



Sunnyview Rehabilitation
Hospital

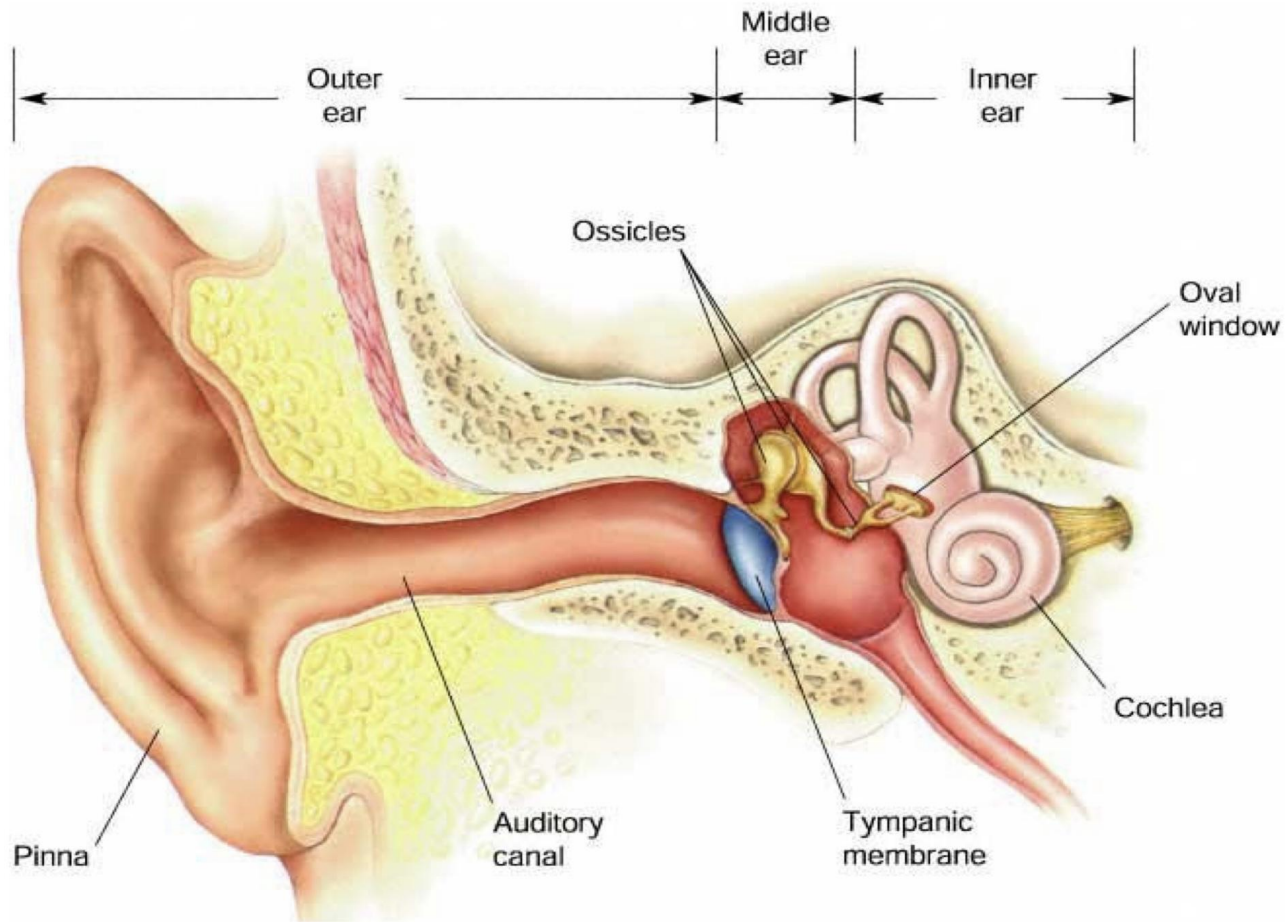
ST PETER'S HEALTH PARTNERS

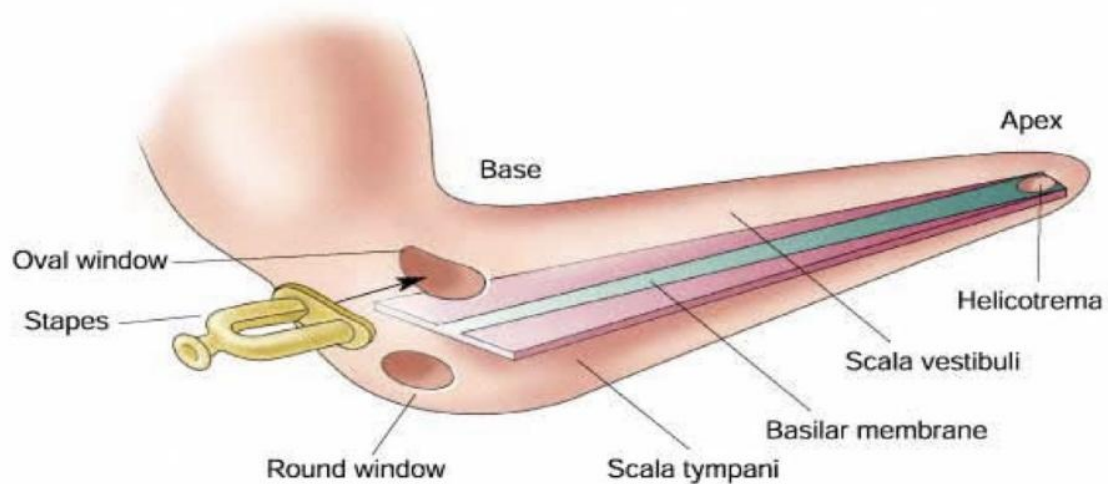
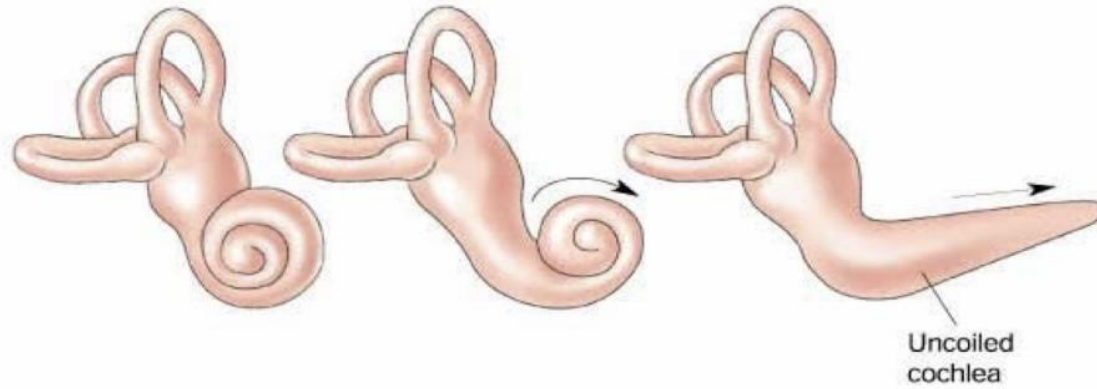
Music Induced Hearing Loss

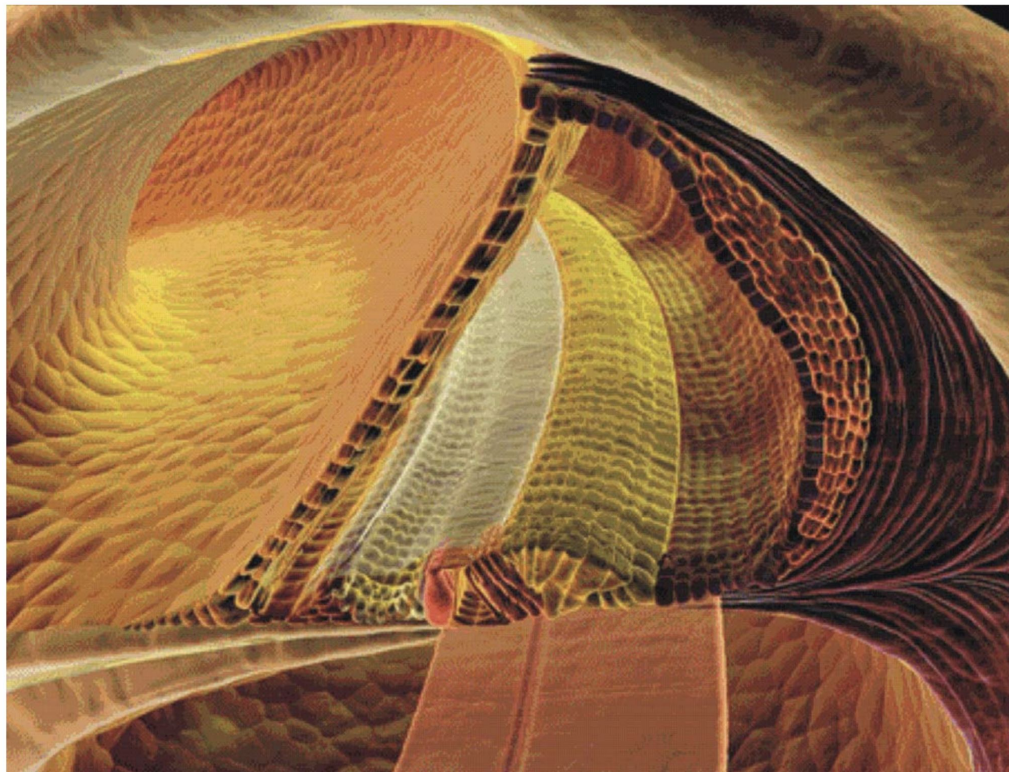
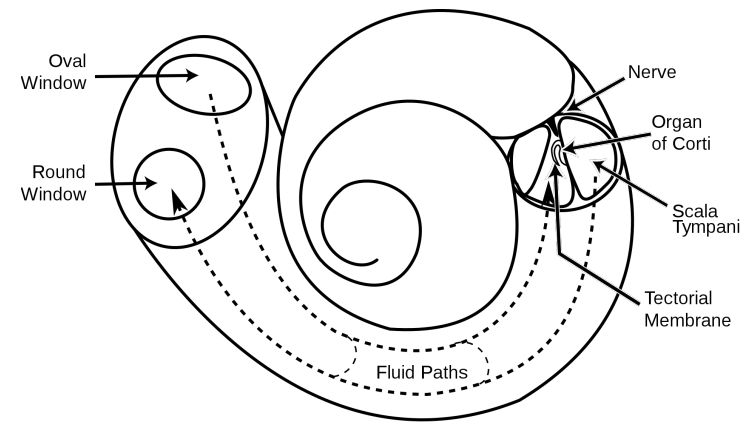
Origins, Mechanisms, and Prevention

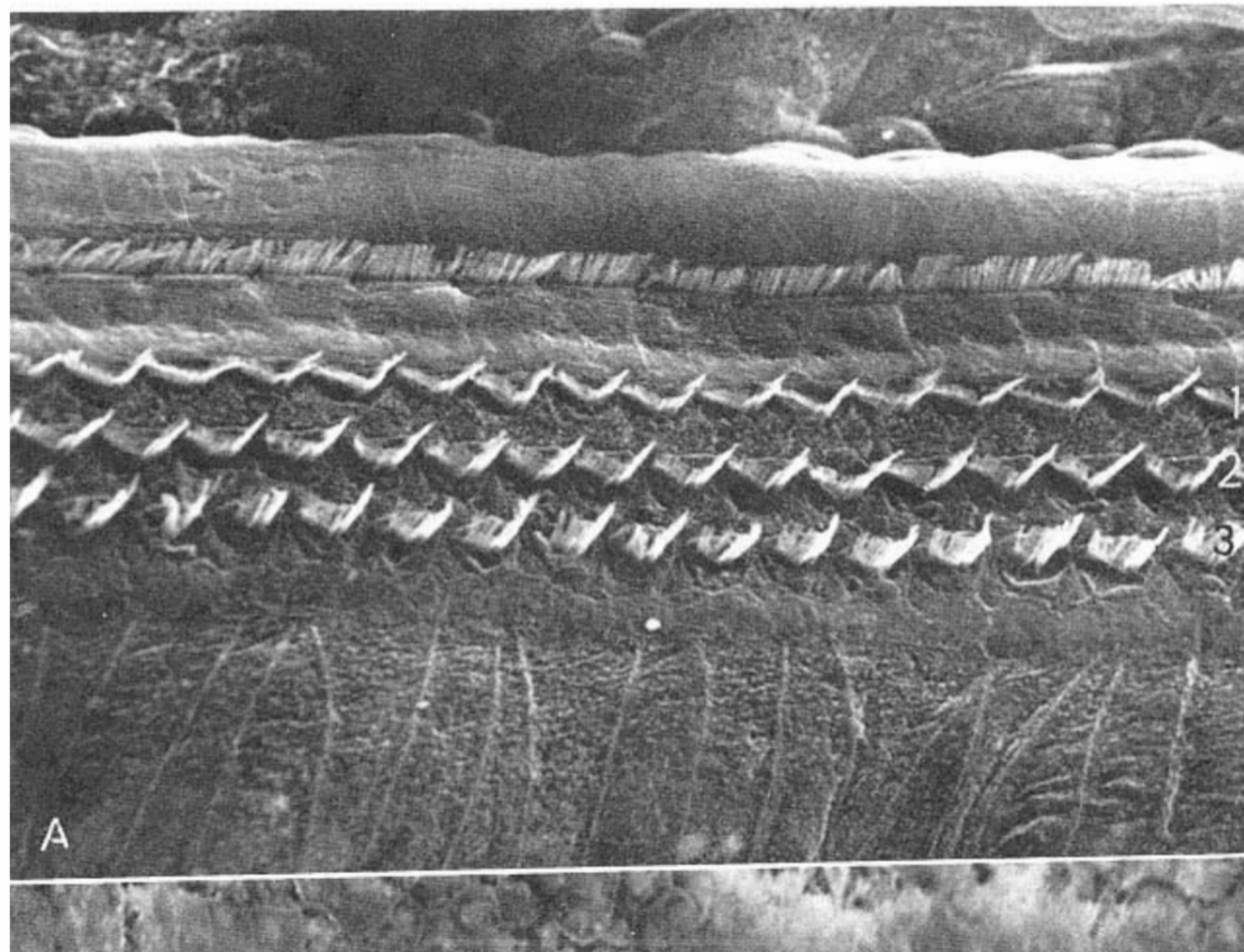
Margaret Halinski, MM AuD
Doctor of Audiology

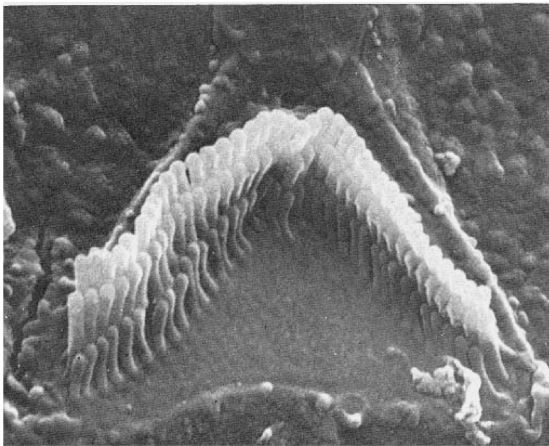


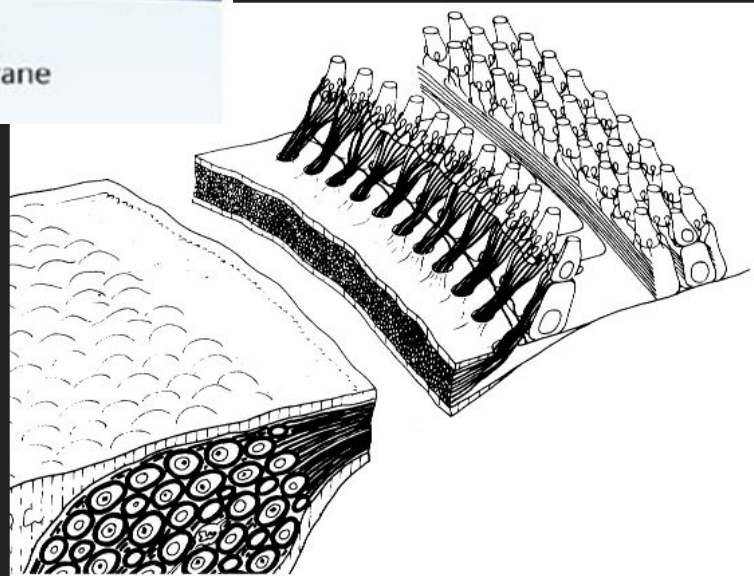
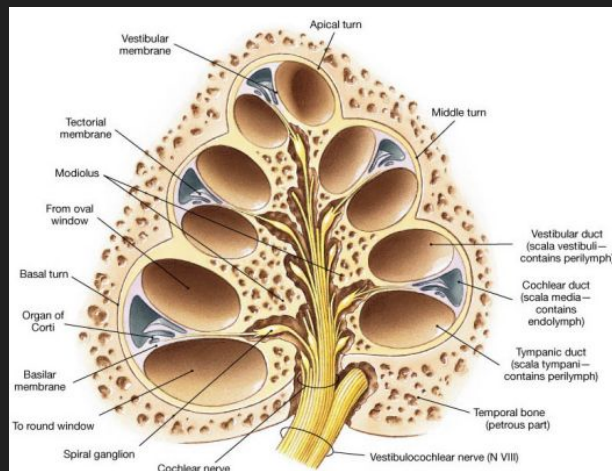
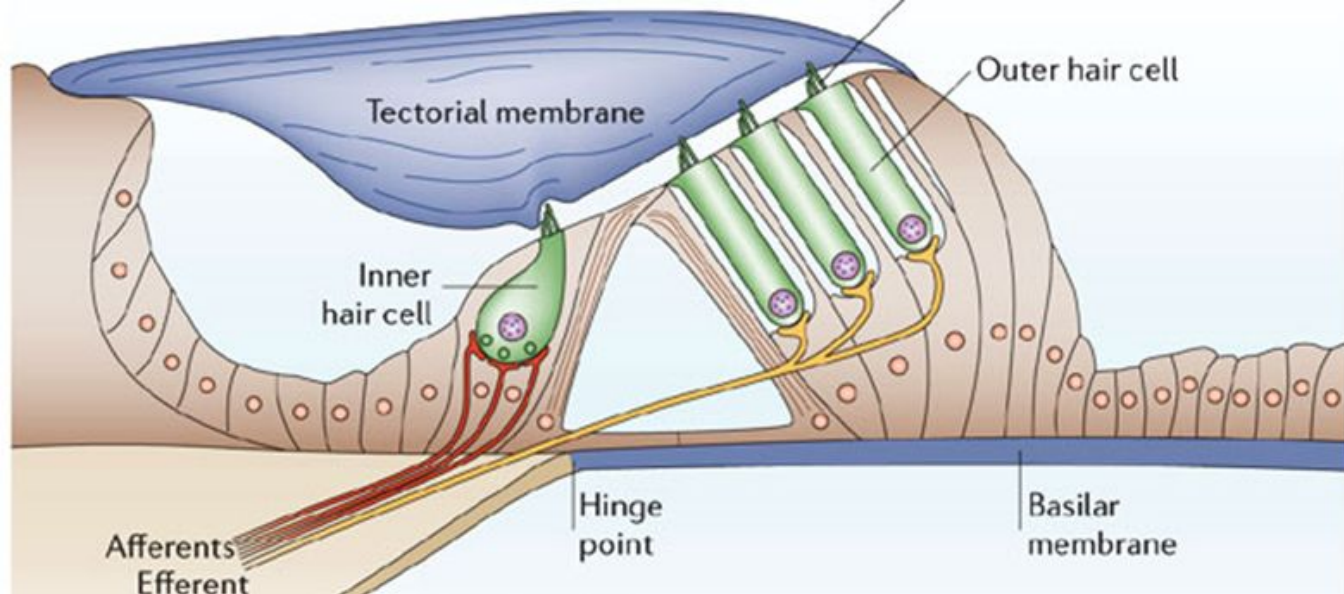




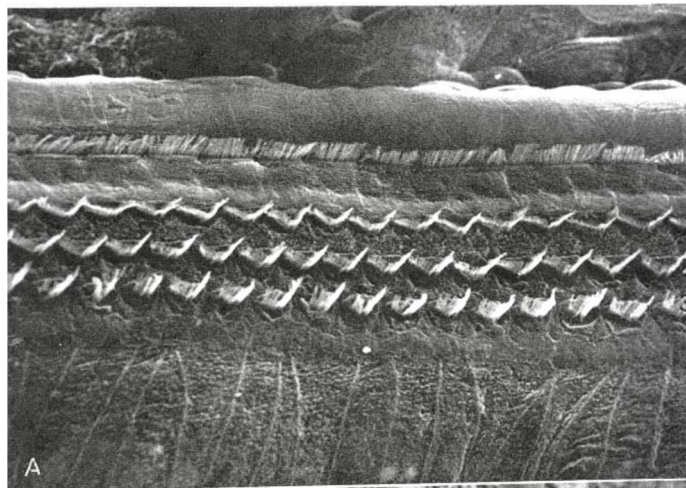




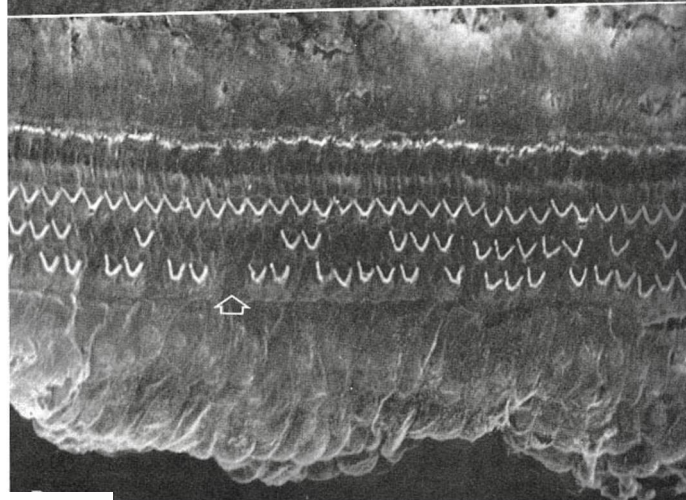




Healthy cochlea



Damaged cochlea



What Causes Damage to the Hair Cells?



Sound Level Measurements

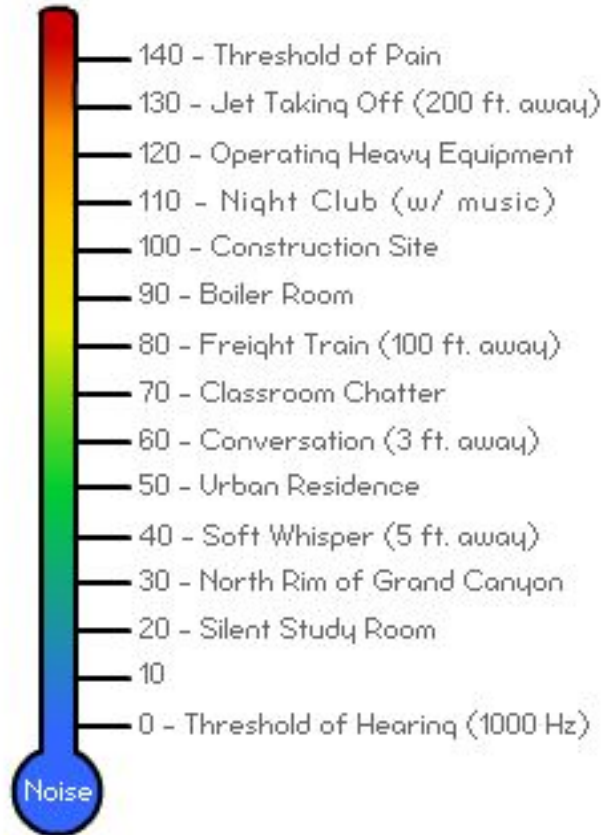
Decibel (dB)

- measurement of the intensity of a sound
- Logarithmic scale
 - 0 dB = softest sound
 - 10 dB = 10 times greater than 0 dB
 - 20 dB = 100 times greater than 0 dB
 - 3 dB increase = sound energy is doubled

dBA - A weighting

- Common measurement for noise
- Averaging dB across 20 Hz to 20 kHz
- More weight is given to frequencies 500-6000 Hz

Typical Sound Levels (dBA)

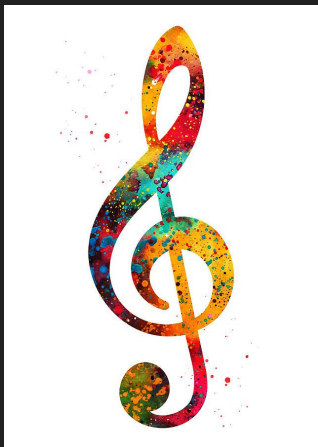


NIOSH Daily Permissible Noise Level Exposure (before permanent hearing loss)

Hours per day	Sound level
8	85dBA
6	86dBA
4	88dBA
3	89dBA
2	90dBA
1.5	92dBA
.5	94dBA
.25 or less	100dBA
0	112dBA

Find additional information at:

<http://www.cdc.gov/niosh/docs/98-126/pdfs/98-126.pdf>



Daily Allowable Sound Exposure Limit

Music Environment	Typical dB	No earplugs
Rock Concert Range: 80-120 dB	106 dB	< 4 mins
Drumline Range: 92-110 dB	102 dB	<10 mins
Marching Band Range: 85-115 dB	100 dB	15 mins
Concert Band Range: 89-97 dB	93 dB	1 hr 15 mins
Symphony Range: 80-102 dB	91 dB	2 hrs
Orchestra Pit Range: 82-95 dB	88 dB	4 hrs



Alto sax	110 – 113 dB
Bass Drum	100 – 122 dB
Bassoon	80 – 93 dB
Clarinet	93 – 119 dB
Cymbals	118 – 121 dB
Euphonium/Baritone	96 – 113 dB
Flugelhorn/Bugle	109 – 120 dB

Flute	100 – 112 dB
French horn	92 – 104 dB
Mellophone	92 – 111 dB
Oboe	74 – 102 dB
Piccolo	102 – 112 dB
Snare drum	102 – 113 dB
Tenor sax	110 – 115 dB

Timpani	74 – 94 dB
Trombone	106 – 113 dB
Trumpet/Cornet	109 – 120 dB
Tuba/Contrabass	110 – 117 dB
Violin	85 – 105 dB
Viola	85 – 105 dB

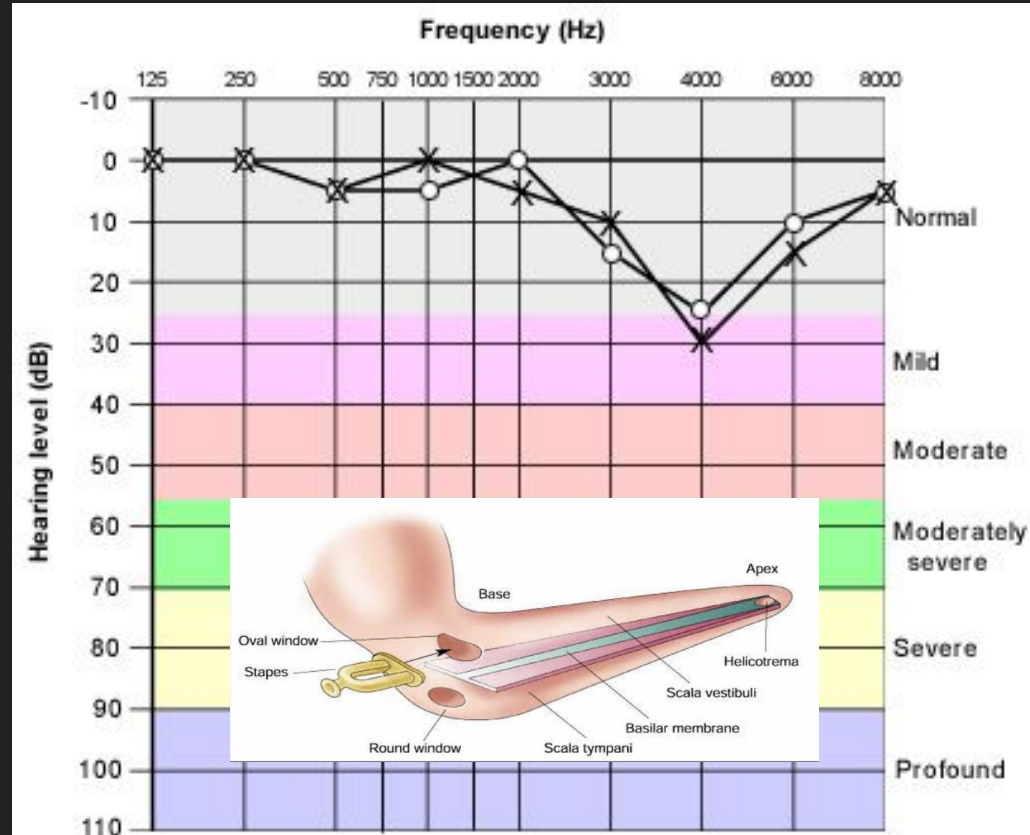
Dosimeter recording

- 52 piece concert band
- average $L_{eq} = 95.99$ dB A
- peaks to 99 dB A
- noise dose = 270% over 105 minutes of recording data, per NIOSH



What happens if you've had too much noise?

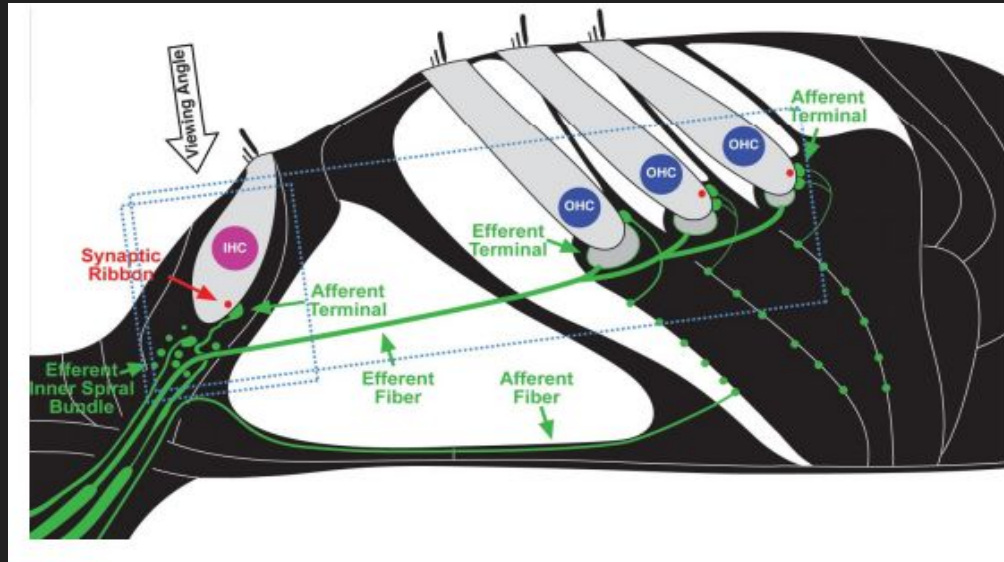
- Tinnitus
- Temporary Threshold Shift
- Permanent Hearing Loss



Adding Insult to Injury: Cochlear Nerve Degeneration after “Temporary” Noise-Induced Hearing Loss

Sharon G. Kujawa^{1,2,3,4} and M. Charles Liberman^{1,2,4}

¹Department of Otology and Laryngology, Harvard Medical School, Boston, Massachusetts 02115, ²Eaton-Peabody Laboratory and ³Department of Audiology, Massachusetts Eye and Ear Infirmary, Boston, Massachusetts 02114, and ⁴Program in Speech and Hearing Bioscience and Technology, Division of Health Science and Technology, Harvard–Massachusetts Institute of Technology, Cambridge, Massachusetts 02139



Kujawa SG, Liberman MC. Adding insult to injury: cochlear nerve degeneration after “temporary” noise-induced hearing loss. *J Neurosci*. 2009 Nov 11;29(45):14077–85. doi: 10.1523/JNEUROSCI.2845-09.2009. PMID: 19906956; PMCID: PMC2812055.

What about humans?

Neural Degeneration from Noise!

Primary Neural Degeneration in Noise-Exposed Human Cochleas: Correlations with Outer Hair Cell Loss and Word-Discrimination Scores

Pei-Zhe Wu,^{1,2,3} Jennifer T. O'Malley,¹ Victor de Gruttola,⁴ and  M. Charles Liberman^{1,2}

¹Eaton-Peabody Laboratories, Massachusetts Eye and Ear, Boston, Massachusetts 02114, ²Department of Otolaryngology, Harvard Medical School, Boston, Massachusetts 02115, ³Department of Otorhinolaryngology Head and Neck Surgery, The First Affiliated Hospital, Sun Yat-sen University, Guangzhou 510080, China, and ⁴Department of Biostatistics, Harvard T.H. Chan School of Public Health, Boston, Massachusetts 02115

Wu PZ, O'Malley JT, de Gruttola V, Liberman MC. Primary Neural Degeneration in Noise-Exposed Human Cochleas: Correlations with Outer Hair Cell Loss and Word-Discrimination Scores. *J Neurosci*. 2021 May 19;41(20):4439-4447. doi: 10.1523/JNEUROSCI.3238-20.2021. Epub 2021 Apr 21. PMID: 33883202; PMCID: PMC8152611.

Auditory filter shapes and high-frequency hearing in adults who have impaired speech in noise performance despite clinically normal audiograms^{a)}

Rohima Badri, Jonathan H. Siegel, and Beverly A. Wright^{b)}

*School of Communication, Department of Communication Sciences and Disorders, Northwestern University,
2240 Campus Drive, Evanston, Illinois 60208*

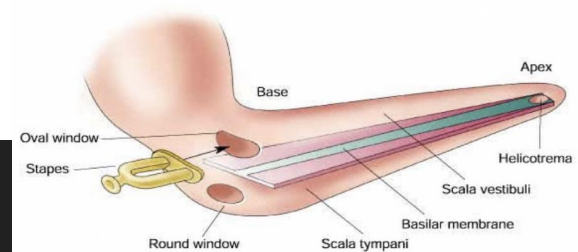
(Received 2 April 2009; revised 11 November 2010; accepted 12 November 2010)

Some individuals complain of hearing difficulties in the presence of background noise even in the absence of clinically significant hearing loss (obscure auditory dysfunction). Previous evidence suggests that these listeners have impaired frequency resolution, but there has been no thorough characterization of auditory filter shapes in this population. Here, the filter shapes of adults ($n = 14$) who self-reported speech recognition problems in noise and performed poorly on a sentence-in-noise perception test despite having clinically normal audiograms were compared to those of controls ($n = 10$). The filter shapes were evaluated using a 2-kHz probe with a fixed level of 30, 40, or 50 dB sound pressure level (SPL) and notched-noise simultaneous maskers that were varied in level to determine the masker level necessary to just mask the probe. The filters of the impaired group were significantly wider than those of controls at all probe levels owing to an unusual broadening of the upper slope of the filter. In addition, absolute thresholds were statistically indistinguishable between the groups at the standard audiometric frequencies, but were elevated in the impaired listeners at higher frequencies. These results strengthen the idea that this population has a variety of hearing deficits that go undetected by standard audiometry.

© 2011 Acoustical Society of America. [DOI: 10.1121/1.3523476]

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Noise is everywhere!



12-35 years of age

- 50% exposed to unsafe levels from streaming under headphones
- 40% exposed to unsafe levels at concerts¹



1.1 billion people are estimated to be at risk for noise induced hearing loss²

40 million adults have audiograms consistent with noise induced hearing loss³

22 million (17%) workers reported exposure to high levels of noise⁴

1. National Institute on Deafness and Other Communication Disorders. (2017, July 27). Listen Up! Protect Your Hearing (infographic). Retrieved from <https://www.nidcd.nih.gov/health/listen-infographic>
2. World Health Organization (2020, March 1). Deafness and hearing loss: Key facts. Retrieved from <https://www.who.int/news-room/fact-sheets/detail/deafness-and-hearing-loss>
3. Centers for Disease Control and Prevention (2000, January 6). Vital Signs – Too loud! For too long!. Retrieved from <https://www.cdc.gov/vitalsigns/hearingloss/index.html>
4. Centers for Disease Control and Prevention (2018, February 6). Noise and hearing loss prevention: Preventing hearing loss caused by chemical (ototoxicity) and noise exposure. Retrieved from <https://www.cdc.gov/niosh/topics/noise/default.html>

What can you do?

#1



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8	85dBA
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3	89dBA
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#2



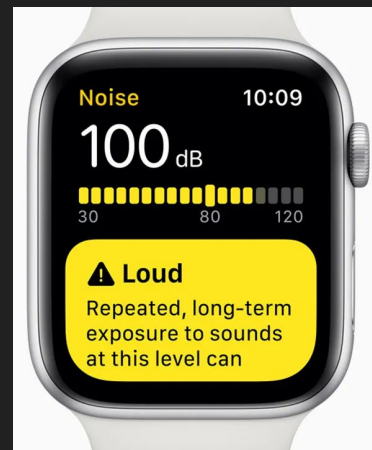
#3



Use a Sound Level Meter App

example:

- NIOSH Sound Level Meter App
- iWatch Noise app



#4

MOVE

#5



Use Earplugs



Earplug Measurements

Attenuation

- Amount of sound in decibels (dB) that is reduced by the earplug
- Usually an average across frequencies
- Even (or flat) attenuation is achieved by introducing a resonant peak in the earplug response to simulate the natural resonance of the ear canal

Noise Reduction Rating (NRR)

- Average reduction of Sound in decibels (dB)
- Established by Environmental Protection Agency
- Derated to account for variability of earplug fit (NIOSH)

Passive Earplugs

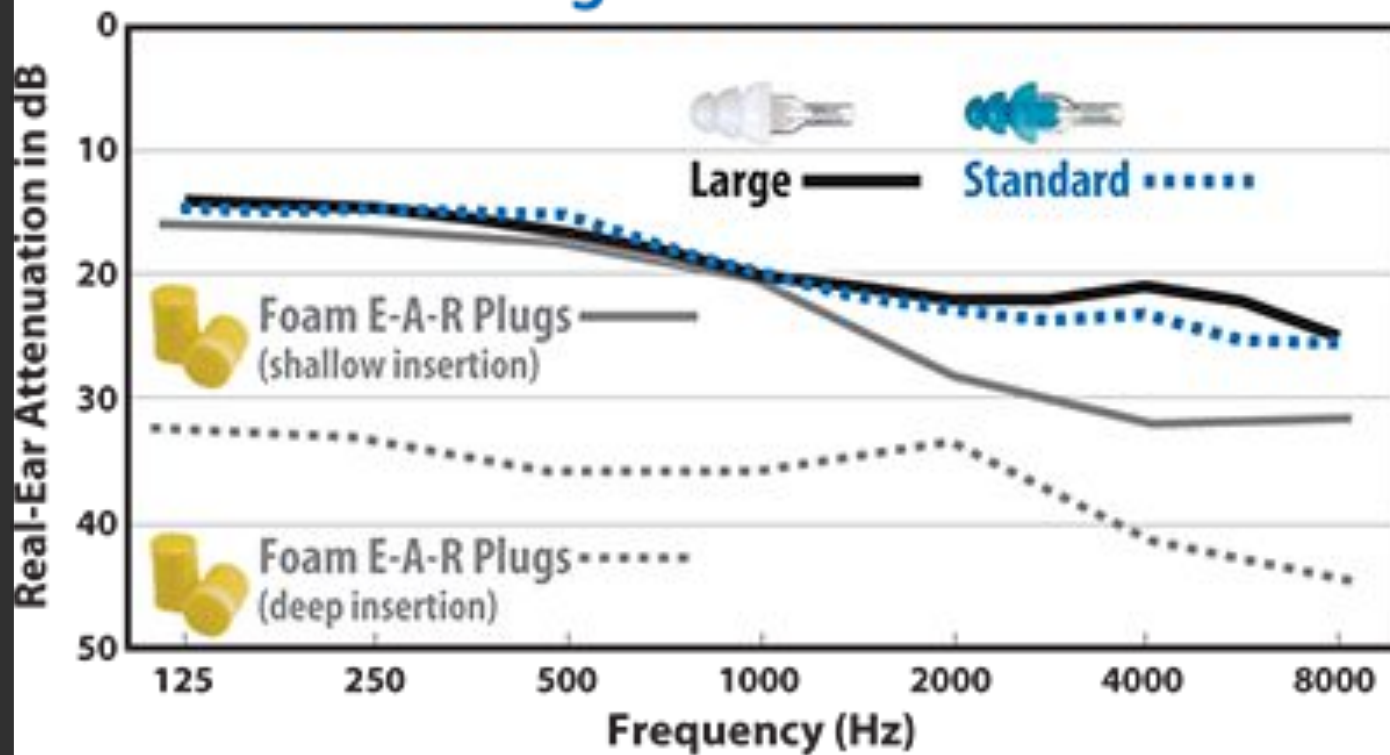
- Even attenuation (20 dB) across most frequencies
- Most economical option

Designed for musicians

- ER•20 XS
 - improved high frequency clarity above 4 kHz
 - low profile
- ETY plugs
 - Replicates natural response of ear canal



ETY•Plugs Noise Reduction



NOISE-INDUCED HEARING LOSS Know the Risk



Daily Allowable Sound Exposure Limit

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Range: 80-120 dB 106 dB < 4 mins

Drumline
Range: 92-110 dB 102 dB <10 mins

Marching Band
Range: 85-115 dB 100 dB 15 mins

Concert Band
Range: 89-97 dB 93 dB 1 hr 15 mins

Symphony
Range: 80-102 dB 91 dB 2 hrs

Orchestra Pit
Range: 82-95 dB 88 dB 4 hrs



With ETY-Plugs® or ER20®XS Earplugs

6 hrs

SAFE

SAFE

SAFE

SAFE

SAFE

1. Locate your instrument below.
2. Note the range of sound levels it can produce.
3. Using the chart above, compare how using ETYMOTIC high-fidelity earplugs dramatically increases the amount of time you can listen without risking hearing loss.

Alto sax 110 – 113 dB
Bass Drum 100 – 122 dB
Bassoon 80 – 93 dB
Clarinet 93 – 119 dB
Cymbals 118 – 121 dB
Euphonium/Baritone 96 – 113 dB
Flugelhorn/Bugle 109 – 120 dB

Flute 100 – 112 dB
French horn 92 – 104 dB
Mellophone 92 – 111 dB
Oboe 74 – 102 dB
Piccolo 102 – 112 dB
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Custom Earplugs

Tru custom

- Filter attenuation of 10 dB, 16 dB, 20 dB, or 25 dB

Style 49

- Filter attenuation of 9 dB, 15 dB, 25 dB
- Etymotic Research Filters



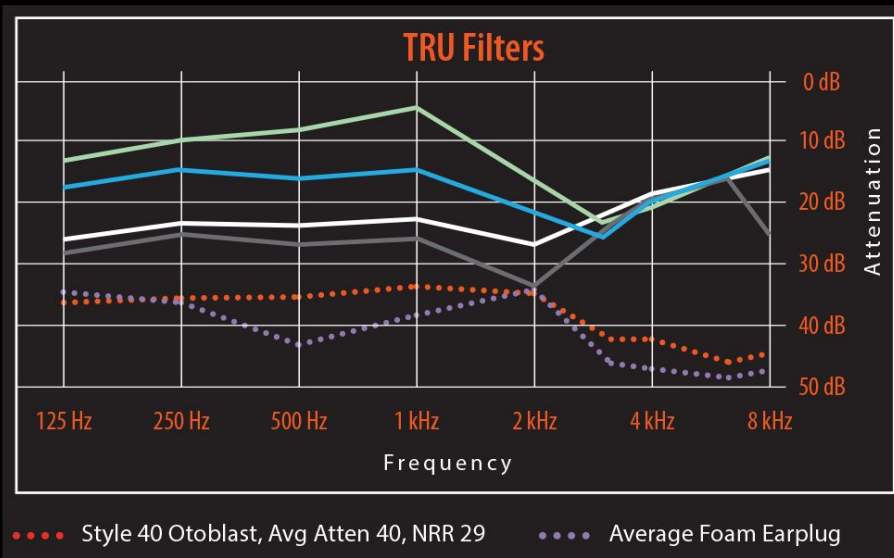
Tru Custom

GREEN WM10 AVG attenuation: 14 dB | NRR: 2

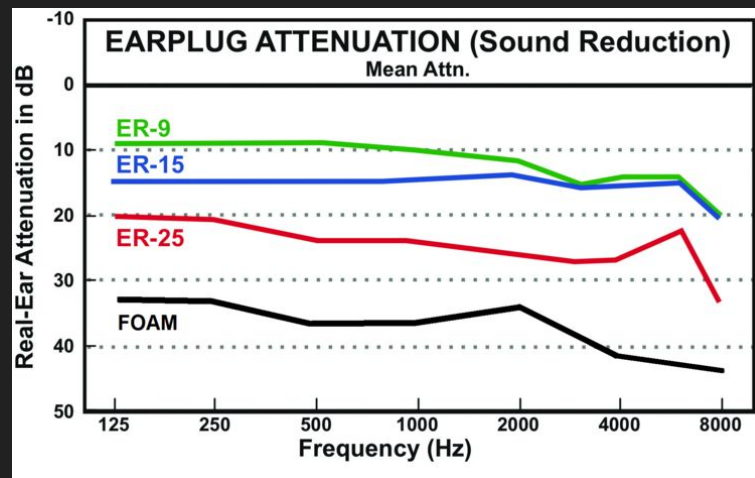
BLUE WM16 AVG attenuation: 18 dB | NRR: 10

WHITE WM20 AVG attenuation: 21 dB | NRR: 13

BLACK WM25 AVG attenuation: 24 dB | NRR: 15

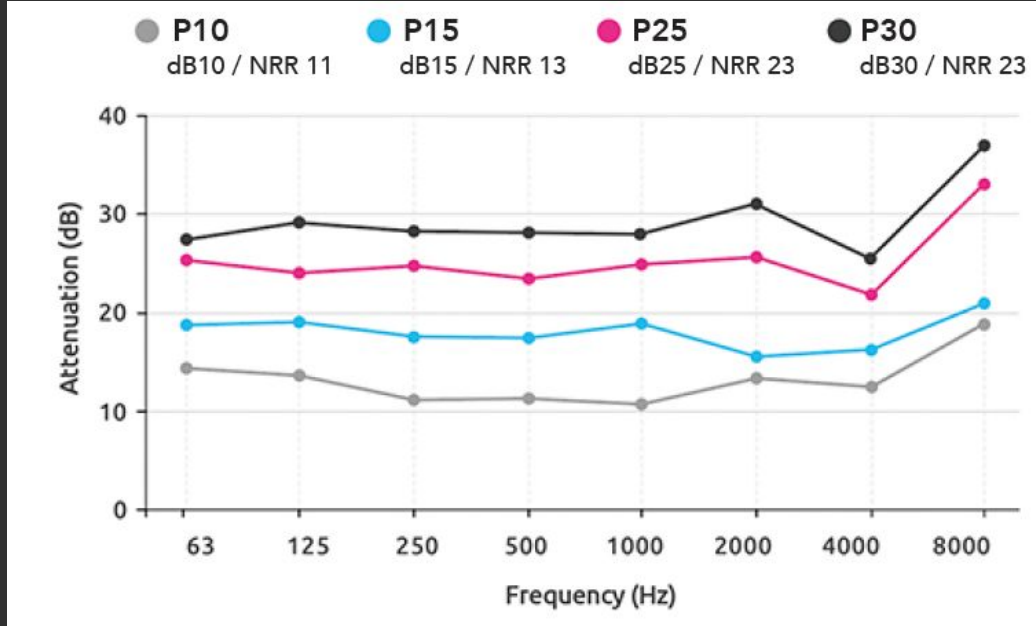


Style 49



Pulse

Filter attenuation of 10 dB, 15 dB, 25 dB, or 30 dB



Electronic Earplugs



- Allows you to hear naturally and protect hearing when at risk
- 2 modes of operation
 - Low mode
 - natural sound under 90 dB
 - 15 dB attenuation when over 90 dB
 - High mode
 - 6 dB of gain under 90 dB
 - 9 dB attenuation when over 90 dB
- 2 models
 - Music Pro Elite (rechargeable)
 - Music Pro (size 10 battery)



Find an Audiologist

<https://members.audiology.org/cvweb/cgi-bin/memberdll.dll/info?wrp=find-an-audiologist.htm>

<https://www.audiology.org>



Sunnyview Rehabilitation
Hospital

ST PETER'S HEALTH PARTNERS

Please complete
this survey!

Questions?

margaret.halinski@sphp.com

www.margiehmusic.com

