

Name:	
Date: _	

# **Sound and Acoustics Lab Worksheet**

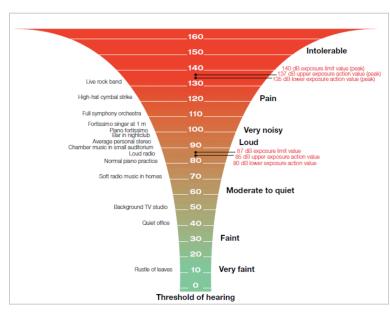
Here you will find the instructions to create your own noise pollution barrier in just a few hours! Follow along with the video and complete all the instructions for this worksheet. Fill in the blanks as you go.

#### **INTRODUCTION:**

# What is Sound?

**Sound** is created when something causes air molecules to **vibrate**. Consider a handbell. When you ring the bell, the metal vibrates, which causes the air molecules next to it to vibrate, which causes a chain reaction all around that we call a **sound wave**. When the wave of vibrating particles reaches our ears, we perceive the vibrations as sound!

Stronger vibrations are louder sounds. Faster vibrations, or a higher **frequency** wave, makes higher pitch sounds. Low frequency waves make low pitch sounds. Not all sounds can be heard by all creatures though. For example, bats can hear really high pitch sounds and elephants can hear really low sounds.



1000 (or 10<sup>3</sup>) times more powerful, and so on.

Sound is measured in **decibels** (dB). A quiet sound, like rustling leaves, is around 10 dB. Sounds over 85 dB can harm a person's ears. As decibel levels get higher, sound waves carry more energy, have greater intensity and sounds are louder. For every 10-decibel increase in the intensity of sound, loudness is 10 times greater. For example, a 10 dB sound is 10 times more powerful than 0 dB. A 20 dB sound is 100 times (or 10<sup>2</sup>) more powerful and a 30 dB sound is



Name: _	
Date: _	

# What is Noise Pollution and How Does it Affect Humans?

**Noise pollution** is considered to be any **unwanted** or **disturbing** sound that affects the health and well-being of humans or other organisms. Noise pollution impacts millions of people on a daily basis. The most common health problem it causes is **Noise Induced Hearing Loss (NIHL)**. These health problems can affect all age groups, especially kids. Many children who live near noisy environments have been found to suffer from problems such as **stress and impairments in memory, attention level, and reading skill.** 

#### WHAT YOU WILL NEED:

In your kit, you should see the following materials. You will connect the battery holder to the buzzer using the jumper wires. Make sure you attach the red wire (+ terminal) of the battery holder to the red wire (+ terminal) of the buzzer and black to black. The color of the jumper wires does not matter and any color may be used for connection. You can use the acoustic panel or other materials that your teacher provides



from around your classroom to construct your noise reduction device.

#### STEP ONE: THINK ABOUT THE PROBLEM

Imagine you are on a team of acoustical engineers working on designing a system to reduce the noise emitted from an airport. What are some things you must consider? How will you use the materials to reduce the noise as much as possible?

For this lab, you will **set up your buzzer 90 cm away** online decibel meter on your **phone** ("Sound Level Meter" on AppStore) or "Online Sound Meter" on a **computer**. You will build a barrier between the buzzer and the phone to try to reduce the noise level sensed by the phone.

<u>Answer Me!</u> What problem or challenge is your group trying to solve? What is the goal of your design? Do you want your system to be the quietest? The smallest?



Name:	 	 
Date: _		

#### **STEP TWO: RESEARCH**

Take a look at some examples of noise reducing barriers to help with your design ideas! First let's consider some **industrial applications**:

The following picture is an example similar to the system you will design! It shows how some airports reduce the noise pollution to the surrounding area.



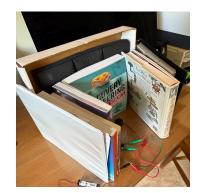
The pictures below show how special placement of soft panels can be used in a gymnasium or restaurant to reduce echo!





Next are some examples of how **you** may design your system to reduce the volume of sound that your phone records. There are also some more materials you can consider using!







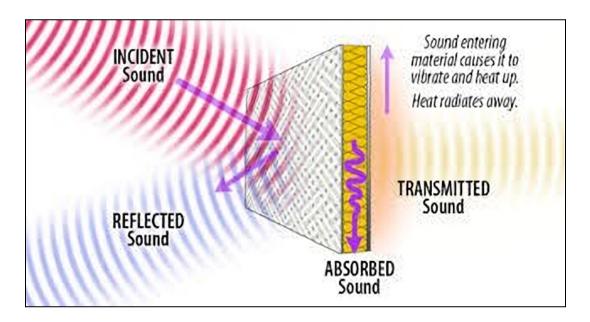




Name: ˌ	 
Date: _	



The type of material you choose is important as well! **Different materials** affect sound in **different ways**. The acoustic panel you have in your kit is an **absorbent** material. This means that most of the sound waves get converted into \_\_\_\_\_\_. On the other hand, wood and stone are **reflective** materials. This means that most of the sound waves get \_\_\_\_\_\_, rather than absorbed. This creates an **echo!** Do you think absorbent or reflective materials are better for a sound proof barrier?



Do some research into all the materials you have available!



Name: .	
Date: _	

<u>Answer Me!</u> What shapes do you think will help the most? What materials do you tink will help the most? Do you think your barrier should be closer or further from the buzzer? Why?

## **STEP THREE: DESIGN**

All designs come with tradeoffs. It would be easy to reduce the noise with a really big system, but in real life we don't have unlimited space to reduce noise. When you are building, **keep your noise reduction system less than 30 cm thick**. Your design must also use a **minimum of 3 different materials**. Make sure to keep this in mind while creating your design!

Answer Me! Draw or upload a picture of your initial design here!		

#### **STEP FOUR: TEST**

Engineers always make sure that they have a baseline to compare against. Be sure to **conduct a control test** that does not have any sound barrier to establish a baseline noise level to compare each of your designs to. Turn on the buzzer and record the noise level before you begin. As you iterate, use the chart below to record your data.



Name:	
Date: _	

Test#	Key Design Aspects	Distance from buzzer (cm)	Perceived Sound (dB)
Control	No barrier in place	N/A	
1	Ex: 2 layers of foam, angled cardboard arms ~30 cm across	35 cm	80
2			
3			
4			
5			
6			

#### STEP FIVE: ANALYZE AND REFLECT

Look at your data and results and analyze! Be sure to discuss this with your group. What strategies seemed to be most effective for reducing the noise? Is bigger always better for this challenge? Did the material used or the shape of the structure seem to be more important?

Answer Me! Which design performed the best? What is one thing that went well?			

<u>Answer Me!</u> Compare your results with your classmates! Who got the lowest decibel value? What did they do that you could change?



Name:	
Date: _	

# **CONTINUE TO EXPLORE**

If you liked today's challenge you may be interested in these topics:

# **STEP SIX: STUDENT EXIT SURVEY**

Once you've finished the lab, please complete the <u>student exit survey</u> to share your feedback.