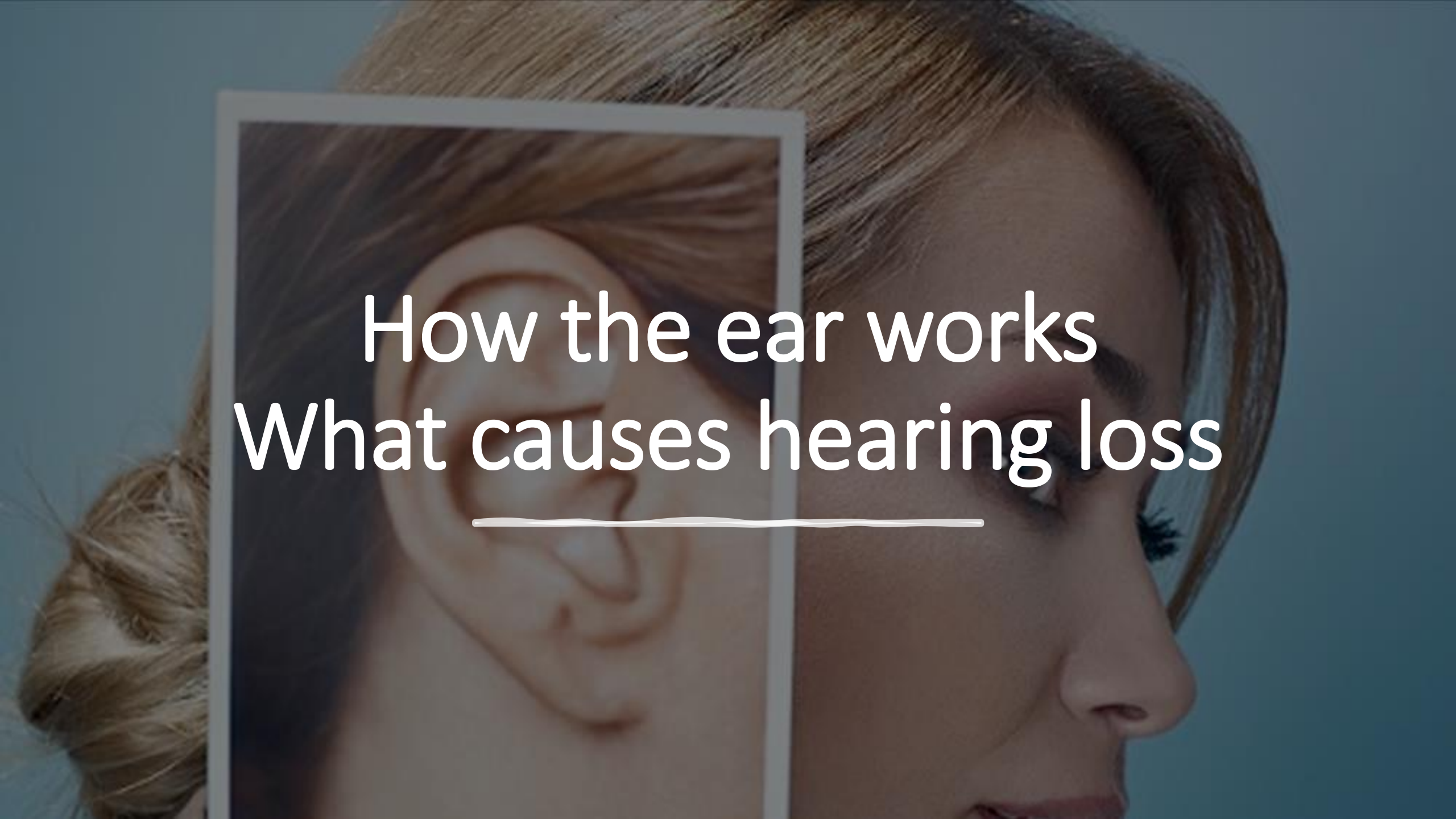


# Noise Induced Hearing Loss & Hearing Conservation



# Objectives...

- How the ear works
- What causes noise induced hearing loss
- Noise exposure limits
- Elements of a hearing conservation program
- Methods for controlling noise exposure
- Apply concepts and techniques to prevent noise induced hearing loss

A woman's face is shown in profile on the right side of the image. On the left side, there is a rectangular inset image showing a close-up of a human ear. The background is a solid light blue color.

# How the ear works

## What causes hearing loss

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# Noise Induced Hearing Loss

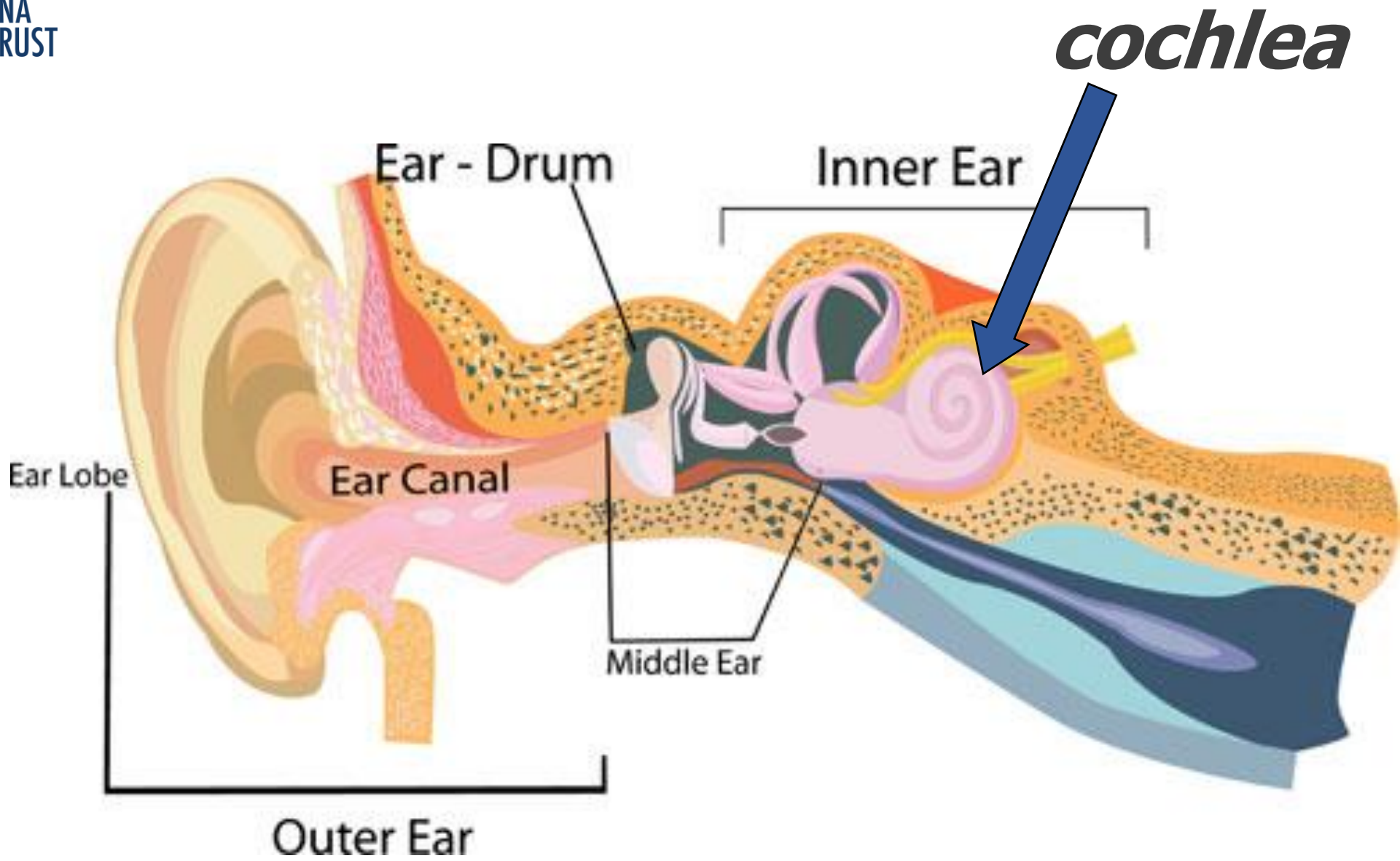
??

Permanent hearing loss is permanent...

HUH

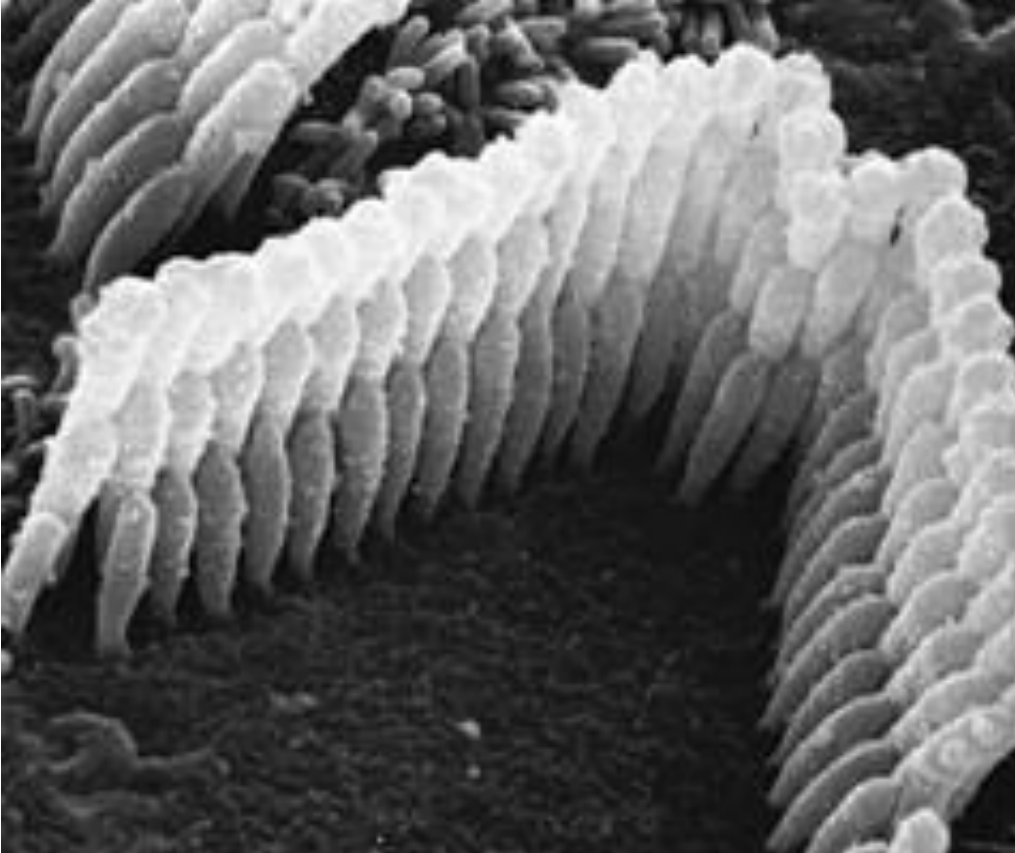
It doesn't get better on its own.

??





## Cochlea – Cilia



# Properties of Sound

## Frequency:

- Also known as pitch
- The number of cycles a sound wave makes per second
- Measured in Hertz (Hz)
- Detectable by humans in the 20-20,000 Hz range



*Hearing loss diminishes the frequency range a person can detect.*

## Frequency of Sounds (measured in hertz (Hz))

Vowel Sounds Like a Short "O"

250 - 1,000 hz

Consonant Sounds Like "S"

1,500 - 6,000 hz

Important Sounds

250 - 6,000 hz

Normal Hearing

20 - 20,000 hz



# Properties of Sound

## Decibels:

- Used to measure the power or loudness of a sound
- Based on sound wave pressure
- Frequency corrected and abbreviated as dBA
- Used to determine noise exposure



*The higher the decibels, the louder the sound.*

# Noise Overexposure

## Warning signs:

- Ringing in the ears
- Trouble understanding speech
- Temporary hearing loss



*These are early indicators of permanent hearing loss and should not be ignored.*

# Noise Overexposure

## Permanent hearing loss:

- Can be caused by long term overexposure.
- Is related to damage in the inner ear.
- Cannot be treated without major medical interventions (hearing aids / cochlear implant).
- Starts with declining sensitivity to high frequencies.



# Noise exposure limits



# Noise Overexposure

## Exposure limits:

- Eight hour average exposure cannot exceed 85 dBA.
- Single exposure cannot exceed 140 dBA.
- Continuous exposure cannot exceed 115 dBA.



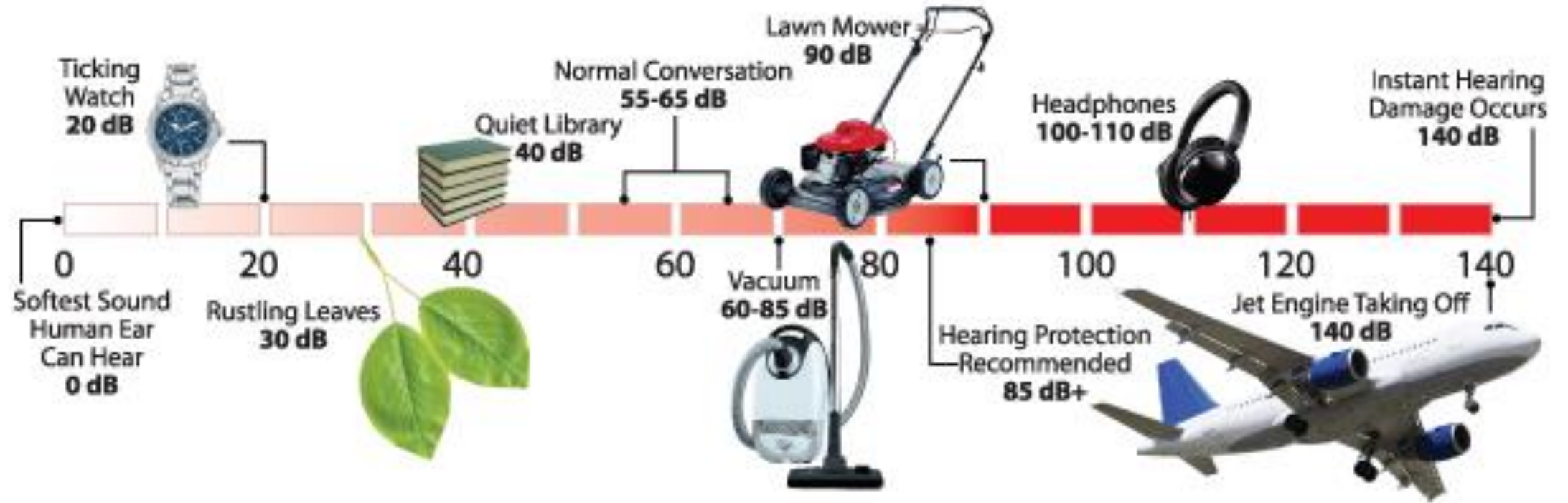
# Noise Exposure Limits

Every 5 dB... increase is a doubling of noise loudness

Every 5 dB... decrease is a halving of noise loudness

Noise Level	Exposure Limit
85 dB	16 hours
<b>90 dB</b>	<b>8 Hours</b>
95 dB	4 hours
100 dB	2 hours
105 dB	1 hour
110 dB	30 minutes
115 dB	15 minutes





# Noise Overexposure

## Hazardous Noise Defined

At 80 dBA (TWA):

- Best practices are to:
  - Provide hearing protection.
  - Encourage proper use.
  - Create a Hearing Conservation Program.

# Noise Overexposure

## Hazardous Noise Defined

At 85 dBA (TWA):

- OSHA requires a Hearing Conservation Program that includes:
  - Exposure monitoring.
  - Training.
  - Hearing tests.
- Hearing protection must be made available and is required for any individuals who have experienced a standard threshold shift\*.

**"[A] standard threshold shift (STS) is a change in hearing threshold relative to the baseline audiogram of an average of 10 dB or more at 2000, 3000, and 4000 Hz in either ear."**

**Source: OSHA**

# Noise Overexposure

## Hazardous Noise Defined

### At 90 dBA (TWA):

- OSHA requires hearing protection.
- Evaluate engineering and administrative controls.
- No more than 8 hours of exposure.

### Employers must:

- Supply hearing protection at no cost to employees.
- Provide a variety of hearing protection types for employees to choose from.
- Evaluate effectiveness.
- Assure proper use.

# WHAT?!?!?!?

## How loud is it???

### Sound Level Meter – Phone Apps

---



**NIOSH Sound Level Meter** 4+

EA LAB

★★★★☆ 4.7, 738 Ratings

Free

# Hearing Conservation Program





# Hearing Conservation Programs

## Program components:

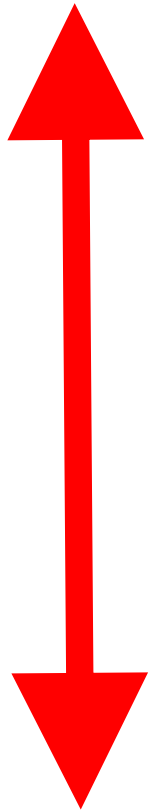
- Monitoring noise levels
- Providing hearing protection devices
- Informing and training employees
- Conducting audiometric tests
- Retaining records



# Methods for controlling noise exposure



**MOST  
effective**



**LEAST  
effective**

**Elimination**

**Substitution**

**Engineering**

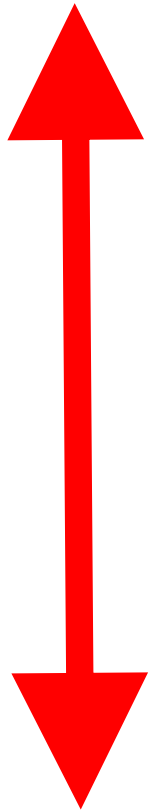
Warnings

Administrative

Personal Protective  
Equipment

**CONTROLS**

**MOST  
effective**



**LEAST  
effective**

**Elimination**

**Substitution**

**Engineering**

Warnings

Administrative

**Personal Protective  
Equipment**

**CONTROLS**

# Hearing Protection Devices

- **Purpose**
  - To further reduce employee exposure to noise in conjunction with other controls.
- **Advantages**
  - Cheap, relatively easy to use, and are effective at reducing an employee's noise exposure – when no other noise controls are possible.
  - Plugs – Better protection when used properly, user friendly in hot and wet environments, > NRR Ratings
  - Muffs – Easier to see “in use”, easier to fit, more comfortable, easier to use correctly

# Hearing Protection Devices

- **Disadvantages**

- Actual hazard has not been reduced/eliminated
- Requires a person to do something & do it right
- Plugs – Harder to use “correctly” and see “in use”, harder to fit properly
- Muffs – Less comfortable in hot or wet environments, large and bulky



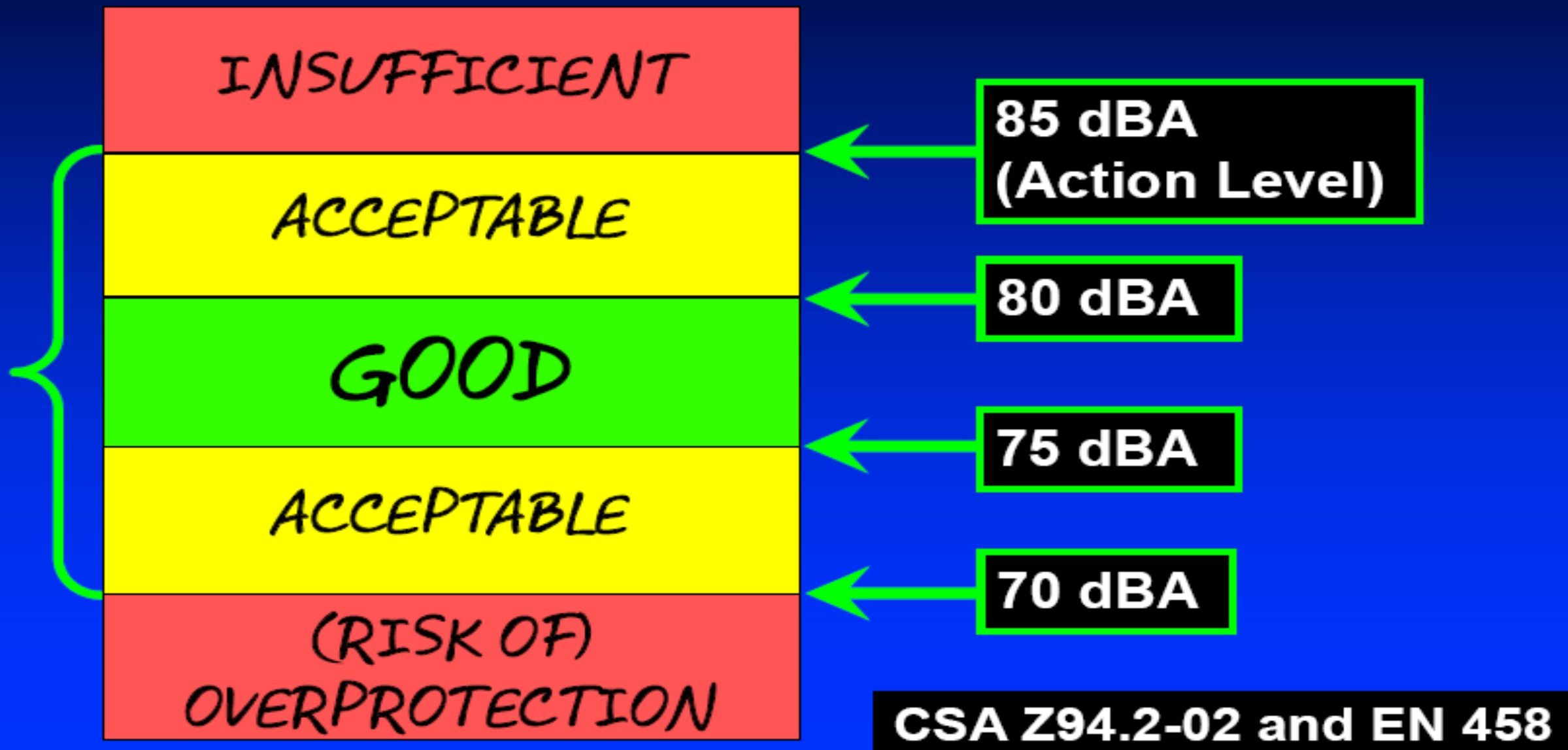




# HEARING PROTECTION



# Matching Hearing Protection to Noise Exposure





**So what  
is the  
NRR #**



# Hearing Protection Devices

- **Examples**

- Leight Plugs – NRR of 32 dB
- Peltor Muffs – NRR of 27 dB
- Tested on a different scale in the lab

NRR = Noise Reduction Rating

Decibel level reduction in ambient noise



# HOWARD LEIGHT



by Honeywell



LL-1-D

3301271

US origin earplug packaged in Mexico

# LASER LITE®

NRR 32 / Canada Class A(L) / SLC<sub>90</sub> 25, Class 4 / SNR 35


Size 6-11 mm

Noise Reduction Rating **32** DECIBELS  
WHEN USED AS DIRECTED

THE RANGE OF NOISE REDUCTION RATINGS FOR EXISTING HEARING PROTECTORS IS APPROXIMATELY 0 TO 30. (HIGHER NUMBERS DENOTE GREATER EFFECTIVENESS)

HONEYWELL SAFETY PRODUCTS USA, INC.  
SAN DIEGO, CA 92184 MODEL NO. LL-1 / LL-80

Federal law prohibits removal of this label prior to purchase



LABEL REQUIRED BY U.S. E.P.A. REGULATION 40 CFR Part 811, Subpart B

Certified Product <sup>TM</sup>



Australian Standard  
AS/NZS 1270 Lic. 1170  
SAI Global

**AS/NZS**  
Hearing protector class 4 tested to AS/NZS 1270. When selected, used and maintained as specified in AS/NZS 1269, this protector may be used in noise up to 105 dB(A) assuming an 85 dB(A) criterion. A lower criterion may require a higher protector class.

**SNR**  
35 dB

---

H = 34 dB  
M = 32 dB  
L = 31 dB





**Noise  
Reduction  
Rating**

**27**

Decibels

(When used as directed)

THE RANGE OF NOISE REDUCTION RATINGS  
FOR EXISTING HEARING PROTECTORS  
IS APPROXIMATELY 0 TO 30  
(HIGHER NUMBERS DENOTE GREATER EFFECTIVENESS)

3M Company,  
St Paul, MN

**H10P3E-01**

Federal law prohibits  
removal of this label  
prior to purchase



LABEL REQUIRED BY  
U.S. E.P.A.  
REGULATION  
40 CFR PART 211  
SUBPART B

The EPA specifies the NRR as the measure of hearing protector noise reduction. However, 3M

L'EPA  
prote  
à l'a  
indiq  
rédu  
la va  
d'aju  
est r  
une  
trava

La A  
Agen  
de r  
prote  
sobre  
inves  
meno  
variac

$$\text{dBA} - (\text{NRR}-7) = \text{dBA}$$

↑  
Workplace  
Noise

↑  
Effective  
Exposure



**NRR 32 - 7 = 25 dB reduction  
IF used properly**





**110 dB – up to 25 dB reduction = 85 dB  
(NRR 32-7) exposure  
IF used properly**



**NRR 32 - 7 = 25 dB reduction  
IF used properly**

**25 dB x 0.50 safety factor = 12.5**

**85 + 12.5 = 97.5 dB = MAXIMUM EXPOSURE  
the plugs are good for**



# Hearing Protection Devices

- Must be provided, used, cared for, etc. properly
  - Employer & Employee Responsibility
- Improperly used and cleaned and cared for decreases the hearing protection (NRR).
- Damaged or dirty – dispose
- If single use – use once and dispose

# EAR MUFFS

**Adjust for Head Size**

**Tight but NOT TOO TIGHT**

**Maintain a GOOD Seal**





# Ear Plugs



**Improper Use**



**Proper Use**



Figure 1



Figure 2



Figure 3

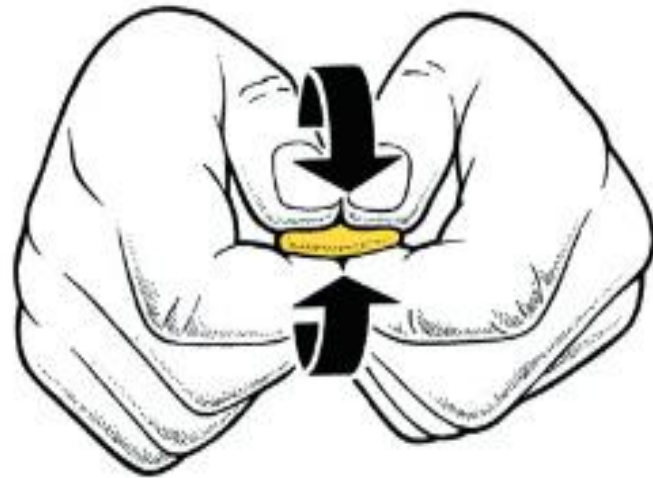


Figure 4

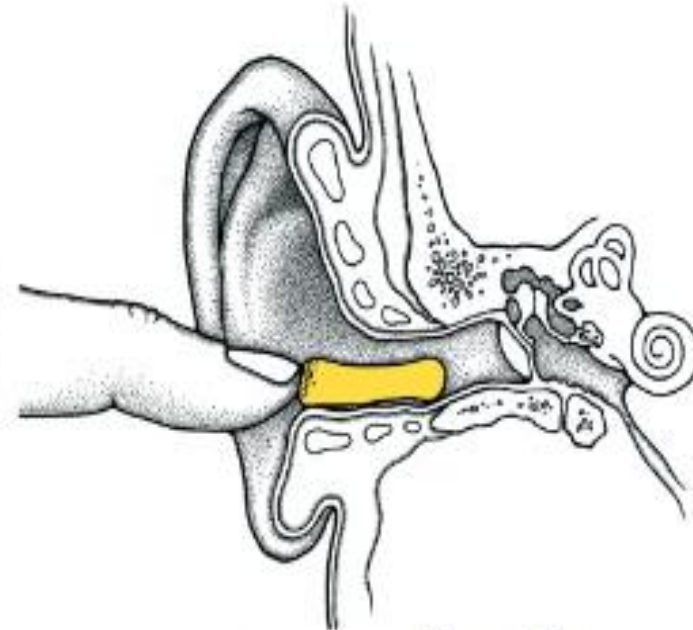
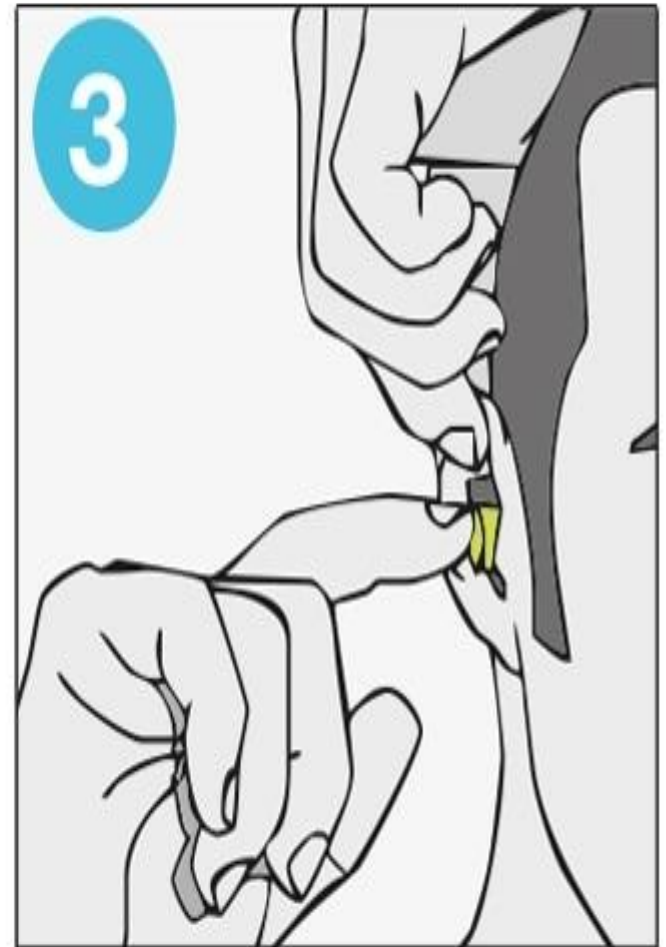
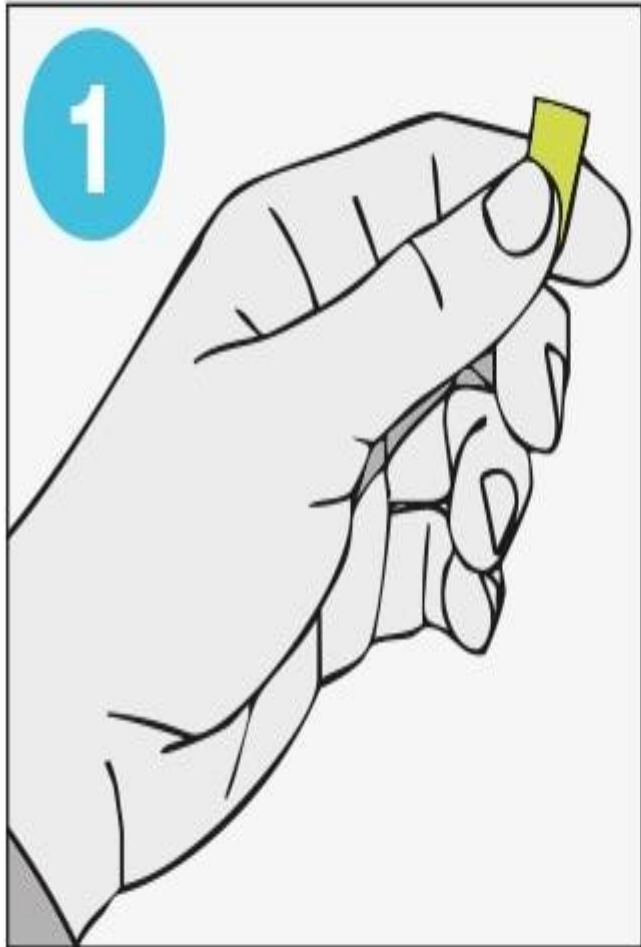
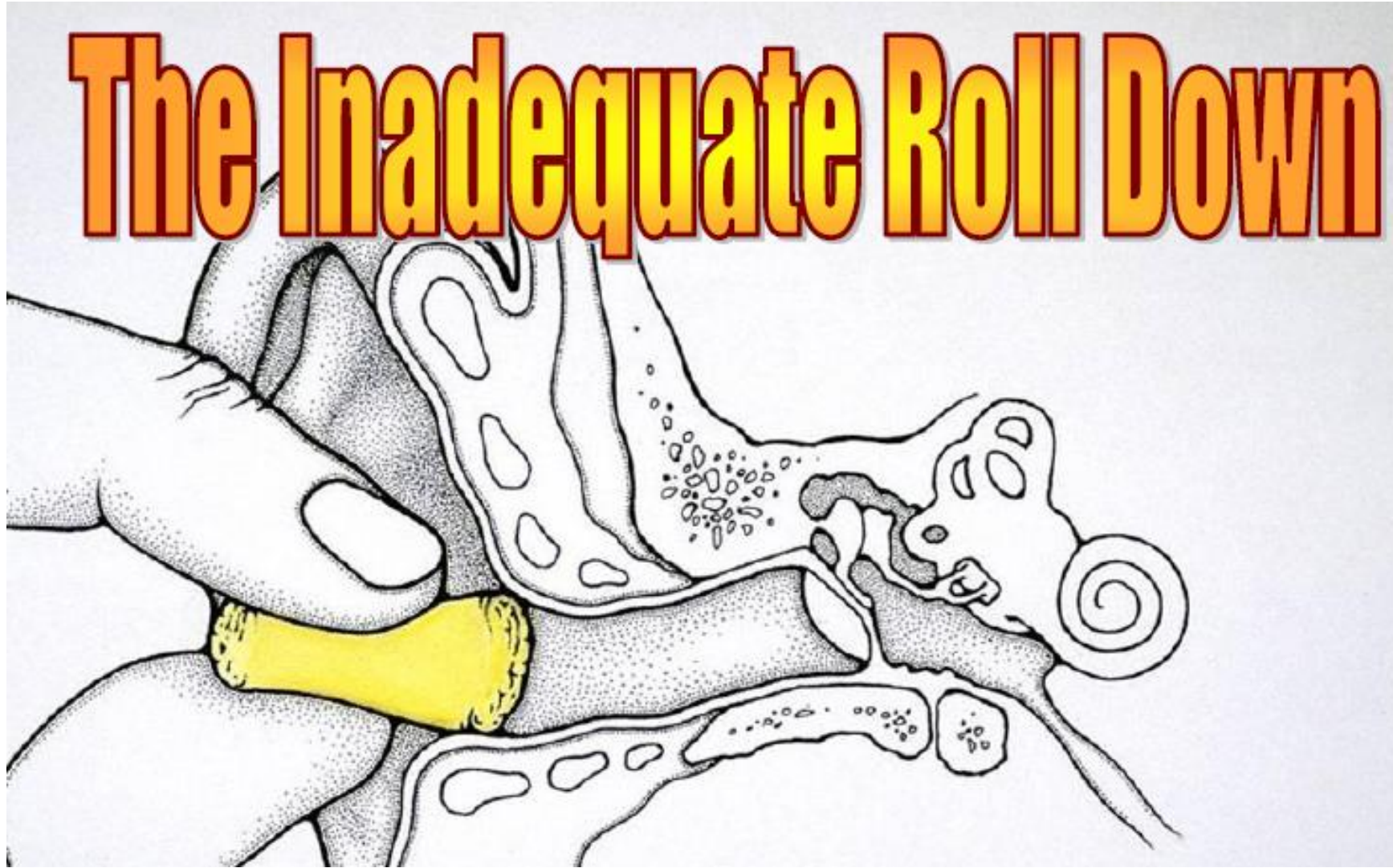


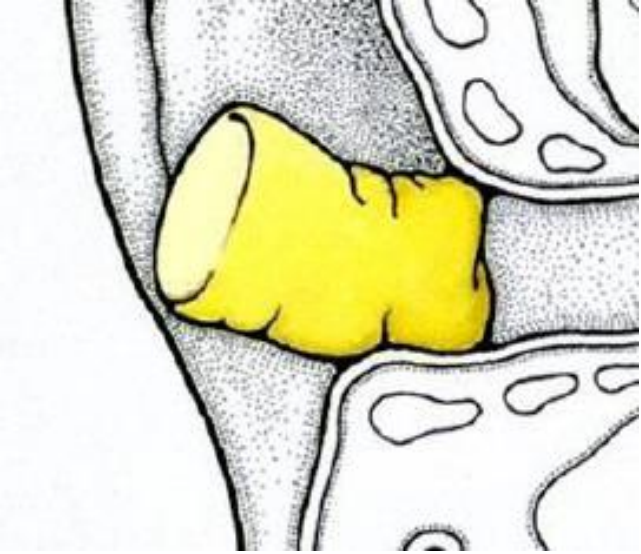
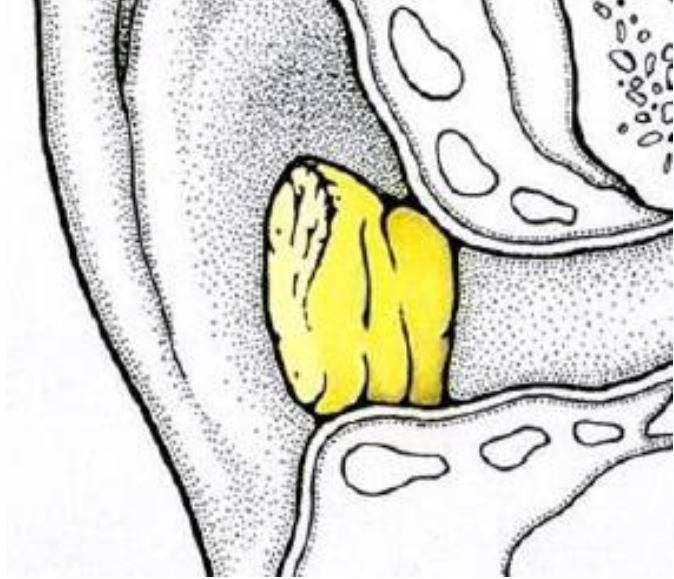
Figure 5



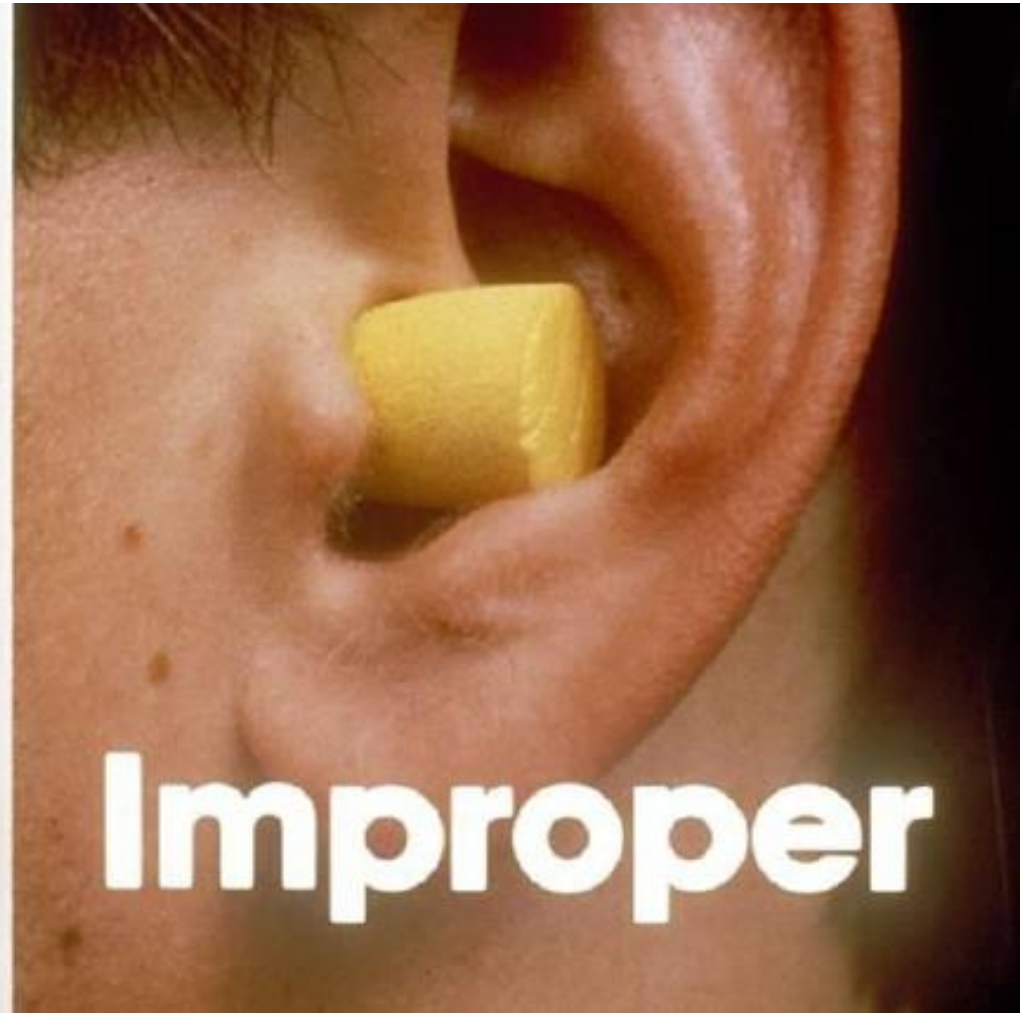
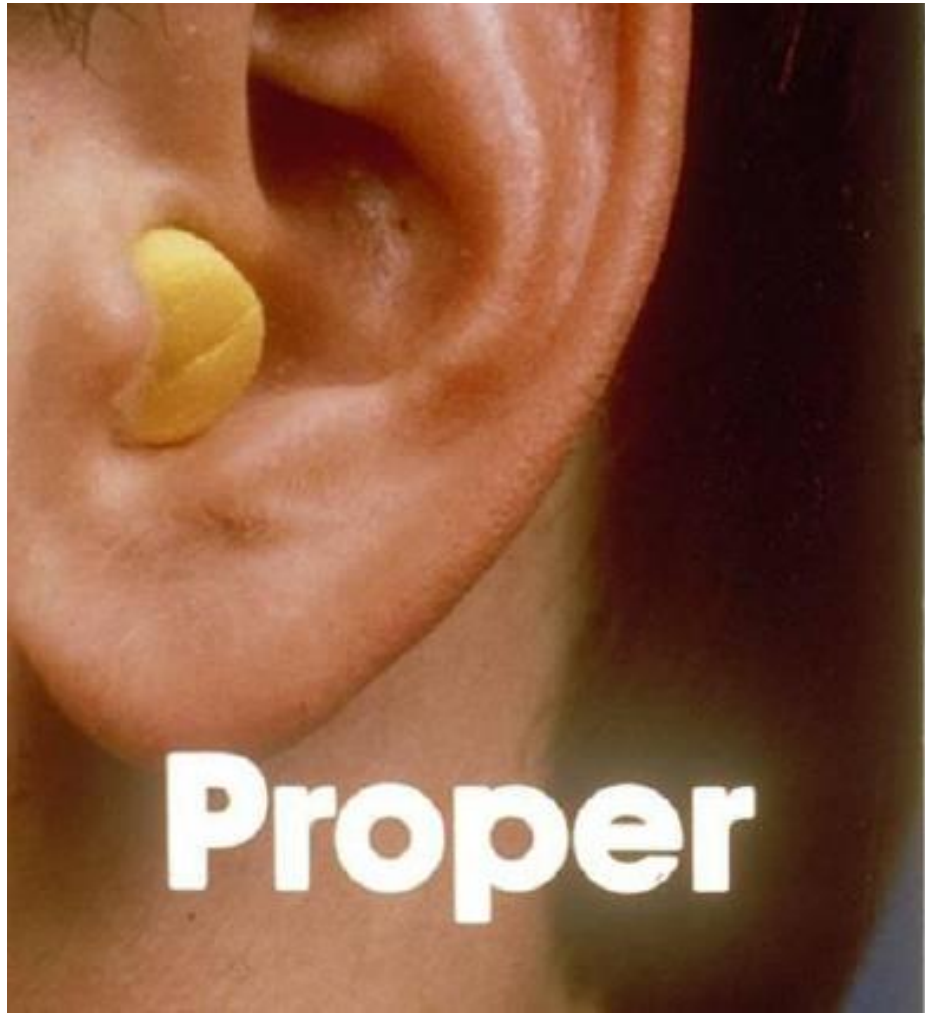


# The Inadequate Roll Down









# Summary... Did We Cover????

- How the ear works
- What causes hearing loss
- Noise exposure limits
- Elements of a hearing conservation program
- Methods for controlling noise exposure
- To give you... concepts and techniques to prevent noise induced hearing loss