

OSHA Occupational Noise



San Diego State University
Environmental Health and Safety
Millie Tran and Sheryl Mansour



Can You Imagine?

- Not being able to
 - Hear what the other person is saying?
 - Listen to the sound of music?
 - Listen to the sound of nature?



- Being afflicted with
 - Uncomfortable ringing in your ears?
 - Abnormal sounds that interfere with your sleep?

Noise Permissible Exposure Limits (PEL)

- Utilize administrative or engineering controls when sound levels exceed Noise Permissible Exposure Levels (Table N-1), e.g. 8 hours permitted duration per workday for 90 dBA sound level.
- Provide hearing protectors if above controls fail to reduce sound levels within Permissible Exposure Levels (Table N-1).
- Impulsive or impact noise should not exceed 140 dB.



Hearing Conservation Program (HCP)

- implemented whenever employee noise exposures equal or exceed an 8-hour time-weighted average (TWA) of 85 dBA without attenuation from use of hearing protectors.



Training

- Elements of HCP
- HCP Flow Chart
- Sound Pressure Level Concepts and Terms
- Anatomy and Physiology of Normal Ear
- How We Hear Sounds
- **Effects of Noise on Hearing**
- Symptoms of Overexposure to Noise
- Anatomy and Physiology of Damaged Ear
- How Hearing is Damaged
- Signs of Hearing Loss
- Types of Hearing Loss
- Noise Induced Hearing Loss
- Occupational/Non-occupational Hearing Loss
- Statistics on Occupational Hearing Loss
- Types of Noise
- Recognizing Hazardous Noise

- **Noise Monitoring**
- Noise Map (area noise level)
- Noise Dose (personal occupational noise exposure level)
- Table of Permissible Noise Exposure Limits
- Impulsive or Impact Noise
- Noise Control
- Administrative Controls
- Engineering Controls
- **Hearing Protectors**
- **Purpose of Hearing Protectors**
- **Advantages and Disadvantages of Different Types of Hearing Protectors**
- **Attenuation of Different Types of Hearing Protectors**
- **Instructions on Selection, Fitting, Use, and Care of Hearing Protectors**
- **Audiometric Testing**
- **Purpose of Audiometric Testing**
- Evaluation of Audiogram
- Audiometric Test Requirement
- **Explanation of Test Procedures**
- **Audiometer Calibration**
- **Training**
- **Record Keeping**

Rule of Thumb

When you feel the need to shout in order to be heard 3 feet away, the noise levels are probably 85 dB or more and hearing protectors are recommended.



Elements of Hearing Conservation Program

- Noise Monitoring
- Hearing Protectors
- Audiometric Testing
- Evaluation of Audiogram
- Audiometric Test Requirements
- Audiometer Calibration
- Training
- Record Keeping

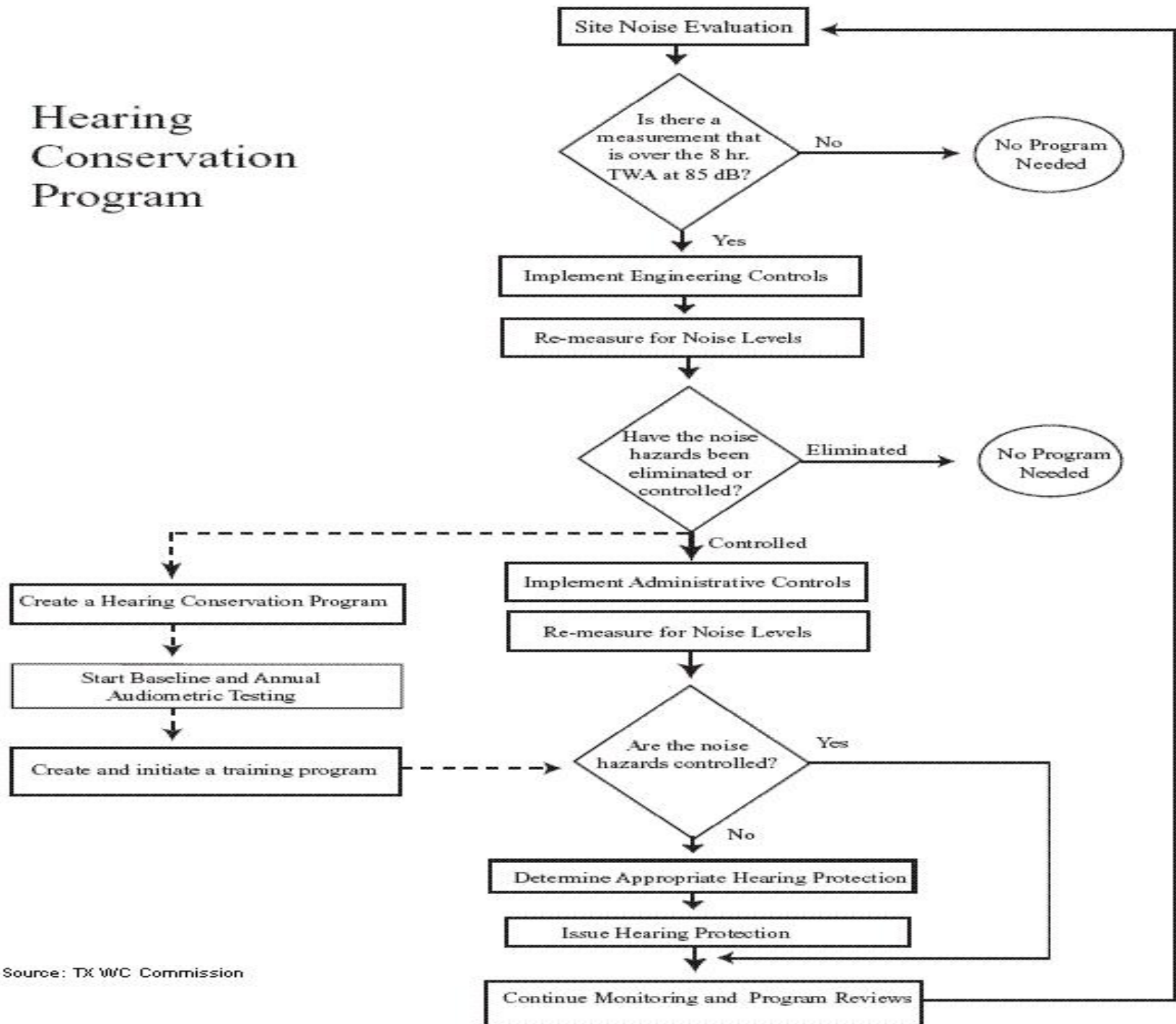


HCP Flow Chart

- Pre-employment Test
- Noise Map (area noise – sound level meter)
- Occupational Noise Exposure (personal noise – noise dosimeter)
- Noise Dose
 - > 100% - noise control – engr. ctrl.; otherwise ppe
 - < 100% - audiometric test
- Engr. Ctrl. / PPE – audiometric test
- Audiometric Test – noise induced hearing loss
 - Yes – utilize noise control
 - No – continue audiometric test
- Training
- Record Keeping



Hearing Conservation Program

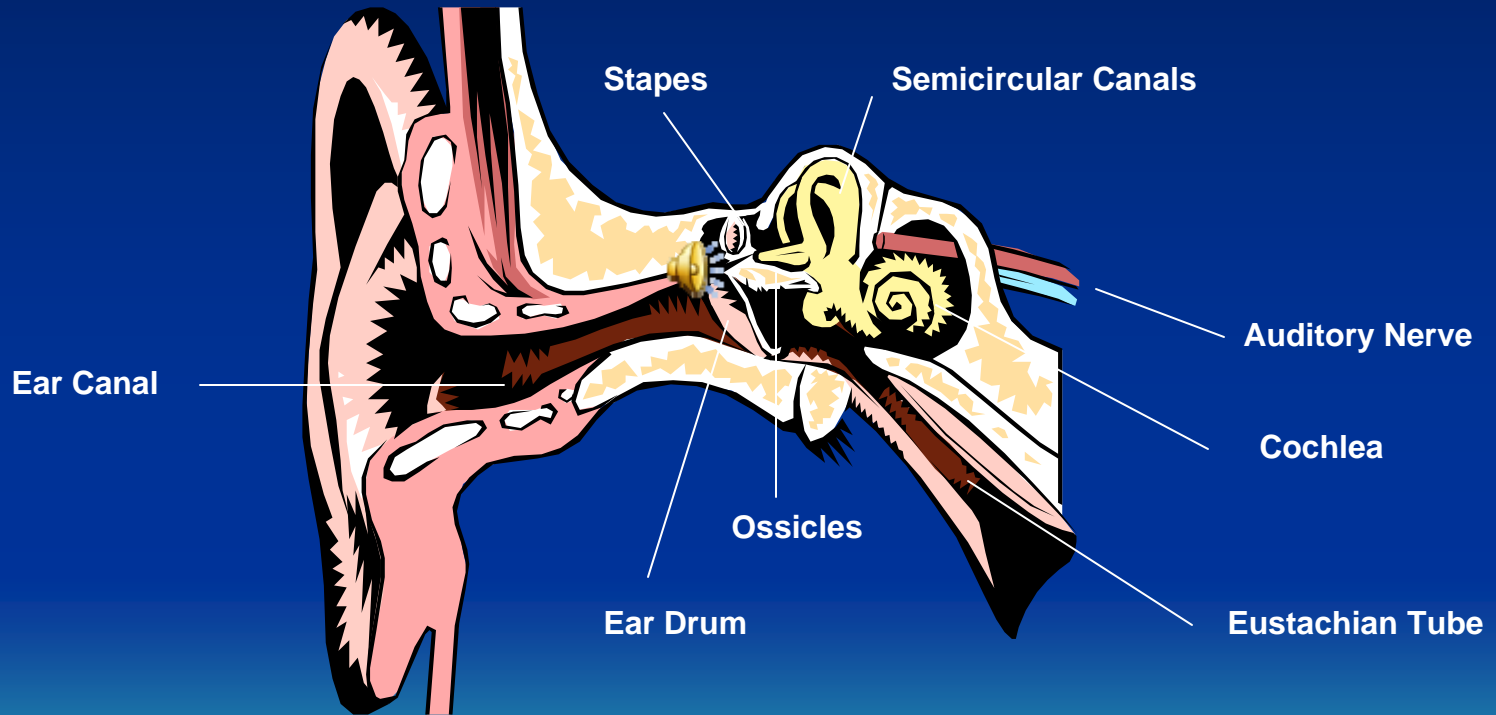


Sound Pressure Level

- Sound waves are energy produced by vibrating objects
- The larynx vibrates to produce the voice
- The vibrations create a pattern, which the ear translates into sound
- As you double the distance from a noise source, the source loudness decreases by half
- Strong vibrations from very loud noises can damage the ear



Anatomy and Physiology of Normal Ear



How We Hear Sounds

- Sound waves enter the ear canal striking the eardrum.
- When eardrum vibrates, ossicles conducts vibrations to the cochlea.
- Tiny hairlike cells in cochlea respond to vibrations by generating nerve impulses.
- Brain interprets nerve impulses as sound.

Note: Healthy hair cells are the key to good hearing. Although, some die off naturally as you age, many more are killed early, from unprotected exposure to hazardous noise.



Effects of Noise on Hearing

Note: How quickly hearing loss takes place depends on the intensity of the noise, its duration, and how often the exposure occurs.

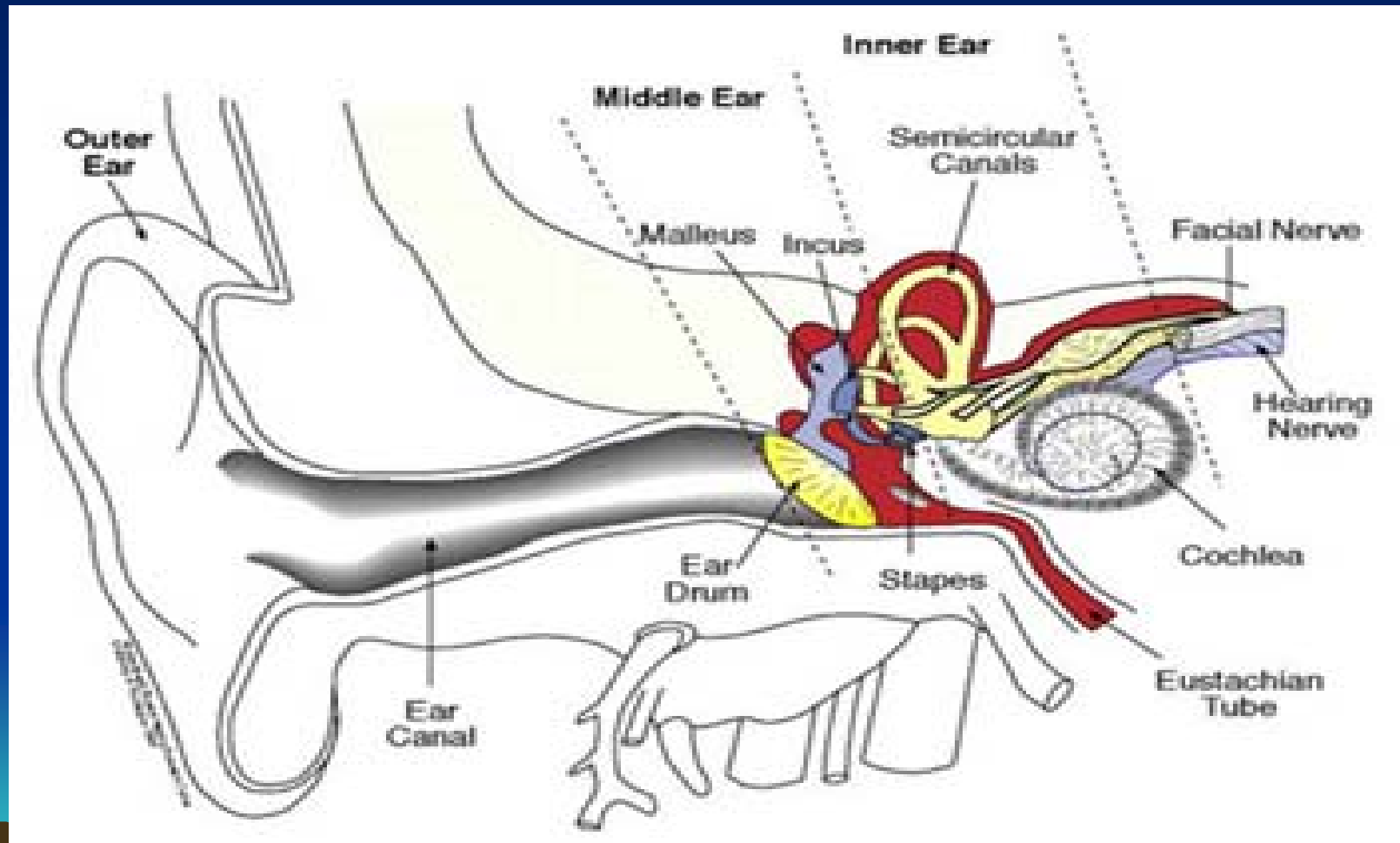


Symptoms of Overexposure to Noise

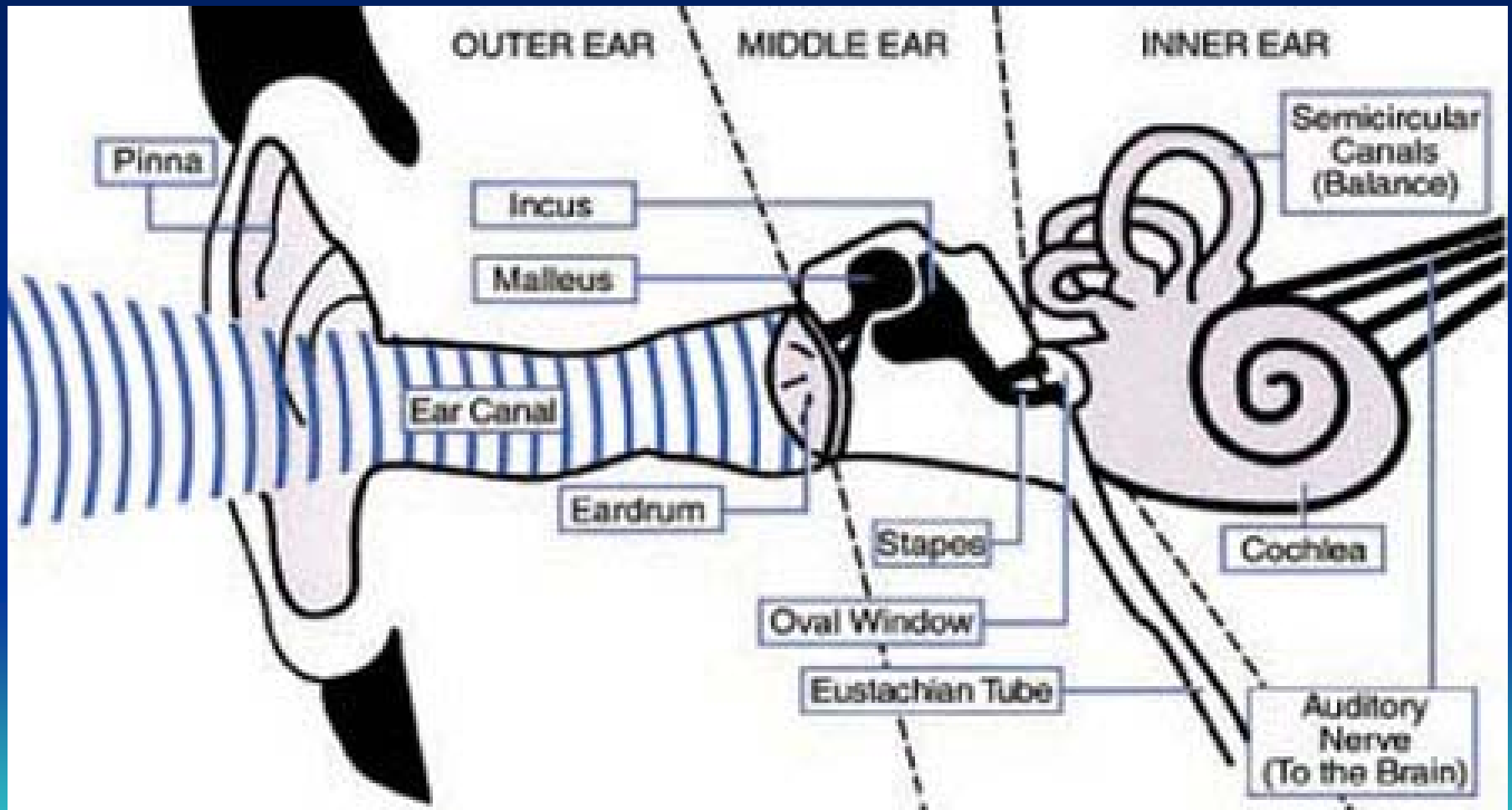
- Temporary Threshold Shift
 - muffled sound after noise exposure
 - if continued overexposure, shift can worsen and become permanent
 - resulting in untreatable damage to hearing
- Tinnitus
 - ringing in the head when trying to sleep at night
 - if continued overexposure, ringing can become permanent, constant annoyance



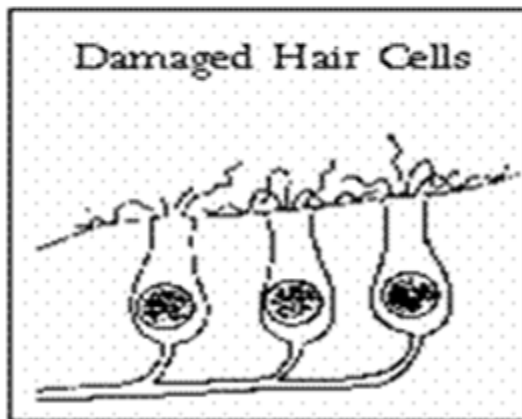
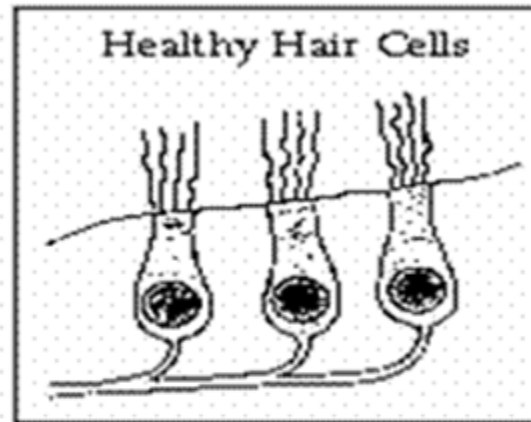
Anatomy and Physiology of Healthy Ear



Anatomy and Physiology of Damaged Ear



Anatomy and Physiology of Damaged Ear

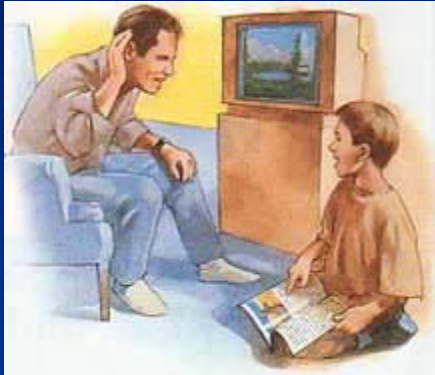


How Hearing is Damaged

- Hairlike cells are flattened.
- You do not get used to noise; you gradually lose your hearing
- Once hearing is damaged, it cannot be repaired or replaced.



Signs of Hearing Loss



- Difficulty hearing people speak.
- Inability to hear certain high-pitched or soft sounds.
- Noise or ringing in ears.
- Getting complaints that the radio or tv is too loud.

Types of Hearing Loss

- **Conductive**

- Sound is not conducted from outer ear to inner ear
- Reduction in sound level
- Condition results from fluid in middle ear, foreign bodies, infection in ear canal, impacted ear wax, malformation of ear

- **Sensorineural**

- Results from damage to the inner ear or nerve pathways from ear to brain
- Corrected through surgery
- Caused by birth injury, diseases, noise exposure, head trauma, aging

- **Mixed**

- Hearing loss resulting from both conductive and sensorineural



Noise Induced Hearing Loss

Noise induced hearing loss stems from exposure to loud noises.

- Constant exposure over a period of time
- Exposed to sound level over 140 dBA
- Tinnitus

Age Induced Hearing loss

- Exposure to high sound levels
- Hereditary
- Nerve damage
- Reduced neuronal response



Occupational/Non-Occupational Hearing Loss

- Occupational Hearing Loss
 - Results from constant exposure to sound levels above 85 dBA TWA
 - Damage to hair cells in cochlea
- Non-Occupational Hearing Loss
 - Results from constant exposure to sound levels above 85 dBA TWA
 - Results from damage to outer, middle, or inner ear, hereditary, ototoxic drugs
 - Damage to hair cells in cochlea, damage to nerve cells relaying sound message to brain, damage to structure of ear

Statistics on Occupational Hearing Loss

Approximately 30 million Americans are exposed to high intensity noise in their workplace.

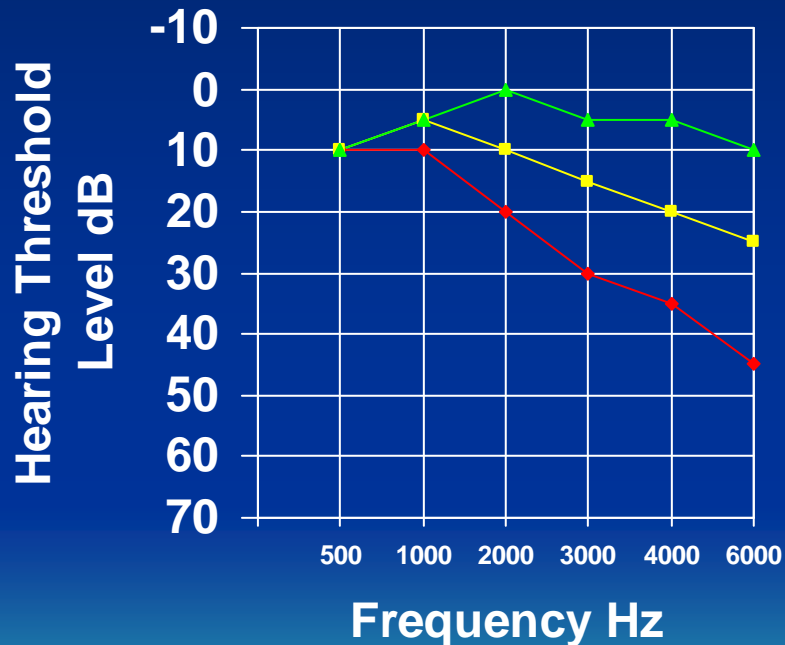
One in 4 of these workers (or 7.5 million Americans) will develop permanent hearing loss.

National Institute of Deafness and Other Communicative Disorders: Noise Induced Hearing Loss. Available at: <http://www.nidcd.nih.gov/health/hearing/noise.asp> Accessed November 7, 2004.

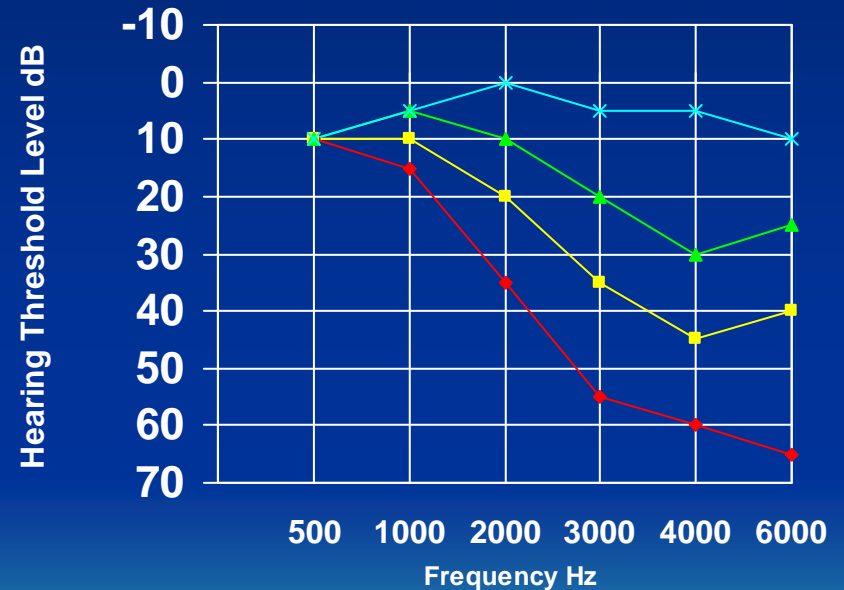


Effects of Age and Noise on Hearing

Normal Aging Effects



Loss from Aging plus 95dB Noise Exposure



age 60 age 40 age 20

40 yrs.exp. 20 yrs.exp.
10 yrs.exp. 0 yrs.exp.

Types of Noise

- Pitch
- Loudness
 - Whisper 10 dB
 - Street sound 70 dB
 - Sander 85 dB
 - Sporting Events 100dB
 - Mowing the Lawn 101dB
 - Motorcycle Riding 112dB
 - Concerts 125dB
 - Shooting Range 130dB



Recognizing Occupational Hazardous Noise

Task	Avg. Noise Level (dBA)
Operating forklift	87
Cutting Wood	93
Cutting lawn	94
Installing trench conduit	95.8
Welding	98.4
Grinding	99.7
Chipping Concrete	102.9
Working near Generator	116

Tools	Avg. Noise Level (dBA)
Lathe	81
Welding Equipment	94.9
Hand Power Saw	97.2
Screw Gun, Drill	97.7
Rotohammer	97.8
Chop saw	98.4
Stationary Power tool	101.8
Chipping Gun	103.0

Recognizing Non-Occupational Hazardous Noise

- Noisy Hobbies
 - Loud music
 - Firearms
 - Car/motorcycle race track
 - Sporting events
 - Loud speakers
- Household noises
 - Crying babies
 - Vacuum
 - Lawn mower
 - Power tools
 - Ipod/Boom box

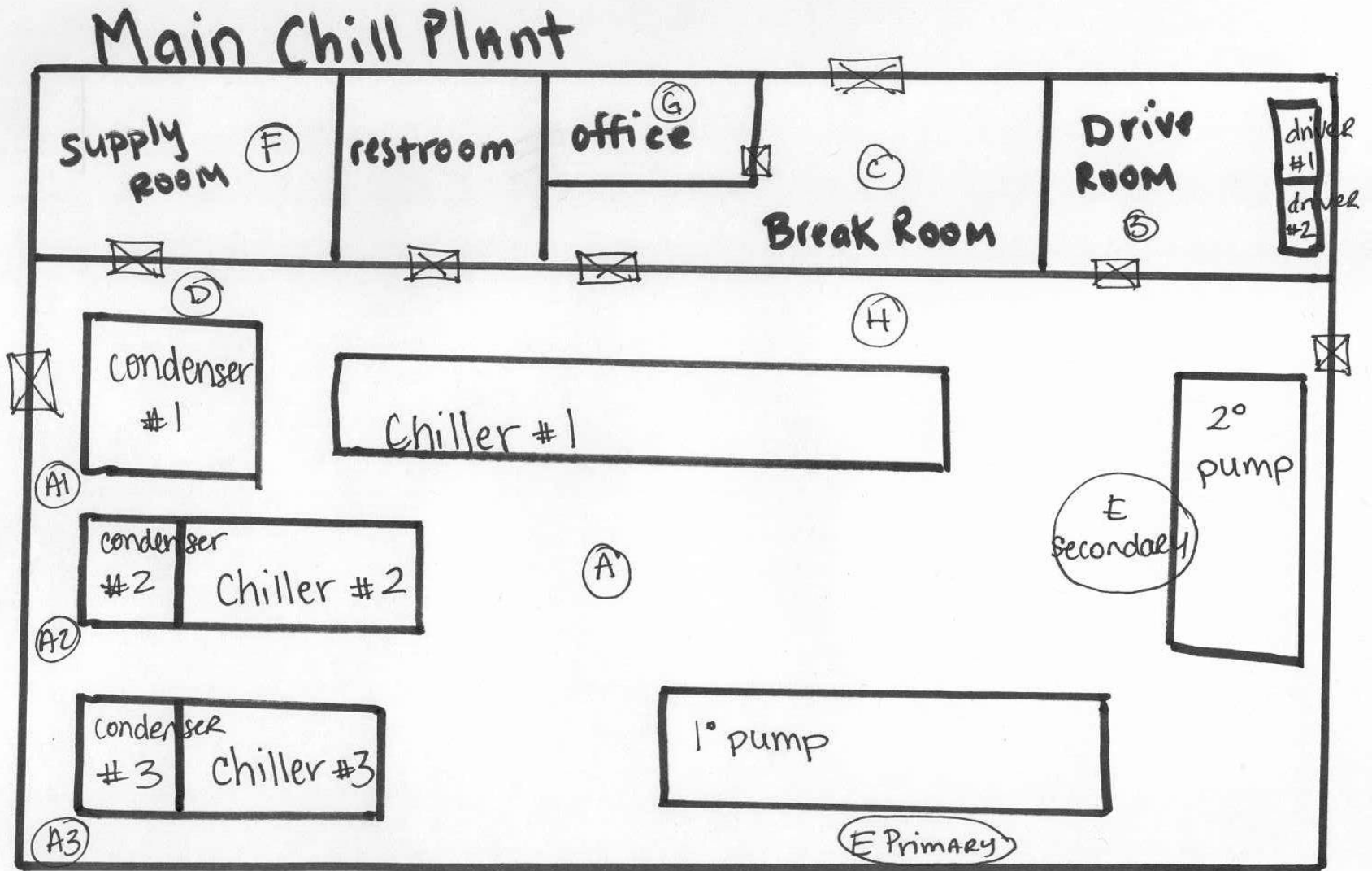


Noise Monitoring

- Used to identify work locations where hazardous noise levels exist.
- Employee exposures to noise monitored periodically with:
 - Sound Level Meter (area noise level)
 - Noise Dosimeter (personal noise exposure level)



Noise Map (Area Monitoring)



Noise Dose (Personal Monitoring)



Table of Permissible Noise Exposure Limits

Sound Level (dBA)	Permitted Duration per Workday (hours)	Sound Level (dBA)	Permitted Duration per Workday (hours)
90	8.00	103	1.32
91	6.96	104	1.15
92	6.06	105	1.00
93	5.28	106	0.86
94	4.60	107	0.76
95	4.00	108	0.66
96	3.48	109	0.56
97	3.03	110	0.50
98	2.63	111	0.43
99	2.30	112	0.38
100	2.00	113	0.33
101	1.73	114	0.28
102	1.52	115	0.25

Impulsive or Impact Noise

- Exposure to impulsive or impact noise should not exceed 140 dB peak sound pressure level.



Affected Employees

- Employees subjected to noise exceeding permissible noise limits shall be provided hearing protection devices, if feasible administrative or engineering controls failed to reduce noise levels.
- Employee exposed to noise at or above the 8-hour time-weighted average (TWA) of 85 dB, or equivalently, a dose of 50% shall be notified and enrolled in HCP.



Noise Control

- Administrative Control
- Engineering Control
- Personal Protective Equipment (hearing protective devices)



Administrative Controls

- Operate noisy equipment on second or third shifts.
- Rotate employees through high-noise areas.
- Modify existing machinery.
- Place noise limit specs. on new equip.
- Maintain equip. in good condition.
- Use noise control when installed.
- Reporting noisy equip. to supervisor for repair.



Engineering Controls

- Reduce noise at the source.
- Interrupt the noise path.
- Reduce reverberation and structural vibration.



Personal Protective Equipment (Hearing Protection Devices - HPD)

- Employers shall provide to employees exposed to 8 hr TWA of 85 dB at no cost.
- Employers shall ensure being worn:
 - by employees exposed to 8 hr TWA of 90dB or greater
 - by employees exposed to 8 hr TWA of 85dB or greater and:
 - Whose baseline audiogram has not been established
 - Who have experienced a threshold shift



Hearing Protection Device (HPD) Noise Reduction

- HPD must reduce employee noise exposure below PEL e.g. below 8 hr TWA of 90 dB.
- Employees with standard threshold shift (STS), HPD must reduce employees noise exposure below an 8 hr TWA of 85 dB.
- Noise Reduction Ratio (NRR)
 1. Convert dose to TWA; subtract 7 from NRR; subtract remainder from TWA to obtain the est. TWA under ear protector
 2. Subtract 7 from NRR; subtract remainder from TWA to obtain the est. TWA under ear protector

Hearing Protection Use

- Voluntary Use
 - Exposed to an 8 hr TWA of 85 dB
- Mandatory Use
 - Exposed to an 8 hr TWA of 90 dB
 - Exposed to an 8 hr TWA of 85 dB but have not had a baseline hearing test
 - Employees who have suffered STS hearing loss and are exposed to an 8 hr TWA of 85 dB



Employee Responsibility

- Understand the need for hearing protection devices.
- Wear HPDs and seek replacements.
- Encourage co-workers to wear HPDs.
- Communicate problems to supervisors.



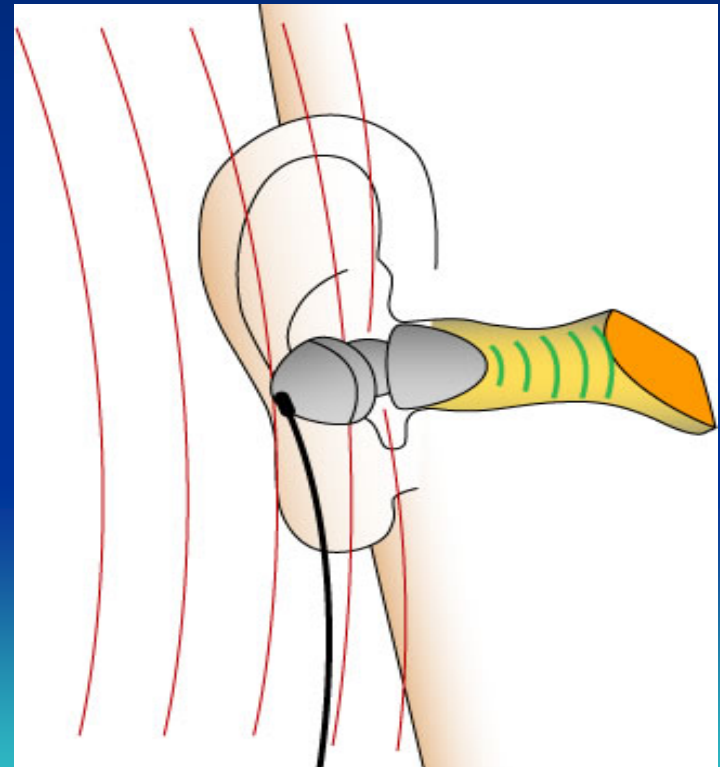
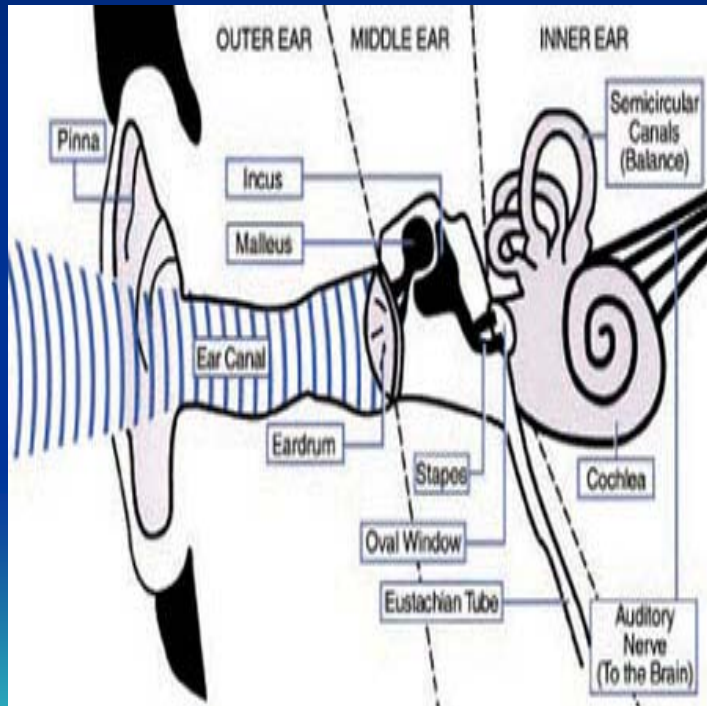
Management Responsibility

- Provide occupational noise training.
- Provide hearing protection devices.
- Demonstrate commitment – wear HPDs.
- Enforce the use of HPDs.
- Keep up to date with HPD selection and use.
- Encourage questions and resolve problems.



Purpose of Hearing Protectors

- Reduction of sound waves traveling to the inner ear



Advantages and Disadvantages of Different Types of Hearing Protectors

Kind of Protector	Advantages	Disadvantages
Ear Plug	<ul style="list-style-type: none">•Free head movements•Good for tight work spaces•Worn with any hairstyle•Worn with hats, eye protection, respirators•Good protection against high frequency sounds	<ul style="list-style-type: none">•Can work loose during the work day•Must be replaced periodically•Small and can easily be lost
Ear Muff	<ul style="list-style-type: none">•Headband can be adjusted for comfort•Seldom come loose during the work day•Free head movements	<ul style="list-style-type: none">•Difficult to wear with eye, head and breathing protection

Attenuation of Different Types of Hearing Protectors

- Ear Plugs
 - Reduce noise by as much as 30 decibels
- Ear Canals
 - Reduce noise by as much as 30 decibels
 - Used when individual is unable to use traditional ear plugs
- Ear Muffs
 - Reduce noise by as much as 15-30 decibels
 - Use in conjunction with ear plugs when exposed to high noise levels (105+ decibels)



Instructions on Selection, Fitting, Use, and Care of Hearing Protectors

Ear plugs

- Keep clean and free of materials
 - Wash in mild liquid detergent and warm water
 - Squeeze excess water and air dry
- Discard plugs when hardened or do not re-expand
- Ear Canals
 - Clean like normal ear plugs
 - Do not tamper with the headband and the acoustic seal

Instructions on Selection, Fitting, Use, and Care of Hearing Protectors

- Ear Muffs
 - Keep clean and free of debris
 - Clean cushions with warm soapy water
 - Do not tamper with the acoustic seal between the cushions and the headband
 - Do not modify the ear muffs in any way
 - Do not stretch or abuse the headband



Audiometric Testing

- Conducted by a qualified audiologist.
- Baseline Audiogram/Test
 - Shows initial hearing status
 - For comparison to future audiograms
- Periodic (Annual) Audiogram/Test
 - To determine if HCP is effective and if non-noise factors affects hearing
 - Recheck audiogram or professional referral necessary if significant hearing change occurs



Purpose of Audiometric Testing

- To measure hearing by sending tones to each ear through headphones.
- To show how one's hearing compares to normal hearing based on age.
- To determine whether hearing is being conserved.
- To alert employee and employer for noise, age or medical related hearing loss.



Explanation of Test Procedures

- **Audiometer** sends tones to each ear through headphones.
- Listen carefully and respond each time you hear a tone.
- Levels at which you can barely hear the tones is your **hearing threshold levels**.
- **Audiogram** records threshold (dB) for different pitches or frequencies (Hertz).



Evaluation of Audiogram

- Annual audiogram compared to baseline audiogram to determine threshold shift
- If threshold shift
 - Employee must be notified in writing within 21 days
- If threshold shift from occ. noise exp.
 - Employee fitted with hearing protectors, trained in use and care, required to use them.
 - Employee refitted with better attenuation hearing protectors and retrained in hearing protector use
 - Refer employee to eval/exam if add. testing necessary or if medical pathology is caused by hearing protectors
 - Inform employee of need to eval/exam if medical pathology unrelated to hearing protectors is suspected

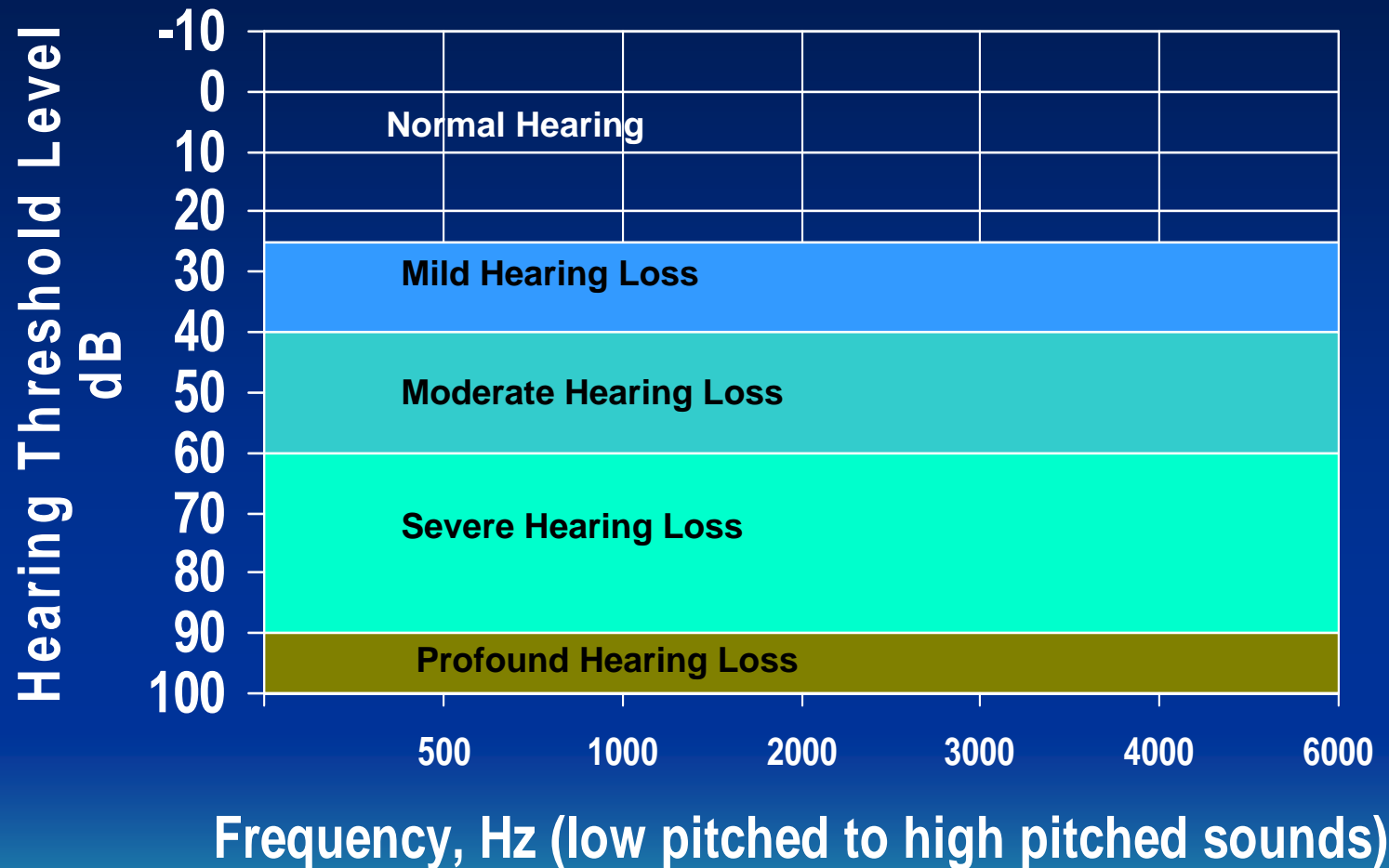


Evaluation of Audiogram (con't)

- If subsequent audiogram to noise exp. less than 8 hr TWA of 90dBA indicates that threshold shift is not persistent:
 - Inform employee of new audiogram
 - May discontinue required use of hearing protectors



Normal Audiogram and Degree of Hearing Loss



Standard Threshold Shift

- Hearing ability changed by an average of 10 decibels.
- Employee notification within 21 days.
- Revised hearing protection required.
- Further medical evaluation.
- Allowance may be made for the contribution of aging.



Audiometric Test Requirements

- Test shall be pure tone, air conduction, hearing threshold exam.
- Test frequencies from 500 to 6000 Hz in each ear.
- Audiometers shall meet ANSI S3.6 and Appendix B
- Audiometric exams administered in room shall meet Appendix C



Audiometer Calibration

- Audiometer functional operation shall be checked daily.
- Audiometer calibration shall be checked acoustically annually per Appendix D



Training

- Provide annually to employees who are exposed to noise at or above 8 hr TWA of 85 dB.
- Topics must include:
 - Effects of Noise on Hearing
 - Purpose of Hearing Protectors
 - Advantages and Disadvantages of Different Types of Hearing Protectors
 - Attenuation of Different Types of Hearing Protectors
 - Instructions on Selection, Fitting, Use, and Care of Hearing Protectors
 - Purpose of Audiometric Testing



Record Keeping

- Employee Exposure Measurements
- Audiometric Tests
 - Audiogram/Noise Exposure Assessment
 - Job classification
 - Audiometer calibration date
- Hearing Protection Devices Used
- Audiometric Test Rooms
 - Background sound pressure level in test room



Summary

- Constant exposure to noise over 85 dB can cause hearing damage.
- Hearing loss can not be cured or repaired.
- Hearing tests are conducted annually.
- Hearing protection devices include ear plugs, ear muffs, and canal caps.



QUIZ

1. Employee participation in the Hearing Conservation Program is required when exposed to an 8 hr TWA noise level of _____ decibels.
2. Hearing damage can easily be repaired with surgery. True or False
3. Describe a sign of hearing loss: _____
4. Name two off-work activities that may expose you to high-noise levels.
5. Your company keeps records of noise monitoring and hearing tests. True or False



QUIZ

6. A noise dosimeter is used to test an employee's hearing capability. True or False
7. Describe one of the ways noise impacts the workplace. _____
8. Name two kinds of hearing protection devices: _____ and _____
9. In order to look for hearing loss, how often are hearing tests conducted? _____
10. Name one of the ways management attempts to control employee noise exposure: _____

