

AG HEALTH 101

# HEARING PROTECTION

UNIT 4



**GREAT PLAINS**  
Center for Agricultural Health

# CHAPTER DISCUSSION QUESTIONS



## **CHAPTER 1. How Loud Is Too Loud?**

When talking with farm workers, how would you start the conversation about noise on the farm?



## **CHAPTER 2. Assessing Hazards with Smartphones**

Go to your telephone's app store and look for sound level meter apps. Find a couple of free ones, check the reviews, and give them a try. Can you set up the meter in A-weighting? Get a TWA of Leg? Select the "NIOSH" setting (exchange rate of 3 dB)?



## **CHAPTER 3. Hearing Loss Prevention Options**

Identify three noise sources and identify which method would be the most appropriate to reduce the risk of long-term hearing damage from each source: Could you buy/use something quieter? Is maintenance needed? Could you move the noise to a location further away from you? Can you minimize time spent being exposed?



## **CHAPTER 4. Hearing Protection: Selection & Use**

Look around the internet and find three examples of reusable plugs and three examples of formable plugs that look like they are different from one another. Pick examples that you would want people to give feedback on which they like better. Make a table with the name, manufacturer and the NRR for each device.



## **CHAPTER 5. Hearing Protection: NRR & Fit Checks**

Use the table you generated for the last section and calculate the  $(NRR - 7)/2$  derating and the NIOSH method ( $NRR \times \text{fraction}$ ) - 7 to calculate effective NRRs for the devices you selected. Are you still willing to recommend the devices you selected last time knowing what you know now?



## **CHAPTER 6. Communicating Risk**

Reflect on PPE that you have been required to wear on the job and remember when you first started to wear it. Then reflect on how confident you were with wearing it correctly and how comfortable it was or wasn't. Now, think about how it has become second nature. How would you use your experience to encourage workers to adopt hearing protection?

# CHAPTER 1

# HOW LOUD IS TOO LOUD?

Farm Equipment	Noise Level	Max Safe Time*	*Max time without wearing hearing protection
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ATV, Push Mower	90 dBA	2.5 HRS
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Tractor/Combine (with Cab), Grain Auger	92 dBA	1.5 HRS
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Air Compressor, Shop Vac	95 dBA	47 MIN
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Pigs Squealing, Irrigation Pump	100 dBA	15 MIN
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Riding Mower, Pressure Washer	102 dBA	9 MIN
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Tractor (No Cab), Grain Dryer	105 dBA	4 MIN
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Leaf Blower	110 dBA	1-2 MIN
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Chain Saw	115 dBA	< 1 MIN
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# CHAPTER 2

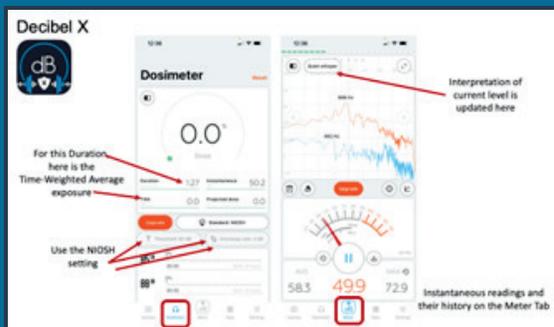
# ASSESSING HAZARDS

## WITH SMARTPHONES

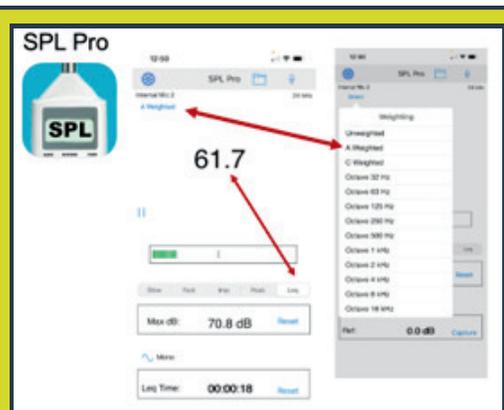
### YOUR APP SHOULD:

- Allow you to take A-weighted sound level measurements.
- Allow for a slow response setting.
- Collect time-weighted measurements (look for "TWA" or "Leg").
- For TWAs, you want to use one that has a criterion of 85 dBA and an exchange rate of 3 dBA, often called "NIOSH" setting.

Look at the two examples (from different apps) located on this page. These graphics illustrate how to look for the components listed above.



To use a smartphone as a sound level survey, position the phone an arm's length away (so the body is not blocking any noise). Use a slow response setting and obtain a 1-minute average. To measure personal exposures, ideally the phone should be placed near the shoulder (by the ear).



The purpose of using these apps is to find tasks, equipment, and operations where a worker would have exposures above 85 dBA and measure what those sound levels are. **Workers should be wearing hearing protection in these areas.**



## CHAPTER 3

# HEARING LOSS PREVENTION OPTIONS

- ① Reduce sound levels by selecting equipment with the quietest option. When purchasing new equipment, go for what is quiet.

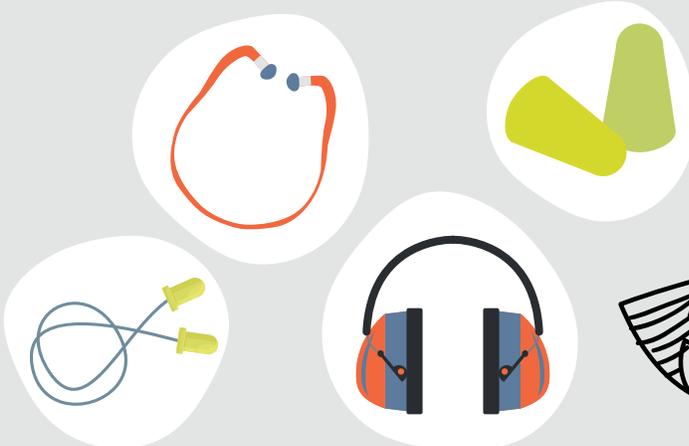
**Rule of Thumb:** Any new equipment that is 10 dB quieter than the existing noise level that it is being added to will not introduce any new sound to the environment.

- ② Perform routine maintenance. By keeping equipment lubricated and balanced, sound levels can be reduced substantially.

- ③ Mark areas/equipment with "HIGH NOISE" signs to remind people to minimize time in the area and to wear hearing protection.

- ④ Isolate workers from noise. If there is equipment that is loud and that workers do not need to be around, block off the area when it is operating. If you double the distance between the worker and a noise source, the level of noise exposure can be reduced by 6 dB.

- ⑤ Limit daily noise exposure durations. This includes moving away from noise sources when possible, scheduling noisy work over several days rather than all at once, and other administrative options to spread the exposure and give ears a chance to recover after reduced exposure time to loud noise.



- ⑥ Select hearing protection that both fit and will be worn in high noise areas. Make hearing protection available at high noise areas.



## EXAMPLES

# CHAPTER 4. HEARING PROTECTION SELECTION & USE

## HEARING PROTECTION



What type is best for you?



### EARMUFFS



#### PROS

- Good protection
- Reusable
- Easy on/off
- Radio option allows you to listen to sports/music

#### CONS

- May not fit well over glasses
- Higher initial price
- Facial hair may affect fit
- Uncomfortable in hot environment

#### PROS

- Good protection
- Lowest initial price
- Comfortable
- Can be worn with glasses and earrings

#### CONS

- Easy to lose
- Disposable
- More time to insert
- Requires clean hands for insertion

### PUSH-IN EARPLUGS



#### PROS

- Low initial price
- Easy on/off
- Reusable
- Use stem for quick and clean insertion

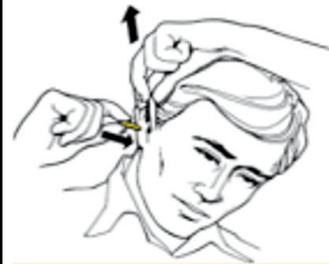
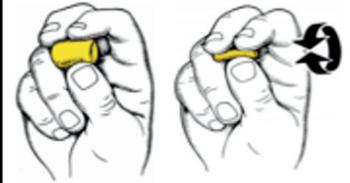
#### CONS

- Lower protection
- Must have correct size
- Easy to lose
- Can become uncomfortable after long periods of time

Earplugs are cheaper than hearing aids!

## HOW TO INSERT FORMABLE EARPLUGS

1) ROLL  
between your  
thumb and  
fingers



2) REACH  
over your head  
and pull up on  
your ear

3) INSERT  
rolled plug into  
ear canal



4) HOLD  
plug in place as  
it expands to  
ensure proper fit



GPOA.org

## Chapter 5. Hearing Protection

# NRR & FIT CHECKS

There are two equations that can be used to help determine the limitations of hearing protection devices.



### OSHA NRR Conversion to A-Weighted Scale:

- Adjust NRR by 7 to account for scale
- Then use 50% safety factor

$$\text{Effective Reduction} = (\text{NRR} - 7)/2$$

### NIOSH Derated NRR

- Use safety factor (function of type of HPD) to derate NRR

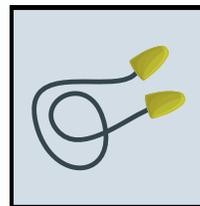
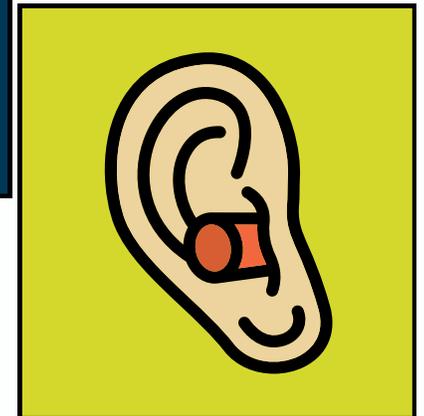
Muffs: 0.75 (NRR)

Formable: 0.5 (NRR)

Other: 0.3 (NRR)

- Subtract this derated NRR by 7 to account for scale

$$\text{Effective Reduction} = \text{NRR}_{\text{derated}} - 7$$



## REMEMBER:

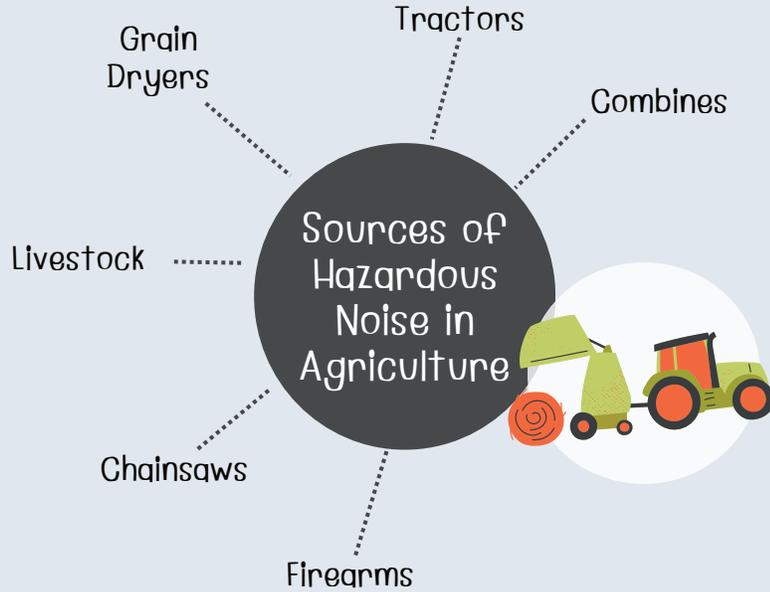
The safe level for noise exposure is less than or equal to 85 dBA for an 8-hour day.

# Chapter 6. Hearing Protection

## COMMUNICATING RISK

### SIGNS & SYMPTOMS OF HEARING LOSS

- A ringing in the ear or buzzing occurring in the ear
- Difficulty hearing other people clearly
- Listening to the radio or television louder than normal
- Asking co-workers or family members to constantly repeat themselves
- Difficulty hearing on the phone



Hearing loss from exposure to noise is common among farmers & agricultural workers

Why should agricultural workers be concerned about hearing loss?



Hearing loss from noise is permanent & irreversible

Hearing loss from noise can be prevented



# Hearing Protection

# RESOURCES

## CHAPTER 1

Here are two papers that report noise exposures on the farm:

- <https://onlinelibrary.wiley.com/doi/epdf/10.1111/j.1748-0361.2010.00306.x>
- [https://www.tandfonline.com/doi/epdf/10.1300/J096v12n02\\_03?needAccess=true&role=button](https://www.tandfonline.com/doi/epdf/10.1300/J096v12n02_03?needAccess=true&role=button)

## CHAPTER 2

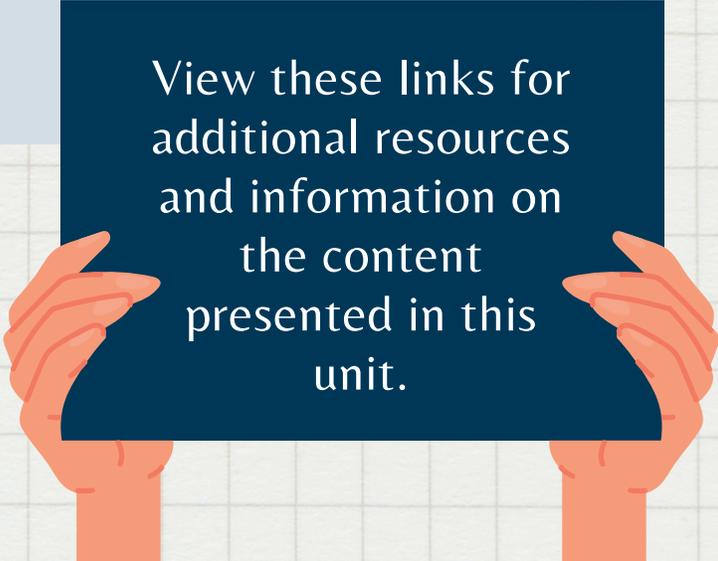
- *So How Good Are These Smartphone Sound Measurement Apps (2022):*  
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4545478/>

## CHAPTER 4

- See posters at: <https://gpcah.public-health.uiowa.edu/materials-for-health-care-providers/>
- See RACK Cards in both English and Spanish at: <https://gpcah.public-health.uiowa.edu/outreach-2/topics/hearing-loss-prevention/>

## CHAPTER 6

- McCullagh, Ronis, Lusk. (2010). Predictors of use of hearing protection among a representative sample of farmers. *Res. Nurs. Health.* 33(6):528-38.
- McCullagh et al. (2016a). Effects of interventions on use of hearing protectors among farm operators: A randomized controlled trial; *International Journal of Audiology.* 2016. 55 (Supp 1): S3-S12.  
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4740201/>
- McCullagh et al. (2016b). Gender differences in use of hearing protection devices among farm operators. *Noise and Health.*  
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5227018/>



View these links for  
additional resources  
and information on  
the content  
presented in this  
unit.

# BONUS CHAPTER

## Calculating 8-Hour Exposure Limits

For this bonus section, we will go through an example for calculating 8-hour exposures, using the table described in the bonus chapter audio file.

(1) The equation for time allowed is:  $Time, hr = \frac{8 hr}{\frac{(L_{av} - 85)}{2} \cdot 3}$

(2) The equation to compute the dose, as a fraction, is:  $Dose = \sum \frac{Time Exposed}{Time Allowed}$

(3) The equation to compute the daily dose into TWA, in units of dBA is:  $TWA = 10 \log(dose) + 85$

Below is our table. We identified tasks, measured Leg from our smartphones, and estimated the amount of time spent doing a particular task on a particular day.

The light gray column (time allowed, hr) is calculated from equation (1). The yellow column (dose) is calculated from equation (2). The orange cells are summations of the numbers in the above columns. The blue cell is the computed TWA using equation (3).

Task	Leg (or TWA) from Smartphone, dBA	Time Doing Task, Minutes	Hour	Time Allowed, hr	Dose
Preparing Equipment	86	30	0.5	6.3	0.08
Operating Grain Cart	83.2	90	1.5	12.1	0.12
Combining Grain	85	202	3.3667	8.0	0.42
Unloading Grain Bins	90.3	80	1.3333	2.4	0.57
Operating Grain Vacuum	99	90	1.5	0.3	4.76
	Sum, minutes =	492		Dose =	5.95
				TWA, dBA =	92.75

The day includes just over 8 hours of information (480 minutes in an 8-hour day). We see that the biggest contribution to the day's exposure is operating the grain vacuum. This task should require hearing protection. To get the 99 dBA down to 85, we need an effective reduction of 14 dBA.

Remember that this means that  $(NRR - 7)/2$  needs to be 14, or back calculating,  $NRR = 14 * 2 + 7 = 28 + 7 = 35$ . This is the target NRR (reported by the manufacturer) that we need to use. There are some devices that are this effective at noise reduction - but, if devices this effective are not accessible, earmuffs can be worn on top of ear plugs (referred to as "using double/dual protection").

### Practice:

Compute the TWA for the following tasks that a worker performs in one 8-hour day. Determine if the exposure is too high and hearing protection should have been used.

**Feeding Pigs: 86.1 TWA, 1 hour**  
**Cleaning Building: 88.2 TWA, 5 hours**  
**Moving Pigs: 84.2 TWA, 2 hours**

You should calculate a DOSE = 1.68 and the TWA = 87.2 dBA