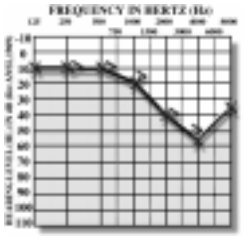
Practical Applications of Acoustics

- Diagnostic Audiology Applications
- Rehabilitative Audiology Applications
- Speech-Language Pathology Applications

Diagnostic Audiology

- Hearing Tests
- **Audiogram** - the fundamental graph for displaying hearing test results
- Note the axes: Frequency in Hertz and Hearing Level in dB

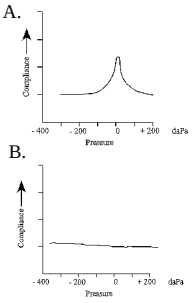


Diagnostic Audiology

- Tympanometry - the assessment of middle ear function
- Probe is placed in the external auditory canal
- Pressure applied via the probe in the canal to assess the **impedance** of the middle ear

Diagnostic Audiology

- Sample tympanograms shown at right
- A. Normal Middle Ear Function
- B. Middle Ear Dysfunction



Rehabilitative Audiology

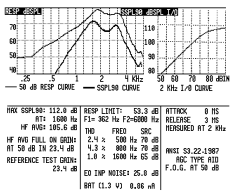
- Hearing Aids
- Cochlear Implants

Rehabilitative Audiology

- Hearing Aids
- Used to amplify sound for the hearing impaired
- Diagnostic assessment of hearing aid function is used to ensure a hearing aid is working correctly
- Diagnostic assessment employs many acoustics concepts

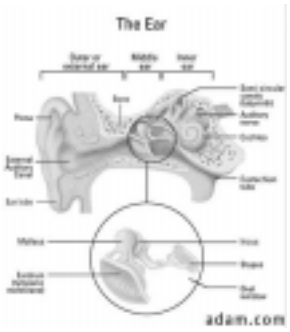
Rehabilitative Audiology

- Results of test of hearing aid function shown at right
- Note the **transfer function** of the hearing aid
- Note the results of testing for **total harmonic distortion** (THD)



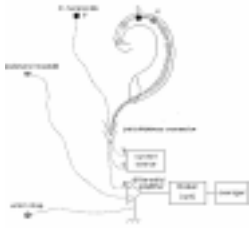
Rehabilitative Audiology

- Cochlear Implants
- Used to restore hearing in individuals with profound hearing losses
- Does not restore normal hearing but is an improvement over a profound hearing loss for many people



Rehabilitative Audiology

- An electrode array is inserted into the cochlea
- A schematic of an electrode array insertion shown at the right
- Current pulses are applied through the electrode array and stimulate the auditory nerve

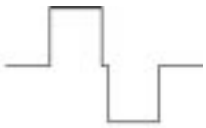


Rehabilitative Audiology

- Another schematic of an inserted electrode array

Rehabilitative Audiology

- How does this apply to acoustics?
- The current pulse delivered to to the electrodes looks like a **square wave**
- An example of one type of current pulse used in cochlear implants is shown at the right



Speech-Language Pathology

- Acoustic principles are used in the treatment of many speech disorders
- Certain types of voice disorders, neurologic disorders, and hearing losses may result in use of inappropriate vocal pitches and vocal volumes

Speech-Language Pathology

- Speech is a complex acoustic waveform with a fundamental frequency - the pitch of a person's voice
- Children who have had profound hearing losses from birth often speak with a **fundamental frequency** that is too high
- Vocal abuse may also result in an inappropriate **fundamental frequency**

Speech-Language Pathology

- Certain neurologic disorders such as Parkinson's disease may also result in the person speaking too softly -- the **amplitude** of their voice is too small
- Hearing impaired people may speak either too loudly or too softly because they cannot hear their own voice

Speech-Language Pathology

- People having problems maintaining the appropriate pitch (F0) or volume (amplitude) may be asked to speak into a microphone hooked to a computer that will display their F0 or speaking volume
- Used in therapy to help person learn to change pitch or volume

Speech-Language Pathology

- An example of the display from the computer program is shown at right
- Top tracing is fundamental frequency
- Bottom tracing is volume