The hearing mechanism
Understanding hearing loss
Noise and hearing loss
Music and musicians

The Hearing Mechanism

We hear a range of frequencies from 20-20,000 Hz
And intensities with a range (from softest sound to feeling of pain) of 1-10^{-14} or about 140 decibels
Auditory Transduction

Understanding Hearing Loss

Sound is Pressure

https://www.youtube.com/watch?v=46aNGGNPm7s
Human Hair Cells Cannot Regenerate
Noise & Hearing Loss

Noise-Induced Hearing Loss
- Occurs slowly over time
- Three stages
  - Damage to outer hair cells
  - Damage to high frequencies first
  - Damage to outer and inner hair cells, affecting speech understanding, beginning with high frequencies and then moving to mid- and lower-frequency sounds

Warning Signs
- Muffling of sound
- Tinnitus

Hearing Loss in Young Adults
National Health & Nutrition Examination Survey of US adolescents 12-19 years

Survey Results
- 1988-1994
  - 3211 participants
  - 12.5% had evidence of noise-induced loss

- 2005-2006
  - 2288 participants
  - 16.4% had evidence of noise-induced hearing loss
  - 31% increase!
  - 1 in 5 teens demonstrated a hearing loss!
Noise-induced hearing loss is PREVENTABLE!

Noise-Induced Hearing Loss

Volume or Intensity

Exposure time

Earphone type

PMPs
- Volume levels average 75-105 dBA
- Levels may exceed 130 dBSPL

Concerts
- Levels range from 120-140 dBSPL

Exposure Time

Time/Intensity tradeoff

Listening to music at 105 dBSPL for 5 minutes = exposure to industrial noise at 85 dBSPL for 8-hours

Recommendations for PMPs

The 60/60 rule:

Listen at 60% volume for no longer than 60 minutes at a time
Music majors more aware of effects of noise on hearing health than non-musicians

BUT . . . in a recent survey

Only 22% wore hearing protection when exposed to what they considered to be harmful noise
79% never wore hearing protection
90% did not wear hearing protection during performances
Why?

- Hearing protection
- Reduced sound quality
- Lessened ability to control sound
- Hindered ability to stay in tune with other performers in an ensemble
- Produced occlusion effect that made it difficult to listen to sound around them
- Could not communicate
- Uncomfortable

Risk of noise-induced hearing loss

- Bassoon, horn, trumpet, trombone, clarinet, and flute players at great risk
- Noise range from 79-99 dBSPL

What’s a Musician to do??

- Get a baseline audiogram
- Pure Tone Audiometry
- Otoacoustic Emissions

Hearing Protection

Etymotic transparent hearing protection