Safety Science Tools

How Much Can You Hear?

Open your students' eyes to the importance of scientific literacy. As a Science Educator, you can help them draw connections between science, engineering, math, and language. These lessons can help build their confidence, strengthen their interest, and apply their knowledge to solve new problems.

When you are wearing headphones or ear buds it's very easy to miss important audio safety clues when riding your bike or even if your are just walking on the sidewalk.

For this activity, we'll use over over-the-ear headphones and in-ear headphones (or ear buds) to observe how difficult it is to hear important outside noises like sirens, train whistles, or a car horn when you're listening to music—especially if the music is turned up loudly. Divide the class into 3 – 4 groups and have them work in teams.

MATERIALS FOR EACH TEAM:

- 1 pair of in-ear phones (ear bud)
- MP3 player such as an iPod
- Whistle
- Noise-making toy
- Bike horn, bell, or smoke detector
- Tape measure

OPTIONAL MATERIALS:

- Smartphone such as an iPhone or Android, or an MP3 player that can load apps, such as an iPod Touch.
- Decibel-measuring app, such as Decibel 10th, Too Loud?, or dB Volume Meter.
- Phonmeter – handheld sound meter

PRE- PLANNING

Select an age-appropriate song on the MP3 player that starts out with about 60 seconds of consistent volume music. You will use this song for all the trials.

Print out the charts below, 2 -3 sets per team, to record predictions and observations.

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EXPERIMENT #1

STEPS

1. Each team should work together to predict whether they will be able to hear the noise alert* for different volume levels for both earphone styles. Have them record their predictions on Chart 2.

   **The noise alert can be a whistle, bike horn, smoke detector, noise-making toy, or other team members having a "somewhat" loud conversation.*

2. Have one team member put on the ear buds.

3. Start the music and set it at a low level, as if listening to music to fall asleep too ("bedtime music" level).

   - On chart 1, draw a picture of the volume level indicator from the MP3.

4. Repeat with two higher volume levels:

   - "Background Music"—a comfortable level for listening to music while doing other activities, such as household chores.

   - "Rockin' Out"—the maximum level you'd set to jam to music. Caution: Be sure it's not so loud that it hurts your ears.

5. Reset the volume to the lowest level, using your drawing from Chart 1 as a guide.

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6. Have another team member make the noise alert sound from behind the member with the ear buds on , out of sight.

   - Can you hear the sound? Record your observations in Chart 2.
   - Repeat for each volume level.

7. Repeat the prediction and experiment with the over-the-ear headphones.

CHART 1

RELATIVE VOLUME LEVEL		DECIBELS (APPROX.)	DECIBELS MEASURED	DRAW HERE
1	BEDTIME MUSIC	60DB		
2	BACKGROUND MUSIC	75DB		
3	ROCKIN' OUT	90DB		

** As indicated on the smartphone app (ex: Decibel 10th, dB Volume Meter, Too Loud?, etc.)*

CHART 2

CAN YOU HEAR THE WARNING SOUND?

RELATIVE VOLUME LEVEL		OVER THE EAR HEAD PHONES		EAR BUDS	
		PREDICTION	OBSERVATION	PREDICTION	OBSERVATION
1	BEDTIME MUSIC				
2	BACKGROUND MUSIC				
3	ROCKIN' OUT				

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8. Repeat the test one more time, have the team member making the noise stand across the room. Record observations on Chart 3.

CHART 3

FROM A DISTANCE OF....	
20 FEET / 6 METERS	
10 FEET / 3 METERS	
5 FEET / 1.5 METERS	

9. If there is time, have the team members change roles and repeat.

ASK THE TEAMS TO SHARE THEIR FINDINGS WITH THE REST OF THE CLASS.

- What did they learn?
- Were they surprised with the results?

SHARE THIS WITH YOUR STUDENTS.

The earphones direct the sound of the music into your ear, while blocking out other sounds by covering the opening of your ear.

Sometimes it's nice to listen only to the music, and block out everything else. But at other times it's important to be able to hear background sounds such as a siren, car horn, train whistle, or call out. Is there a magic "safe" level of volume for MP3's so important background noises can still be heard? Not really. No one volume level is safe for all situations. The "safe" volume level will vary depending on location and the kind of activity being done. When in doubt, start with the volume set very low and determine whether important background noises can be heard while gradually increasing the volume to a safe maximum. Or use one ear bud instead of two, which leaves one ear completely uncovered and alert.

In Experiment #2, teams will more accurately measure the decibel level at each of the three levels of volume used in Experiment #1.

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THE SCIENCE

A decibel is a unit used to measure the intensity of sound. The louder the sound, the higher the decibel level. Silence is 0 decibels. Normal conversation is about 60 decibels. You can damage your ears with extended listening of sounds over 100 decibels. The decibel was named for Alexander Graham Bell, a pioneer in sound research and commonly known as the inventor of the telephone. “Deci” means 1/10, so a “decibel” is 1/10 of a bel, though the unit “bel” is rarely used.

Decibels (approx.)	Sample Sounds
0 dB	Threshhold of hearing
20 dB	Rustling of leaves
40 dB	Bird calls
60 dB	Normal conversation, Dishwaser
80 dB	Alarm clock, Heavy Traffic
85 dB	Smoke Alarm
90 dB	Truck Traffic, Lawnmower
104 dB	Auto Horn

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EXPERIMENT #2

STEPS

Using a smartphone and a decibel-measuring app such as Decibel 10th, TooLoud?, or dB Volume Meter, teams can measure the approximate decibels of the music at different levels of volume. Using the same MP3 player used in Experiment #1 have the teams:

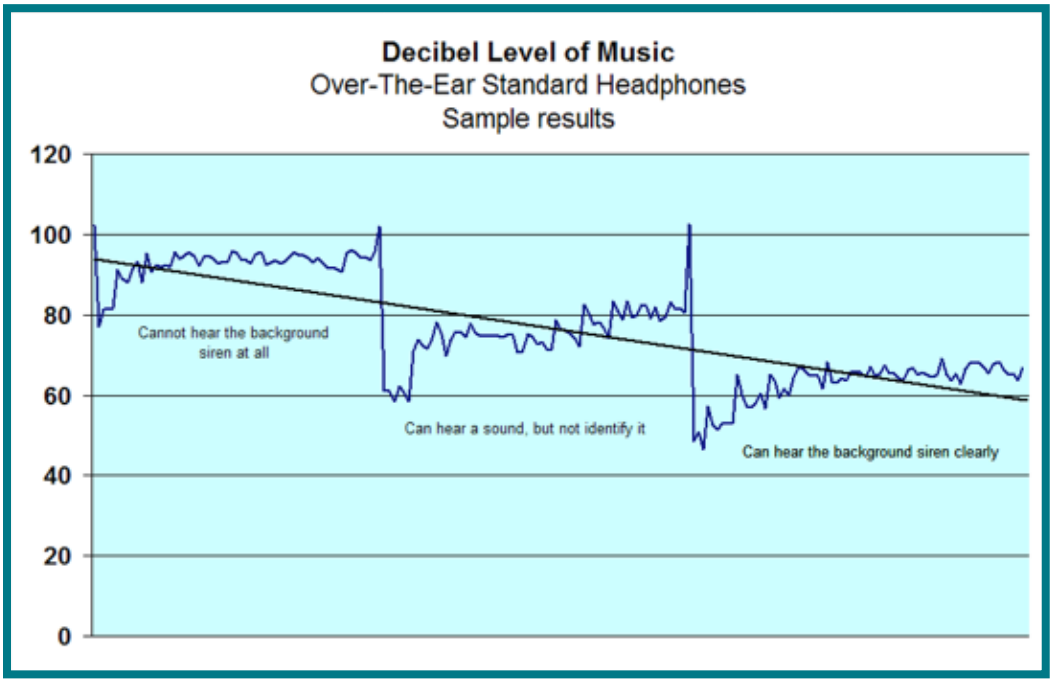
1. Plug the headphones into the MP3 player. Start the music. Set the volume level on the MP3 at the "Rockin' Out" level, using the drawing from Experiment #1 as a guide.

2. Position the microphone of the smartphone inside the cup of the headphone. Start the app on the smartphone.

3. Watch the line graph form on the screen of the smartphone as the app records the decibels. Stop the app. Record the average decibel level (dB) for that trial.

4. Restart the song at the "Background Music" volume level. Start the app. Record the dB level for this trial on Chart 1. Repeat for "Bedtime Music" volume level.

Depending on the app used, you may be able to send the results of your tests to a printer via email. See the sample below:



Ask the teams to share if the decibel app helped them to more accurately quantify the different levels of volume. Were their findings from Experiment 1, the approximate decibel measurement for each level of volume, confirmed? Were they able to find a "safe" level for wearing headphones?