Engineering Tomorrow

Name: _____
Date: _____

Sound and Acoustics Lab Worksheet

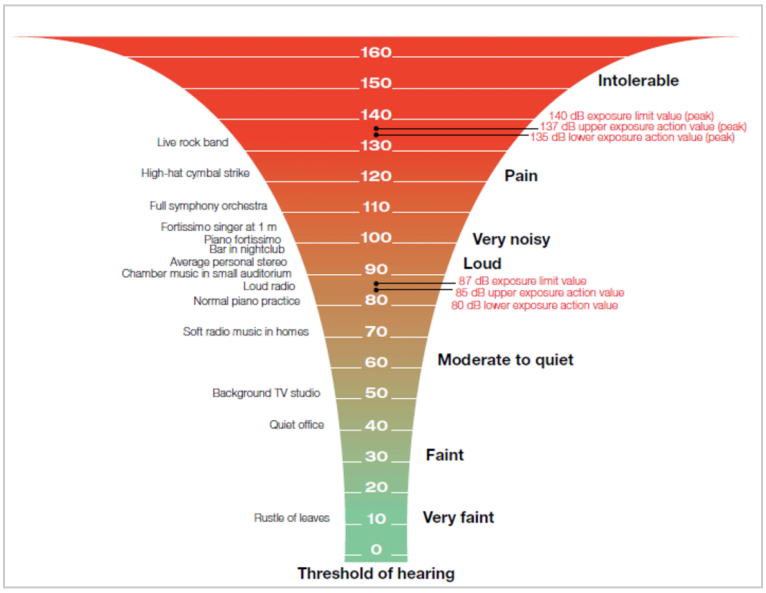
Here you will find the instructions to create your own noise pollution barrier in just a few hours! Follow along with the video and complete all the instructions for this worksheet. Fill in the blanks as you go.

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.



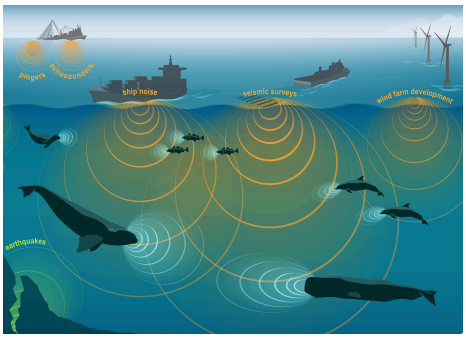
Sound is measured in **decibels (dB)**. A quiet sound, like rustling leaves, is around 10 dB. Sounds over 85 dB can harm a person's ears. As decibel levels get higher, sound waves carry more energy, have greater intensity and sounds are louder. For every 10-decibel increase in the intensity of sound, 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 10^2) more powerful and a 30 dB sound is 1000 (or 10^3) times more powerful, and so on.

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.**

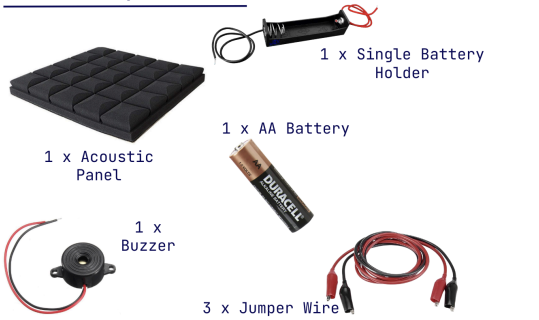
How does Noise Pollution Affect Wildlife?



Noise pollution also affects the health of wildlife. For example, some birds have fewer chicks and caterpillars' hearts beat faster. Some animals, like whales and bats, use sound to find their food in a process called **Echolocation**. Echolocation involves making noise and listening to how it bounces off other objects to "see" in low-light environments. Noise pollution can confuse these animals making it harder for them to find food.

WHAT YOU WILL NEED:

The Components for Sound & Acoustics



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 from your phone and use an app such as "Sound Level Meter" to record the noise level. You will build a barrier between the buzzer and the phone to try to reduce the noise level sensed by the phone.

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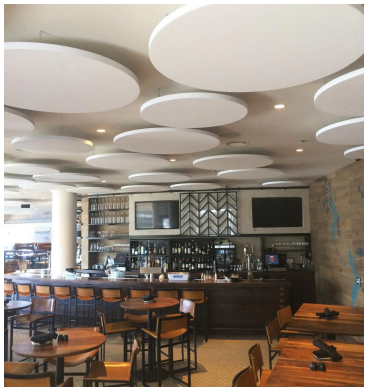
Answer Me! What problem or challenge is your group trying to solve? What is the goal of your design? Do you want your system to be the quietest? The smallest?

STEP TWO: RESEARCH

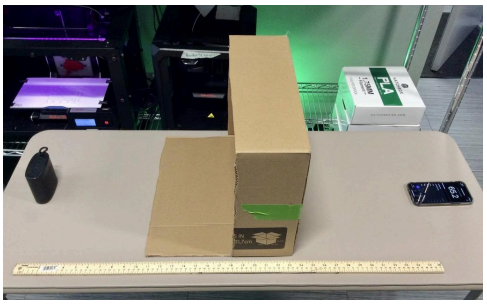
Take a look at some examples of noise reducing barriers to help with your design ideas! First let's consider some **industrial applications**:

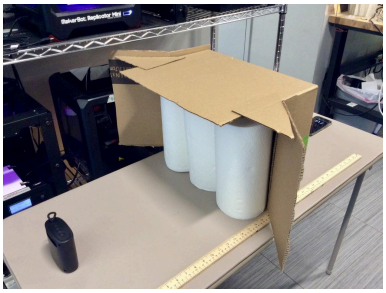
The following picture is an example similar to the system you will design! It shows how some airports reduce the noise pollution to the surrounding area.

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.





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Answer Me! What shapes do you think 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**. 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.

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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? Would you change anything about your process if you did it again?

CONTINUE TO EXPLORE

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

* Noise pollution
* Musical Acoustics
* Architectural Acoustics
* Sound Design - Engineering in the Entertainment Industry

STEP SIX: STUDENT EXIT SURVEY

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