



Drexel-SDP GK-12 ACTIVITY

Activity Template

Subject Area(s): Sound

Associated Unit: None

Associated Lesson: None

Activity Title: Sound Booth Construction

Grade Level: 8 (7-9)

Activity Dependency: None

Time Required: 180 minutes

Group Size: 3-4 students

Expendable Cost per Group: US \$1.50

Summary:

In this activity, students will explore the sound dampening ability of several materials through experimentation and construction of a sound booth. As a result, the students will learn about how sound is reflected, absorbed and travels through different materials, thus giving the students an overview of sound dampening, energy absorption and sound propagation.

Engineering Connection:

Engineers developing various sound proof structures are constantly concerned with the products' ability to dampen sound both entering and exiting their structures. In a recording environment the objective is to create an acoustic space (sound booth) that is able to isolate that space from all outside noises. Therefore, the sounds generated outside of the booth would need to be damped or reflected before entering the inside of the structure so that the recording microphone only records the desired sounds. In another instance it may be important to not let the sound generated inside a room escape into adjacent rooms. This would be needed in a house with a practice studio where

the music created would not be wanted throughout the rest of the house. Many other applications benefit from sound dampening and sound reflecting materials as will be seen throughout this experiment.

Keywords: sound, acoustics, sound dampening, energy absorption, sound propagation

Educational Standards

- Science: 3.1 – Unifying Themes of Science
- Math: 2.3 – Measurement and Estimation

Learning Objectives

After this lesson, students should be able to:

- Explain how surfaces reflect sound waves
- Develop blueprints for a structure that will be constructed
- Explain why certain materials absorb more sound than others
- Write a formal lab report

Materials List

Each group needs:

- Poster board (2' x 3')
- Scissors
- Ruler
- Pencil
- Elmer's Glue
- Approximately 30 cm duck tape
- Any 3 of the following materials
 - 50 jumbo cotton balls
 - 40 wide popsicle sticks (6" x 3/4")
 - 20 paper towels
 - 30 tissues
 - 1 large sheet of construction paper (2' x 3')

To share with the entire class:

- Computer or any device that can play audio such as an iPod
- Small speaker
- Decibel meter
- Homemade platform to sit the sound booths down into to create a seal around the bottom of the booth (optional, but very helpful in obtaining accurate results)

Introduction / Motivation

The use of sound booth and sound dampening materials are used in the recording industry to produce high quality recordings of music that people listen to on iPods, CDs, the radio and on the internet. Without the production of high performance sound dampening materials music tracks would be mixed with environment noise from outside the recording studio. Also, recording studios and practice studios would not be as readily available if sound dampening materials did not perform well. For example, if your band rented a practice space in a building with other practice spaces and no sound proofing then you would constantly be hearing everyone else playing. The only time you would ever get a chance to practice and only hear your band's music would be when all other bands are not in the studio. Therefore, this creates a definite need for sound proofing and sound dampening capabilities for musical interest along with various other activities such as a meeting in a conference room.

Vocabulary / Definitions

Word	Definition
sound dampening	reducing the intensity of a sound
sound reflection	bouncing a sound off of a surface into another direction

Procedure

Background

Standalone sound booths or sound isolation booths are built with fairly thick walls of about 3.75". The interior walls of the booth are covered with polyurethane acoustic foam or some other sound dampening type of material. The exterior of the booth is covered with an acoustic fabric that attempts to dampen the sound. Various other types of materials, such as baffles, ceiling tiles, vinyl barriers and some rubber products are used to dampen the sound in the booths. In situations where a sound booth is not used a room can be made more sound proof by adding products to the walls, ceiling and floor to help eliminate any outside noise from entering the room. In some instances the floor of the studio can be elevated to decouple the floor from the overall building structure, eliminating more vibrations in the room.

Before the Activity

- Print out a copy of the lab for each group
- Divide the various supplies into groups

With the Students

1. Ask the students which materials would be best for sound dampening and why
2. Explain to the students that their job is to build a sound booth that can dampen the sound generated inside the sound booth as much as possible given the materials in the list
3. Hand the students the lab handout and have them complete the *Hypothesis* section with their group with a sample of each supply available for the students to see and touch
4. Have the students create a blueprint of the sound booth with an detailed list of materials needed
5. Accept the blueprint from each group only if all supplies are listed with exact numbers and the design is realistic
6. Once all groups have their blueprints accepted demonstrate the proper procedure for cutting the poster board to form the shell of the sound booth as is described in the handout
7. Make the students trace the outline of the shell on the poster board

8. Check each group's traced outline before allowing the students to cut the poster board
9. Distribute only the materials each group needs to construct their sound booth
10. Have the students construct their sound booths with their materials only
11. Only allow the students a given amount of time to construct their booths to simulate a real world situation
12. After the students have completed their sound booths, it is time to test each sound booth
13. To test a sound booth, place the booth overtop of the speaker like an upside down cup with a decibel meter beside the booth
14. For each booth play the same clip of audio at the same volume level to make the testing accurate
15. Have the students record the highest decibel level reached for each sound booth in the table in the *Data* section on the handout
16. After testing have each group go to the front of the room and explain the construction of their sound booth and why it was constructed in that manner
17. Discuss why certain sound booths performed better than others and why certain materials work better than others

Attachments

- [Building a Sound Booth Handout](#)

Safety Issues

- The students will be cutting poster board with scissors

Troubleshooting Tips

Often times the sound booths will not be flat on the bottom edge due to improper construction of the booth and/or warping of the walls of the booths from drying glue. This creates gaps for audio to escape from when playing the sound file. Therefore, when testing the sound booths it is beneficial to make a homemade device to sit the sound booth down into to create a better seal.

Investigating Questions

- What materials, besides the ones used, would have a better ability to dampen the sound?
- What type of materials are better to use, sound reflecting, sound absorbing materials or both?

Assessment

Pre-Activity Assessment

Class Discussion:

- Talk with the students about what materials might be useful for making something not sound as loud
- Talk with the students about materials that reflect sound and instances where sound is reflected (i.e., Grand Canyon echo)

Activity Embedded Assessment

Lab handout: Have the students fill out the lab handout and write a lab report as a measure of the concept comprehension

Post-Activity Assessment

Lab Report: Have the students write a lab report in similar format to the lab handout, but in a formal manner with greater detail. The report should begin by with statement of the problem and the predicted hypothesis of the student with reasoning. The materials and procedure sections follow with enough detail for someone to replicate the experiment exactly, adding details to the procedure in the lab handout when needed. The decibel reading and booth description of each group's sound booth should be written formally in a table in the data section of the report. The results section is a restatement of the observations with analysis of the data, such as the general relationship between the materials, construction and sound dampening ability. Last is the conclusion paragraph, which states whether the hypothesis was correct or not and why. This formally written report will judge the comprehension of the overall activity.

Activity Extensions

- The students could experiment with sound dampening ability of other materials for homework or during free time
- The students could create a new sound booth with an unrestricted supply list and test its sound dampening ability

Activity Scaling

- For lower grades, the intensity of explanation will need to be reduced to more general concepts with a more straight forward explanation
- For upper grades, the complexity of detail should be increased with more supplies, more strict requirements on interior dimensions and permission to modify the supplies given

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Building a Sound Booth

Names: _____

Problem

How do different materials affect the ability of sound to travel?

Hypothesis

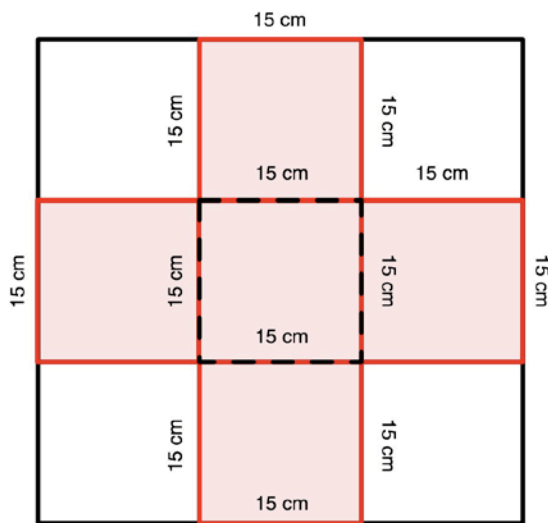
I think that the combination of _____, _____ and _____ will make the poster board box most sound proof because _____

Building Materials

-
- Poster board (2' x 3')
 - Scissors
 - Ruler
 - Pencil
 - Elmer's Glue
 - ~30 cm of duck tape
 - **Choose 3 of the following materials:**
 - 50 jumbo cotton balls
 - 40 wide popsicle sticks (6" x 3/4")
 - 20 paper towels
 - 30 tissues
 - 1 large sheet of construction paper (2' x 3')

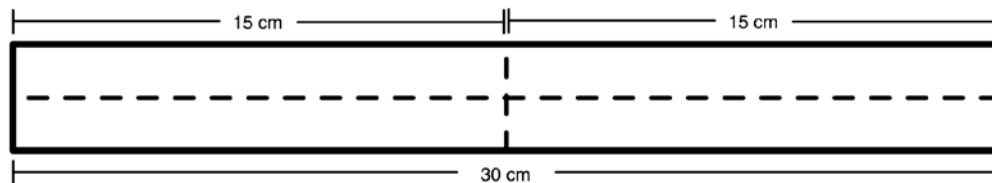
Building Instructions

-
1. Begin by tracing the outline of the box on the poster board as follows:



A box with only five sides will be cut from the poster board. The red (light) line represents the outline of the box with each side having a length of 15 cm. The black (dark) and red (light) dashed line shows where to fold the box. The white sections will be cut off and discarded.

2. WAIT for your teacher to come around and approve your trace
3. Cut out the box and fold on the dashed lines
4. Paste your materials ONLY on the inside of the poster board
5. Fold the box so that it has all but one side closed
6. Cut the duck tape into four pieces by cutting the tape on the dashed lines as shown below



7. Place the duck tape on the outside of the box along the open edges to seal the box
8. Write your group members names on the box
9. Place materials into the sound booth as is specified in your approved blueprint

Testing Materials

- Computer or device that can play audio
- Small speaker
- Sound meter
- Homemade platform to sit sound booths down into for a better seal (optional but very helpful in obtaining accurate results)

Testing Instructions

1. Have your teacher connect a computer or audio playback device to a small speaker
2. Place the speaker inside the sound booth with the booth positioned like an upside down cup

3. Play a small segment of a song or audio clip with the sound meter placed outside of the booth but next to it
4. Record the maximum decibel level reached for the small audio clip for each group in the Data section below (Make sure that the same audio clip is played when testing each sound booth)
5. Present your sound booth to the class by describing your design in detail and specifying your materials
6. Listen to each group explain how they designed their box
7. Write down a description of each groups design and make sure to note the supplies used

Data

Group Number	Design Description	Sound Level (dB)
1		
2		
3		
4		
5		
6		
7		

8		
9		
10		

Results

-
1. Compare your results with the best performing box in the classroom
 2. If your group did not perform the best then your hypothesis is not correct

Conclusion

My hypothesis was _____ because _____
