# Soundproofing

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What is the effect of the materials lining the inside of a box on the volume of sound outside of that box? This experiment was used to determine which material best works to create a soundproof room. It also determined how loud the noise was from outside of a box. For my procedure, I lined three cardboard boxes with different soundproofing materials (ceramic tiles, felt, and egg boxes), each glued onto the walls of individual cardboard boxes. Then I placed a radio inside of each box, and used a sound meter app on my phone to measure the sound coming out of each box. I measured how loud the sound coming from the radio was on the sound meter and I wrote it down in a journal. I repeated the same procedure with the two other boxes and compared results.

# Materials

1. Three large cardboard boxes
2. Heavy porcelain tiles
3. Felt fabric
4. Egg boxes
5. Radio
6. Sound meter app
7. Paper
8. Pencil
9. Hot glue
10. Ruler

# Introduction

Did you know that one can soundproof a room so effectively that even a very loud car or a helicopter hovering 50 feet above that room could barely be heard from inside it? For my experiment, I explored techniques of soundproofing and researched what materials can be used for soundproofing a room, box, or any kind of enclosed space. I was brainstorming different ideas of what I could do for my experiment, and then I thought about sound and how it can travel from room to room inside a house, sometimes causing annoyance for all the people involved. I decided to consider soundproofing specifically. There are many different spaces and places in our noisy world that need to be made quiet, or soundproofed. Some of these places include yoga studios, hospital rooms, hotel rooms, offices, recording studios, or ballet studios. These are just a few examples of the many places around us that need to be places of silence. What is the effect of the materials used

to soundproof a space? Let's take a cardboard box as an example of an acoustic space, and let's explore the best way to prevent sound from coming out of that box. What materials will most affect the volume of the sound outside the box?

**SF Background Research**

Soundproofing is very important in places that need to stay quiet. There are many spaces that use soundproofing rooms such as hospitals, hotel rooms, yoga studios, and certain concert halls. These places need to be silent, with no echo. There are many different types of materials that can help soundproofing, but there are also a lot of materials that can amplify sound in a room. Some materials that can help soundproofing are: acoustic panels, foam, rubber, dense polyester fiber, and cork. Some materials that increase the volume sound in a room are hardwood floors, marble, painted walls, and tiles. Such places tend to be full of echos. Think of the sound of your footsteps as you walk through the marble halls of a post office or a library.

A lot of noise or vibrations can bounce off hard surfaces like hardwood floors. Something that can help to cut the sound amplified by hardwood floors are special sound-absorbing rugs. These rugs are also useful if you live in an apartment and you have downstairs neighbors who yell a lot of the time. Using soundproof rugs on the floor can absorb any sound from downstairs and help keep your apartment nice and quiet.

Soundproofing blocks noises coming from any space around you. In your house, this can be a bedroom. By putting different materials on the walls and floor of that room, you can stop sound from coming into or out of your room or space. An easy and effective way to get rid of sound or vibrations in a room is to add mass in a room, such as a bookshelf, or any type of wall covering, like a curtain or tapestry.
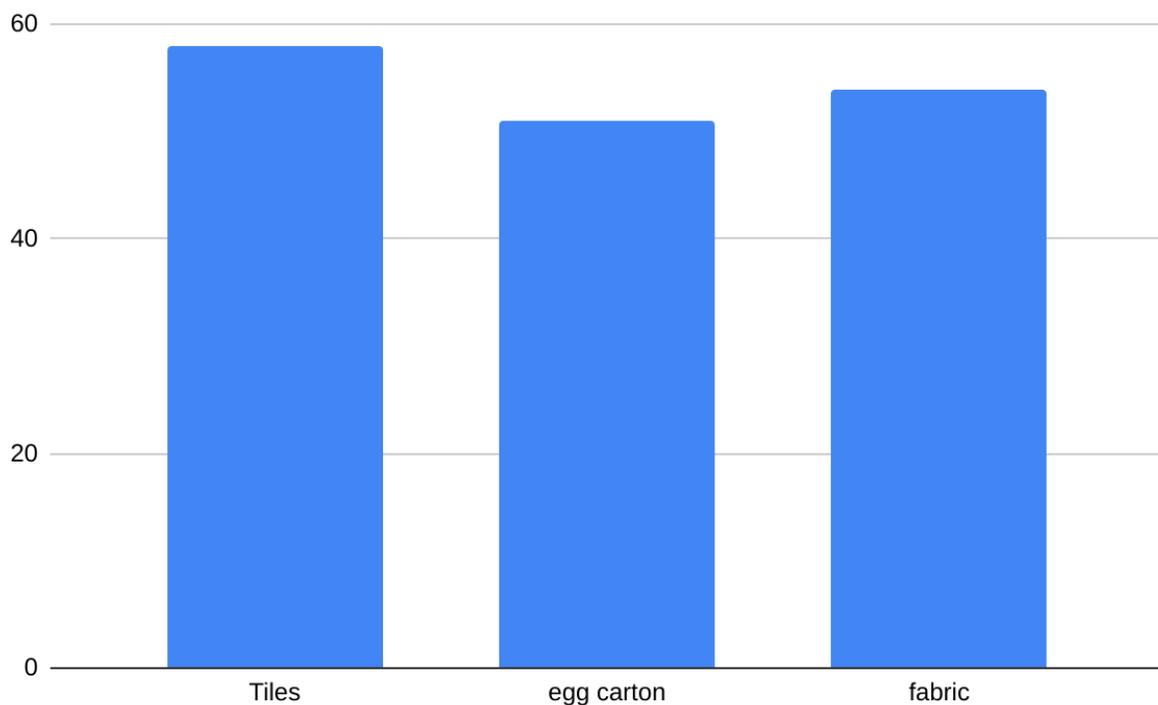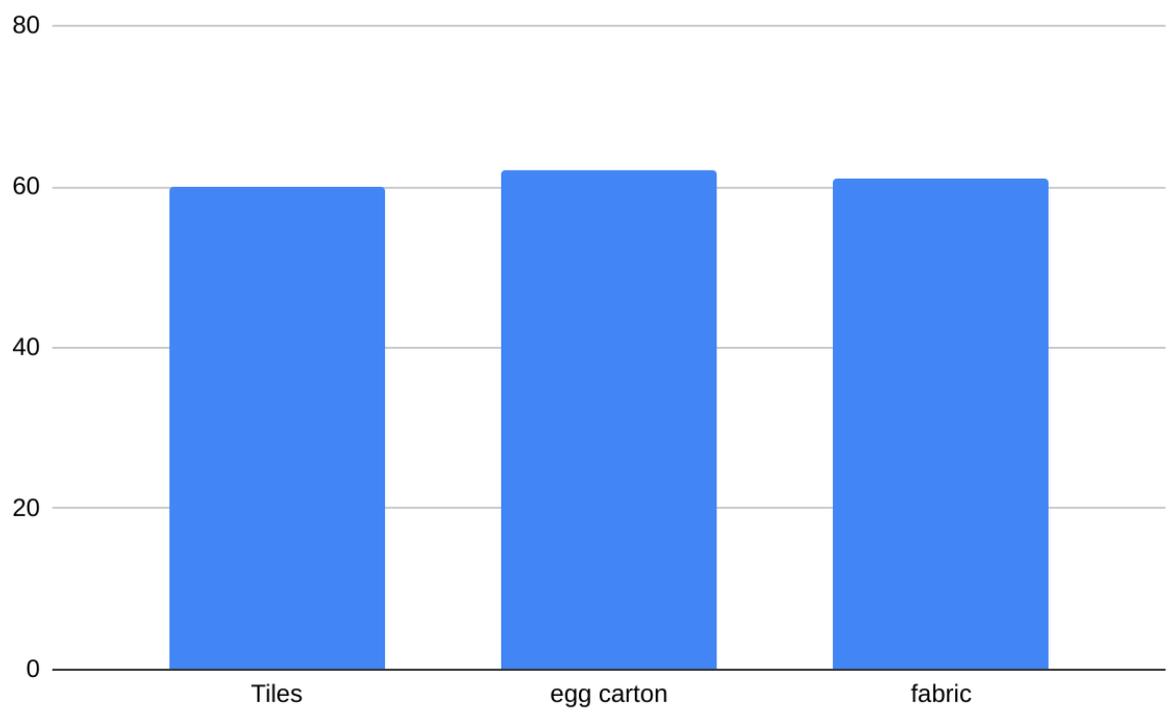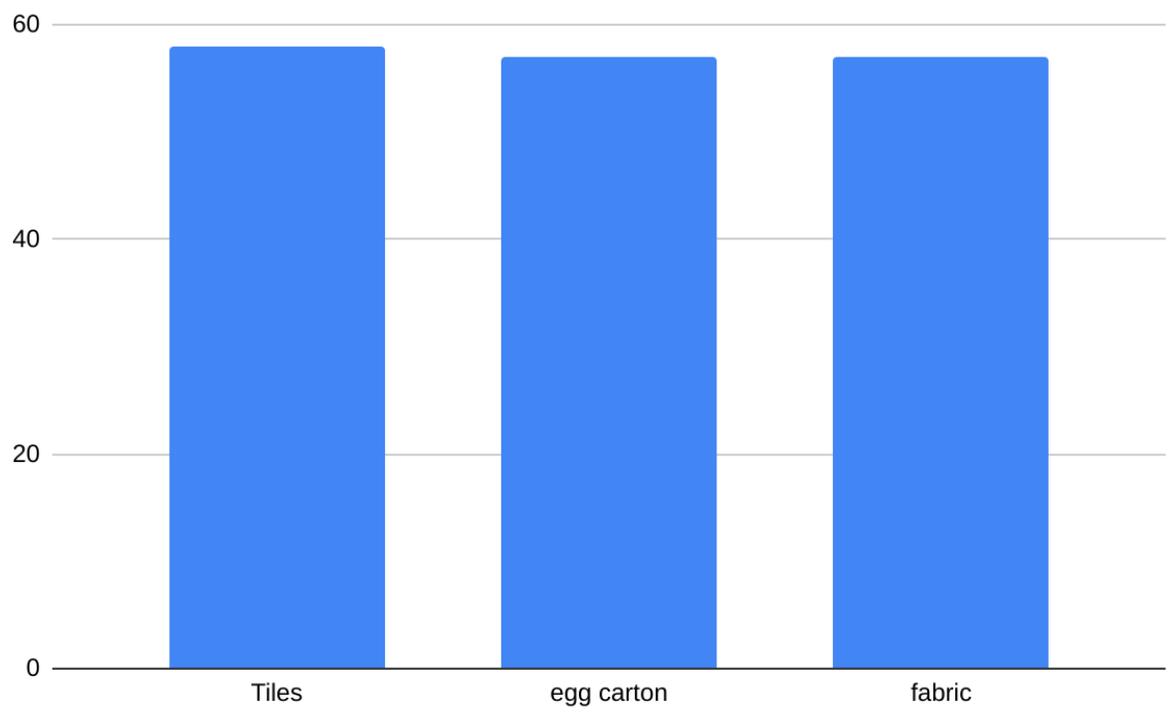
## SF Procedure

The first thing I did was go to my local grocery store, and I asked the people there if I could have three large cardboard boxes. My mom put them in the back of our car trunk. We then drove to our local fabric store, and I got some thick felt fabric to put into one of my boxes. Then we went to the local hardware store, and we got heavy porcelain tiles to put on another box.

Once we got back home, I took the egg boxes I had been collecting for about a month, and I put the rest of my materials on our kitchen table. I first started out by assembling the three cardboard boxes. I made sure to cut a hole in the top of each box, so I could put my radio in it. Then, I labeled each box: box one, box two, and box three. I then took a hot glue gun, and I started by gluing tiles onto box number one. Then, I glued the felt on the walls of box number two, making sure to not leave one side uncovered. Finally covered every wall of box three in egg cartons. I also made sure that I had not left one side, nook, or cranny uncovered.

Once all my boxes were covered in their materials, I took out my science notebook, a pen, a radio, and my phone. I downloaded a sound meter app called sound print on my phone. Once I made sure that my sound meter worked, I put the radio with a song playing not too loudly in box number one. I put my phone with the sound meter 30 cm away from box number one. I turned on the radio, and measured how loud the music was outside of the box. Finally, I repeated this process two more times, using the other two boxes and making sure to write my findings in my science journal.

## Results and Analysis

## Chart 1

| | Tiles | egg carton | fabric |
|---|---|---|---|
| Value | 58 | 57 | 57 |



## Chart 2

| | Tiles | egg carton | fabric |
|---|---|---|---|
| Value | 60 | 62 | 61 |

The results of this experiment were a little unexpected. After I had finished the experiment, and I looked at my results, I was pretty surprised. The tiles had no work as I thought, amplifying the sound. The fabric worked better than I thought, but I think that is because the sound was absorbed by the thickness of the fabric. The thing that really puzzled me was that when I looked over at my results, the egg cartons came out as the loudest box in the last try, which meant that the egg boxes had not helped to block out the sound in the third try. However, my hypothesis was mildly correct. The tiles had not worked  as an effective sound proofing material, because the sound just bounced off of the hard surface of the tiles. Just as with my tile-lined bathroom at home, the box was full of echo. Tiles are not good sound proofing material.

## Conclusion

Overall, I had a very fun time designing my experiment and finding out about acoustics and soundproofing. I learned that one of the best soundproofing materials out there is an egg carton -- or rather, several of them assembled together. A material similar to an egg carton is a foam panel. Just like egg cartons, their surface is soft, elastic, and bumpy. Both are good materials to absorb sound waves. Since the felt fabric lining the box worked fairly well as a soundproofing material, I suspect that one could add extra layers of felt padding or rug-like material to cover the walls and floors of a room needing to be sound proofed. Lastly, if you want to create a wall that is sound absorbent but also modern-looking, you can use special felt tiles that help hide the ugliness of the sound absorbent materials behind them while contributing to the sound absorption. These

acoustic panels are often shaped like hexagons and made out of thick fabric-like felt. This is also a great example of how fabric is a good sound absorbing material. Here is a picture of these tiles on a wall.



In doing this experiment, I learned a lot about soundproofing and what materials to use to make sure that a room is as quiet as possible. When I grow up, I would like to be an architect who builds sustainable housing with ecological or recycled materials,

meaning that I would build homes that stay warm, not use too much energy, and not pollute as much as other homes. I think that I could use some eco-friendly soundproofing materials to make quiet spaces. I would also like these houses and buildings to be for everyone, not just wealthy people, because we all need to live in better, more beautiful, non-polluting spaces. Today, many poor people live in polluted and noisy places, and they can get sick because of the pollution. I want to stop that. I definitely learned a lot about how to make a room soundproof, but I'd like to experiment with other materials, like paper-mache or cork. This experiment could help me if, in the future, I wanted to build housing with soundproofed rooms. It would not be very different from soundproofing a small cardboard box.

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