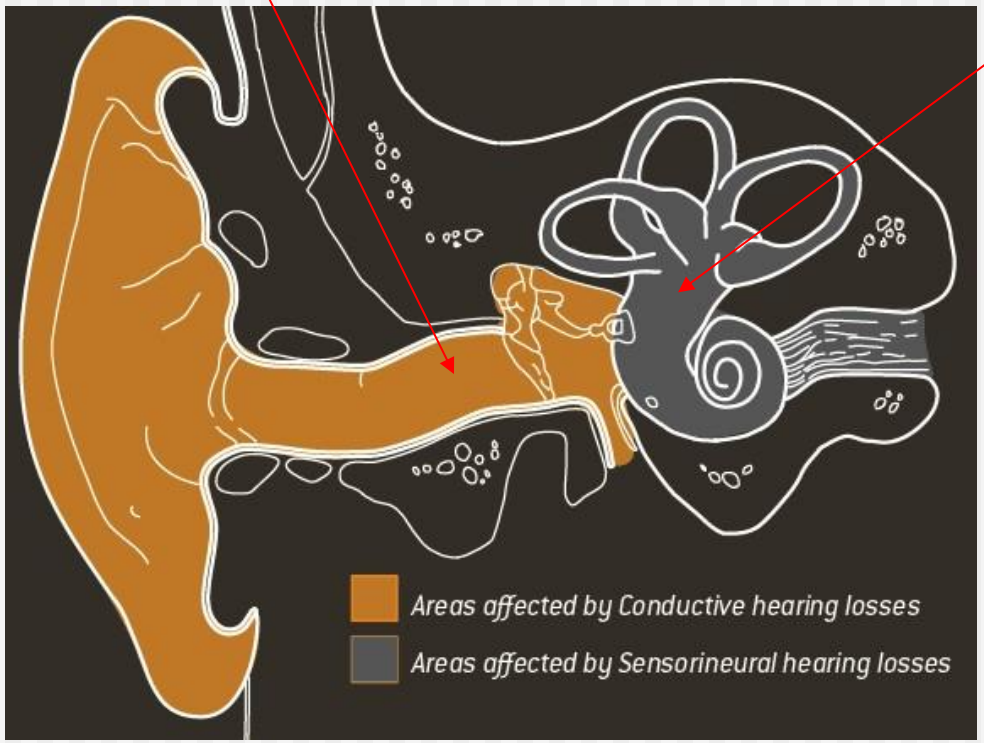
- Anatomy of the Ear
- How the Ear Works
- Types of Hearing Loss
- Diseases of the Ear
- Treatment Options for Hearing Loss

Physiology of Hearing



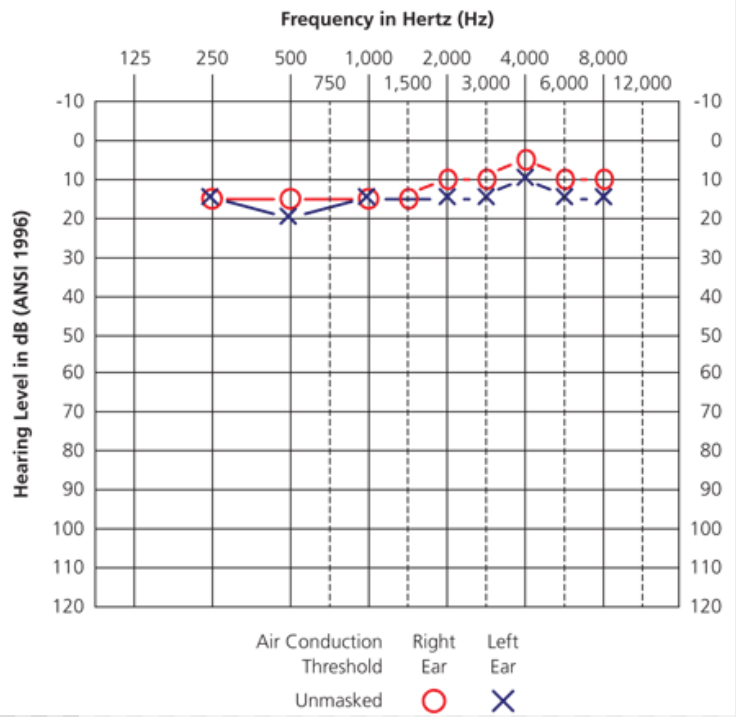
Types of Hearing Loss

- **Conductive**
  (EXTERNAL AND MIDDLE EAR)
- Sensorineural
  (Inner Ear or Nerve)

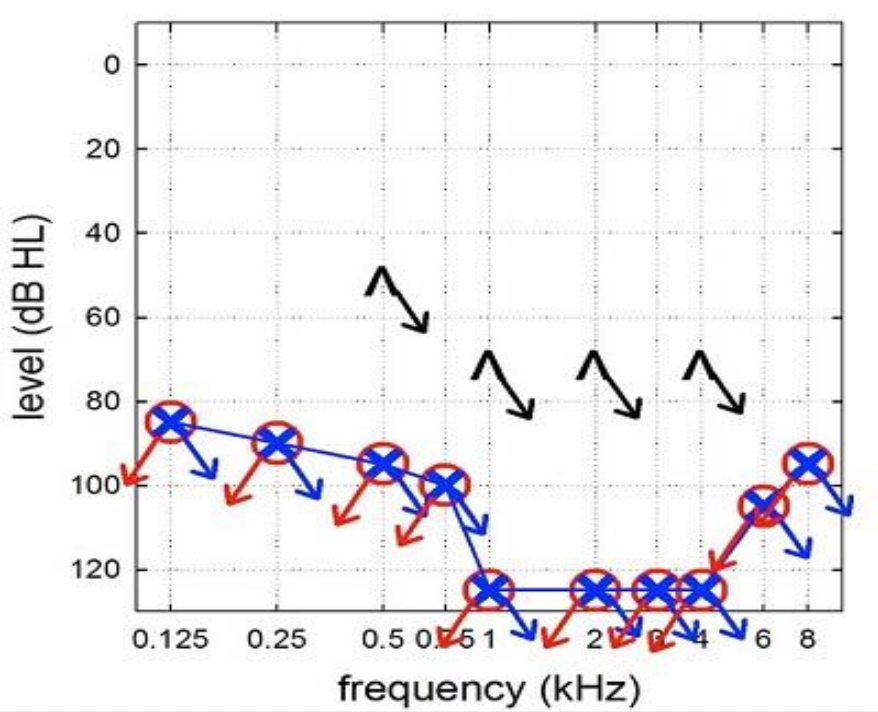


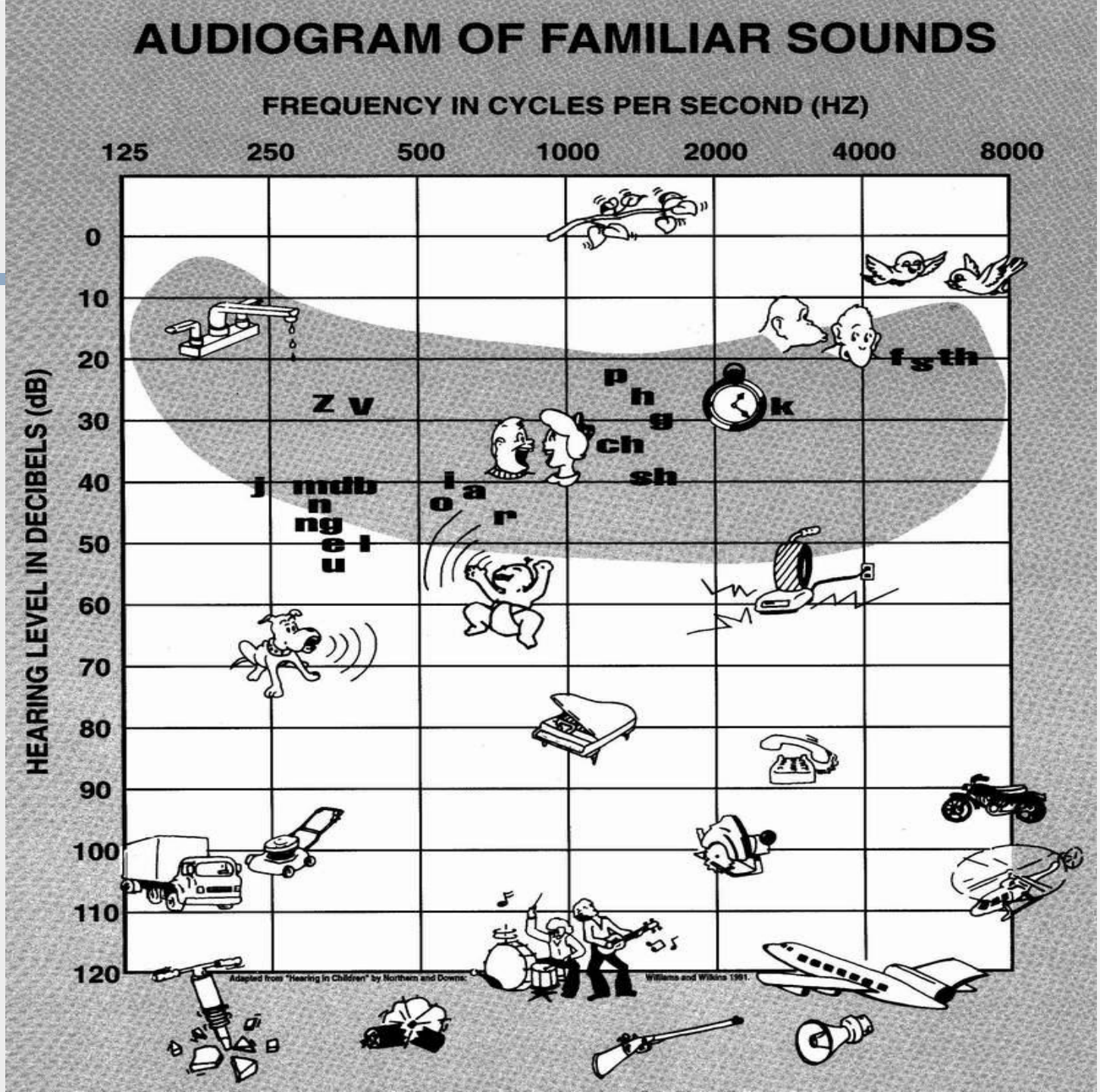
Hearing Evaluation (Pure tone audiometry)

Normal Hearing



Bilateral Total Hearing Loss




AUDIOGRAM OF FAMILIAR SOUNDS
FREQUENCY IN CYCLES PER SECOND (HZ)
125
250
500
1000
2000
4000
8000
HEARING LEVEL IN DECIBELS (dB)
0
10
20
30
40
50
60
70
80
90
100
110
120
z v
j
m d b
n
n g
e
l
u
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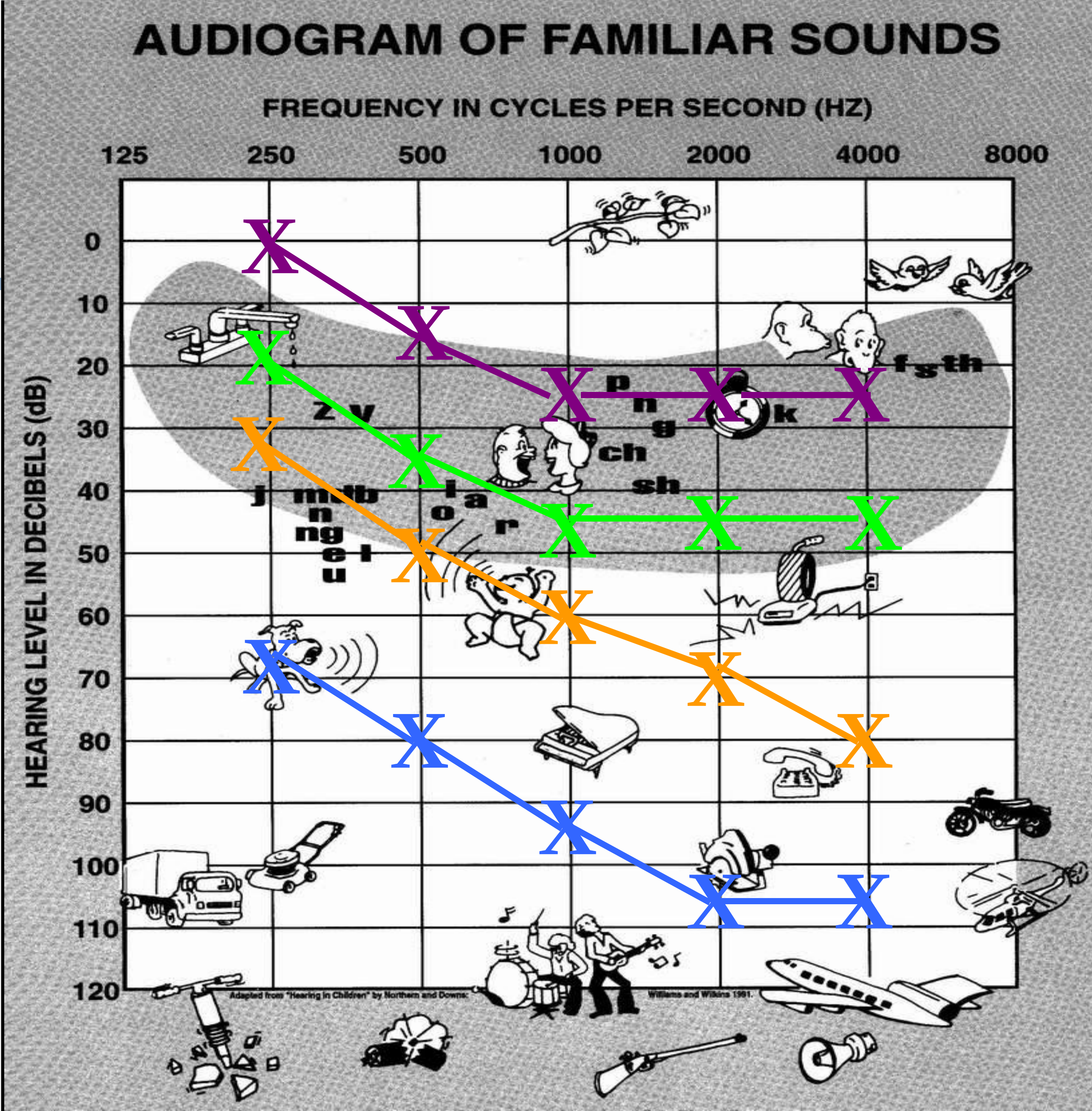
Adapted from "Hearing in Children" by Northern and Downs;
Williams and Wilkins 1991.



AUDIOGRAM OF FAMILIAR SOUNDS
FREQUENCY IN CYCLES PER SECOND (HZ)
125 250 500 1000 2000 4000 8000
HEARING LEVEL IN DECIBELS (dB)
0 10 20 30 40 50 60 70 80 90 100 110 120
z v
j m d b
n
ng
e l
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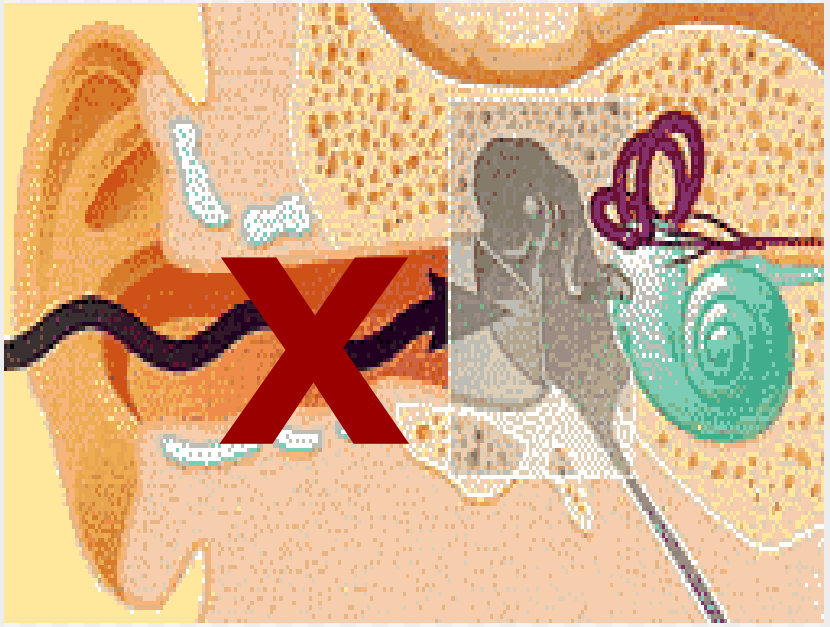
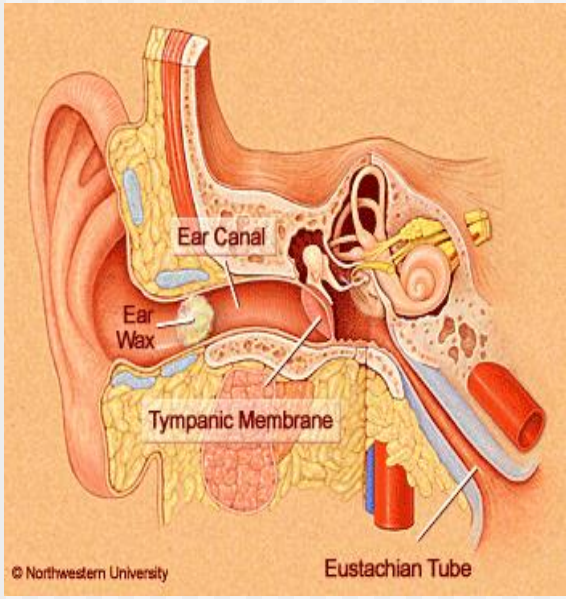
f s th
Adapted from "Hearing in Children" by Northern and Downs: Williams and Wilkins 1991.

- **External Ear**
- **Conductive Hearing Loss**



Conditions of the External Auditory Canal

- **Cerumen Impaction (Ear wax)**
  - Ear wax build up which blocks sound waves from the eardrum
  - A common cause of temporary hearing loss
  - Treated by removing ear wax
  - Prevention:
    - Do not use Q-tip!



Disease of the External Auditory Canal

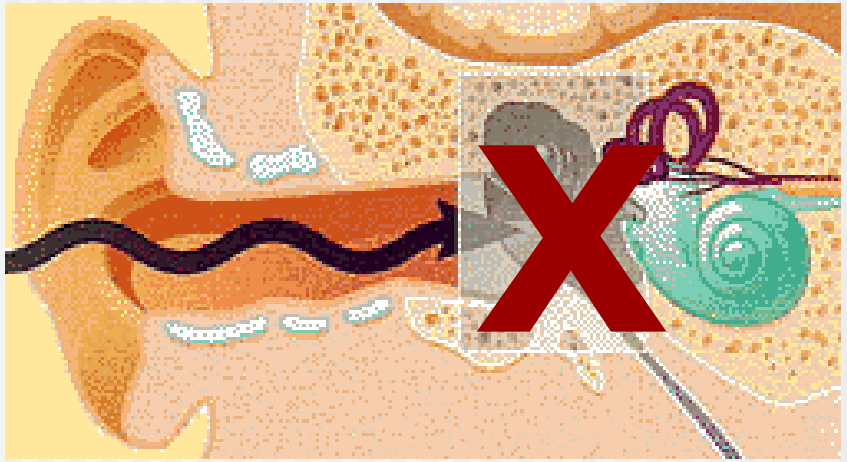
- **External Otitis**

(Swimmer's ear)

- Inflammation of the skin of the ear canal.
- It is usually caused by a bacterial infection.
- Humidity or trauma to the EAC.
- Treatment: Ear drops
  - Preventions (swim ear molds,…)

- **Middle Ear**

- **Conductive Hearing Loss**



Disease of the Middle Ear

- **Tympanic Membrane Perforation** (Hole in the ear drum)
  - Has a variety of causes (Infection, trauma, etc)
  - May cause pain, imbalance and hearing loss
  - Treatment: Surgery for repair

Disease of the Middle Ear

- **Acute Otitis Media**
  - Middle ear infections
  - Most common in children
  - Often, due to the presence of another illness (cold…)
  - It can cause temporary hearing loss
  - Treatment:Antibiotic, pain medication

Disease of the Middle Ear

- **Serous Otitis Media**
  - Fluid in the Middle ear.
  - Most common in children
  - Also, in adult after flu
  - Eustachian tube dysfunction caused by:
    - Allergies
    - Infection
    - Variation of anatomy of eustachian tube
    - Enlarged adenoids

- Treatments:
  - Nasal spray
  - Adenoidectomy
  - Myringotomy and Tympanostomy tube placement .

Disease of the Middle Ear

- **Otosclerosis**
  - Fixation of the stapes bone in the middle ear causing it to be immobile.
  - This immobility prevents it from setting the fluid in the inner ear in motion and in turn preventing stimulation of the auditory nerve.
  - Most of the cases are genetic.
  - It causes gradual HL
  - Treatment: Hearing Aids, surgery (stapedectomy)

Middle Ear Surgery

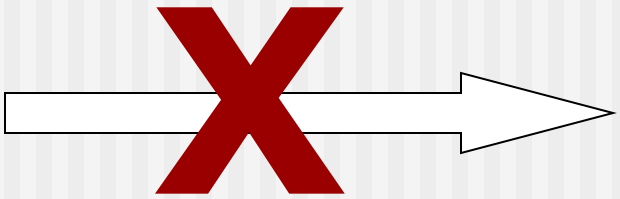
- **Stapedectomy**
  - The stapes, the innermost bone on the middle ear, is replaced with a small plastic tube of stainless-steel wire to improve hearing.
  - Used to treat progressive hearing loss due to otosclerosis.

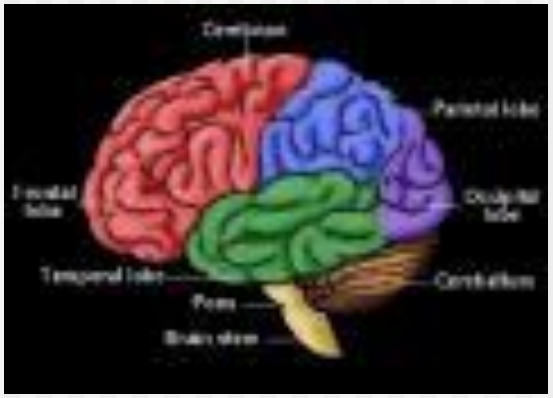
Disease of the Middle Ear

- **Cholesteatoma**
  - An abnormal skin growth in the middle ear behind the eardrum
  - Usually due to repeated infection, which causes in growth of the skin.
  - As they grow, they can damage the middle ear and cause hearing loss, **dizziness** and **facial paralysis.**
  - Treatment
    - Surgery

Inner Ear

- **Sensorineural Hearing Loss**
- Develops when the auditory nerve or hair cells in the inner ear are damaged.
- The sources of sensorineural hearing loss may be located in the **inner ear**, the **nerve** from the inner ear to the brain or in the **brain**.





Disease of Inner Ear

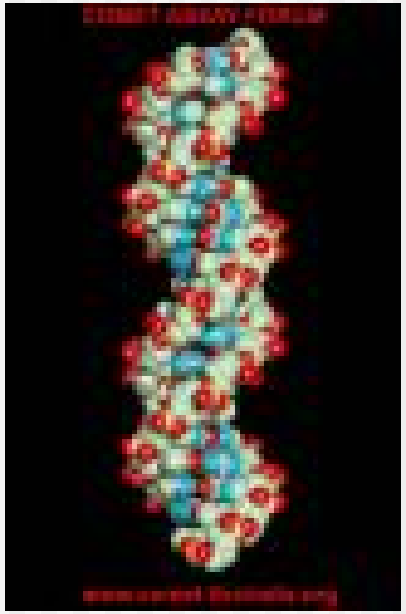
- **Meniere's Disease**
  - Recurrent:
    - Dizziness attacks
    - Fluctuating Hearing loss
    - Ringing in ears
    - Feeling of fullness in ears
  - Treatment
    - Dietary restrictions, smoking cessation
    - Medical treatment (Serc, Steroids,…)
    - Meniett
    - Gentamicin
    - Shunt surgery or nerve section
    - Hearing Aids

Disease of Inner Ear

- **AIED** (Auto-Immune Inner Ear Disease)
  - AIED usually occurs in both ears
  - Your own immune system attacks the tissue of the inner ear
  - Frequently occurs along with other auto-immune diseases
  - Causes progressive hearing loss
  - Genetic factors and allergies may contribute to AIED
  - Treatment: Steroids (Timely treatment)

Other Causes of Hearing Loss

- Genetic
  - Congenital
  - Delay onset



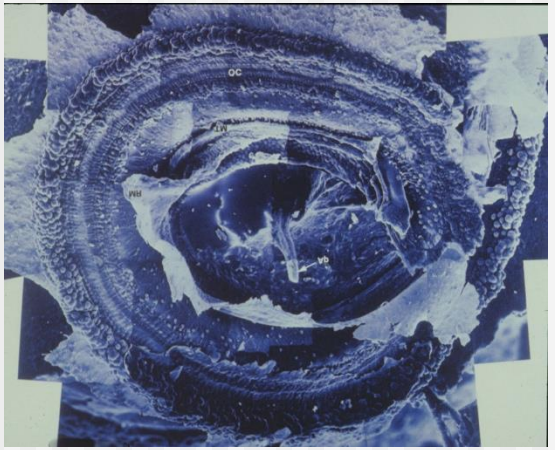
- Infection

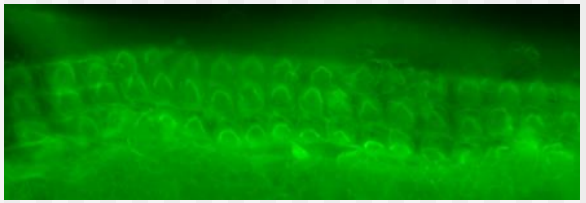
- Trauma

- Drugs

Sudden Hearing Loss

- Sudden
- Vascular, viral, inflammation?
- Emergency+++
- Treatment
  - Steroid
    - Oral intake
    - Injection in ear
  - Looking for etiology
  - Hearing aids, cochlear implant





Other Causes of Hearing Loss

- **Presbycusis:** Hearing loss due to aging.
  - A gradual hearing loss in most individuals as they age
  - Usually associated with difficulty hearing high pitch sounds.
  - Can be due to changes in the middle or inner ear.
  - Usually affects both ears equally
  - Treatment: Hearing aids, cochlear implant
  - Can be delayed/prevented: Our Research at UM!

Consequences of Hearing Loss

- **Adult:**
  - Communications difficulties ：At work, home, social gathering, on the phone
  - Communicating with children and grandchildren
  - Increased isolation, depression, dementia, Tinnitus
  - Impact on personal safety: fall, accident
- **Children:**
  - Language development
  - School challenges
  - Isolation and bully

Medical Treatment

- Prevention: Noise trauma, Some meds
- If Sudden: Emergency+++
- Treatment
  - Steroid
    - Oral intake
    - Injection in ear
- Managing the associated Tinnitus
- New drugs

Treatment – Hearing Aids

In the Canal

In the Ear Hearing Aid

Behind the Ear Hearing Aids

Treatment – FM Systems

-Great for engaging in conversation in crowded environments.

- theater, lectures and conferences

Treatment - BAHA

- **BAHA** (Bone Anchored Hearing Aid)
  - Picks up sound and converts them into vibrations
  - These vibrations are carried via titanium implant to the inner ear
  - Very effective in those with conductive hearing loss
  - Helps patients with one sided sensorineural hearing loss (transmits sounds to the unaffected ear)

Treatment: Cochlear Implants

- First surgical devices that can re-establish one of the human senses!
- **A completely deaf person can hear** !
- A cochlear implant bypasses the damaged or missing sensory structures of the inner ear to stimulate the hearing nerve directly

Biomedical Engineering Principles of Modern Cochlear Implants and Recent Surgical Innovations

ADRIEN A. ESHRAGHI,[1]* CHHAVI GUPTA,[1] OZCAN OZDAMAR,[2] THOMAS J. BALKANY,[1] ERIC TRUY,[3] AND RONEN NAZARIAN[1]

[1]Department of Otolaryngology, University of Miami Miller School of Medicine, University of Miami Ear Institute, Miami, Florida

[2]Department of Biomedical Engineering, University of Miami, Coral Gables, Florida

[3]Institut National de la Santé et de la Recherche Médicale U960, Department of Cognitive Studies, Ecole Normale Supérieure, 75005 Paris, France

The Cochlear Implant: Historical Aspects and Future Prospects

ADRIEN A. ESHRAGHI,[1]* RONEN NAZARIAN,[1] FRED F. TELISCHI,[1] SUHRUD M. RAJGURU,[1] ERIC TRUY,[2] AND CHHAVI GUPTA[1]

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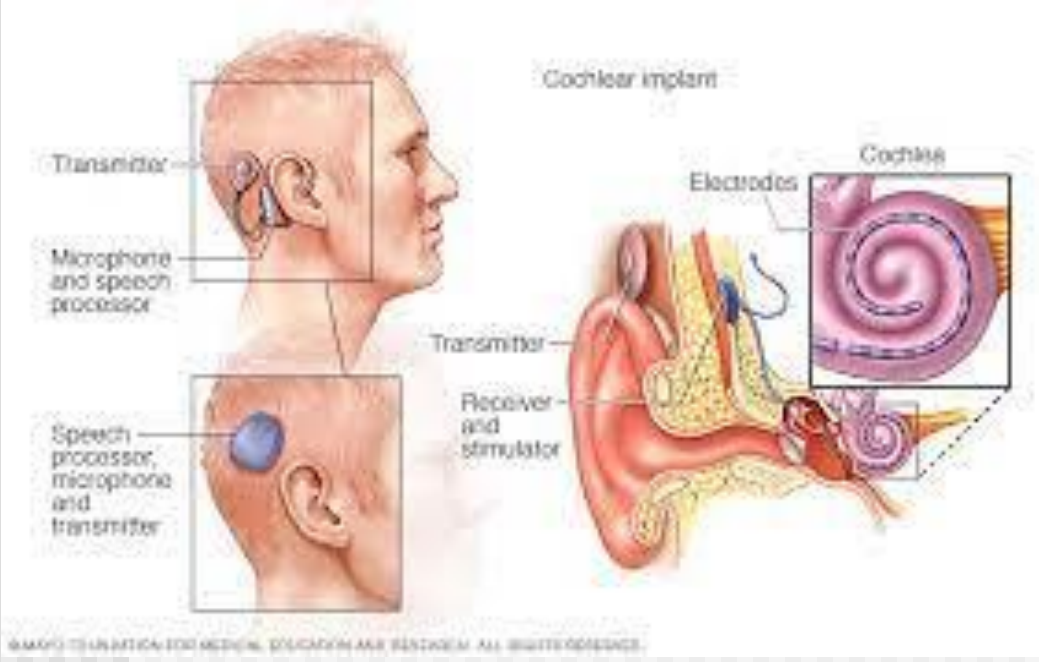
The Laryngoscope

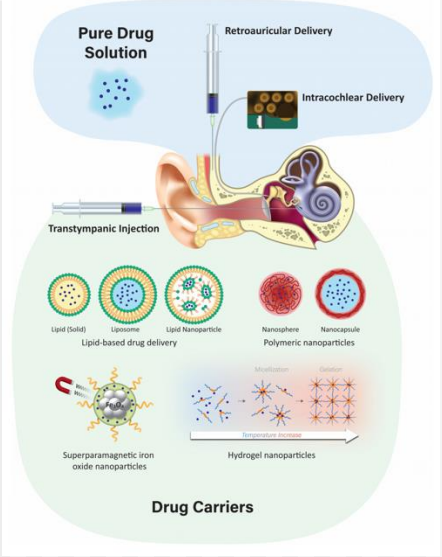
Cochlear Implant Surgery in Patients More Than Seventy-Nine Years Old

Adrien A. Eshraghi, MD, MSc; Michael Rodriguez, MD; Thomas J. Balkany, MD; Fred F. Telischi, MD, MEE; Simon Angeli, MD; Annelle V. Hodges, PhD; Eelam Adil, MD

- No complications
- Improves quality of life



Hearing Research Laboratory at UM

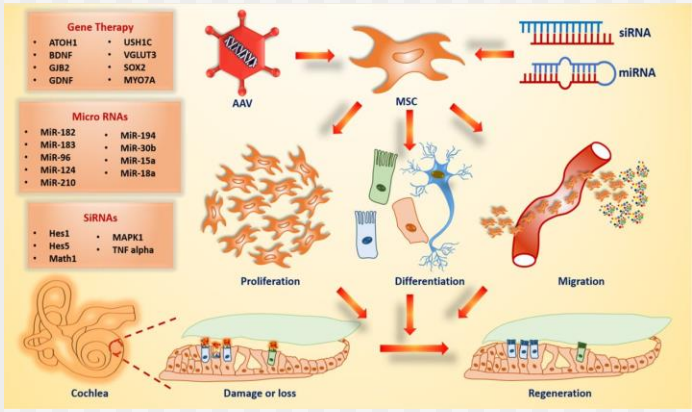


Forefront in the following areas:

- Identifying, screening and determining efficacy of **new drugs** to preserve natural hearing and improve clinical outcomes in **cochlear implan**t patients.

- Explore the potential of **stem cells** and new drug carriers such as **nanoparticles and slow releasing hydrogels** for hearing disorders.

- Utilizing **gene therapy** techniques to develop cures for hearing loss and other auditory disorders.



Thank You
I'm (H)Ear for you!

- Appointment:
  - 305-243-3564
  - 1-800-432-0191
  - TDD: 305-585-2351
- Office:
  - 305-243- 3397 (My secretary : Glenda)
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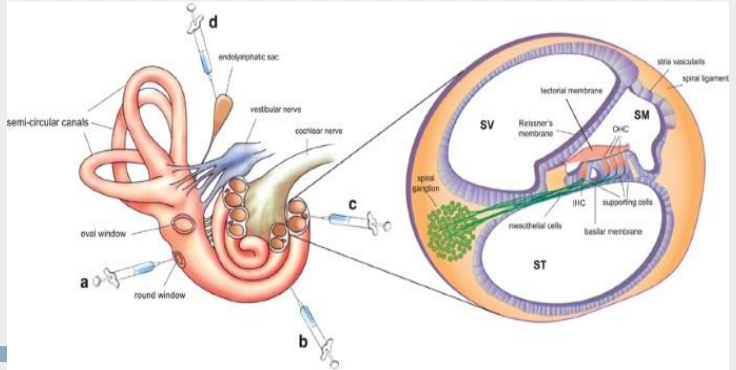
Selected Publications from Our Lab



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Pena SA, Iyengar R, Eshraghi RS, Bencie N, Mittal J, Aljohani A, Mittal R, Eshraghi AA. Gene therapy for neurological disorders: challenges and recent advancements. J Drug Target. 2020;28(2):111-128.

Bergman JE, Davies C, Denton AJ, Ashman PE, Mittal R, Eshraghi AA. Advancements in Stem Cell Technology and Organoids for the Restoration of Sensorineural Hearing Loss. J Am Acad Audiol. 2021;32(10):636-645.

Eshraghi AA, Ocak E, Zhu A, Mittal J, Davies C, Shahal D, Bulut E, Sinha R, Shah V, Perdomo MM, Mittal R. Biocompatibility of Bone Marrow-Derived Mesenchymal Stem Cells in the Rat Inner Ear following Trans-Tympanic Administration. J Clin Med. 2020;9(6):1711.