

Physics Project

Investigate and compare the quantitative effects of changing (a) material type and (b) material thickness on the level of sound insulation provided by a range of materials.



Background - Sound is a vibration and it needs something to help it move through, e.g. solid, gas, liquid. Loudness of sound is measured in **decibels (dB)**. Some materials allow sound pass through them very easily, especially hard rigid ones like metals as the atoms are close together. Other materials, especially soft ones like cotton wool, have a lot of air spaces that help **absorb** sound waves.

http://www.primaryscience.ie/media/pdfs/col/Sound_Insulation_Older.pdf



Part 1 (Introduction)

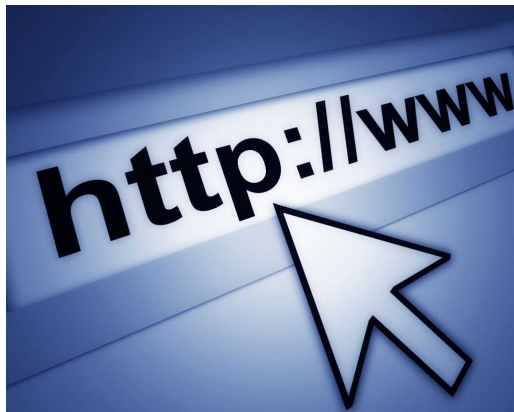
(i) Statement or problem to be investigated - What you are going to do **in your own words**

(ii) Background research undertaken - You will have to look up a few websites and books to find information for your investigation.

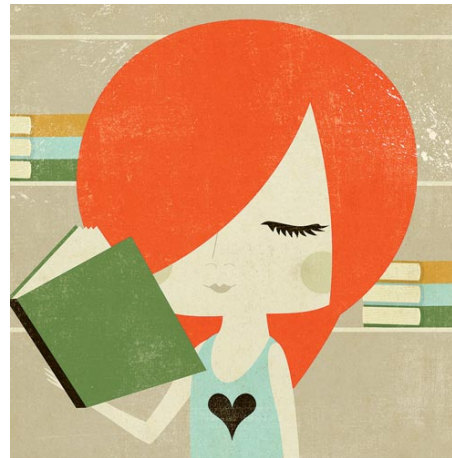
You may even have to ask your teacher or someone at home for information.

This is your background research you will need to give **at least 3 pieces** of background research. Make sure for all three you mention where you got the piece of information and what you used it for.

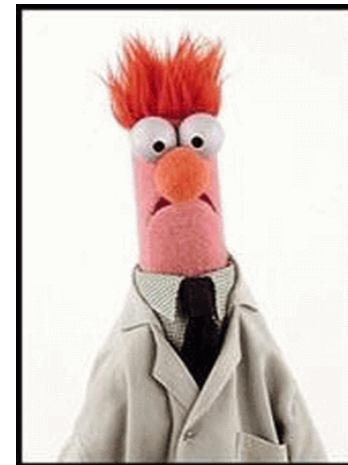
**Internet
(Give full link!)**



**Books
(Author and Publisher
Page and Details)**



Teacher



Part 2 (Preparation and Planning)

(i) Variables

1. The **Independent** Variable (what I will change - **Material Type & Thickness**)
2. The **Dependent** Variable (what I will measure - **Sound Volume**)
3. **Controls** (what I will keep the same -
 - **Volume of the sound source (buzzer, timer or phone)**
 - **Box over the sound source**
 - **Distance/direction of sound meter from the source**

(ii) Equipment: List every piece of equipment you use, leave nothing out!
e.g. Safety glasses, ear protection, shoe box, scissors, phone/timer with buzzer, roll of cotton wool, 2 egg boxes, material (jumper), bubble wrap, sound meter (app on phone), notebook and pencil.

(iii) Tasks This is the list of jobs that need to be done in order.
e.g. Place a buzzer/phone in a shoebox and set it to ring.
Place a small hole in one side of the box (facing the sound meter)
Record the volume of the sound using a sound meter or app on a phone. This will be the control for the experiment.
Place a layer of a material to be tested over the hole and record the sound level twice more. Repeat for other 2 materials.
Repeat the whole experiment with different thickness of the same 3 materials. Make tables and draw graphs of the results.



Part 3 (Procedures, apparatus etc.)

(i) Safety - Ear protection may be worn to prevent damage or annoyance!
Take care cutting the hole in the cardboard box with scissors/scalpel

(ii + iii) Procedure with diagrams - Write it like a recipe
People should be able to read your steps and reproduce your experiment and results.

- Carefully cut a **hole** in the side of your box.
- Place your phone/buzzer in the box and switch on.
- Place your sound meter a set **distance** from the box.
- Record the sound **3** times and write down both results.
- The average of these is your **control** volume.
- Place your first material over the hole and measure the volume. (Repeat 3 times)
- Repeat these steps using each of the two other materials covering the hole.
- Write your results into a table (Table 1) for this **single** layer of materials.
- We will now repeat the testing of the 3 materials again but we will **double** the thickness of the materials being tested.
- Add these results to another table (Table 2).
- Next we can calculate the average volume for each thickness of material and we can also calculate the **difference** of the volume from the control (see Calculations section) and show these results on a graph (see Graphs 1 and 2).



(iv) Data and observations - Decide what results you are going to take and how you are going to take them before starting the test.
e.g. Make sure volume of sound source is always the same and the sound recorder is always facing the same direction and the same distance from the source.

Make a data table before you start your experiment so you can record your measurements as soon as you observe them. This will ensure that you are consistent in the way that you record your results and it will also make it easier to analyse. Make sure to give your tables and graphs a name or number.

e.g.

Table No. 1 - Thin Samples (single)

| | Test 1 | Test 2 | Test 3 | Average |
|-----------------------|--------|--------|--------|---------|
| Cotton Wool (15mm) | | | | |
| Egg Box (10mm) | | | | |
| Bubble Wrap (12mm) | | | | |
| Jumper (5mm) | | | | |

These tables should be written onto the graph paper and labelled.
The average can be calculated under the calculations section.

Difference from the control sample can also be put into table if found to be useful.
You can also compare the samples by individual thickness but here I have kept it as simple as possible.

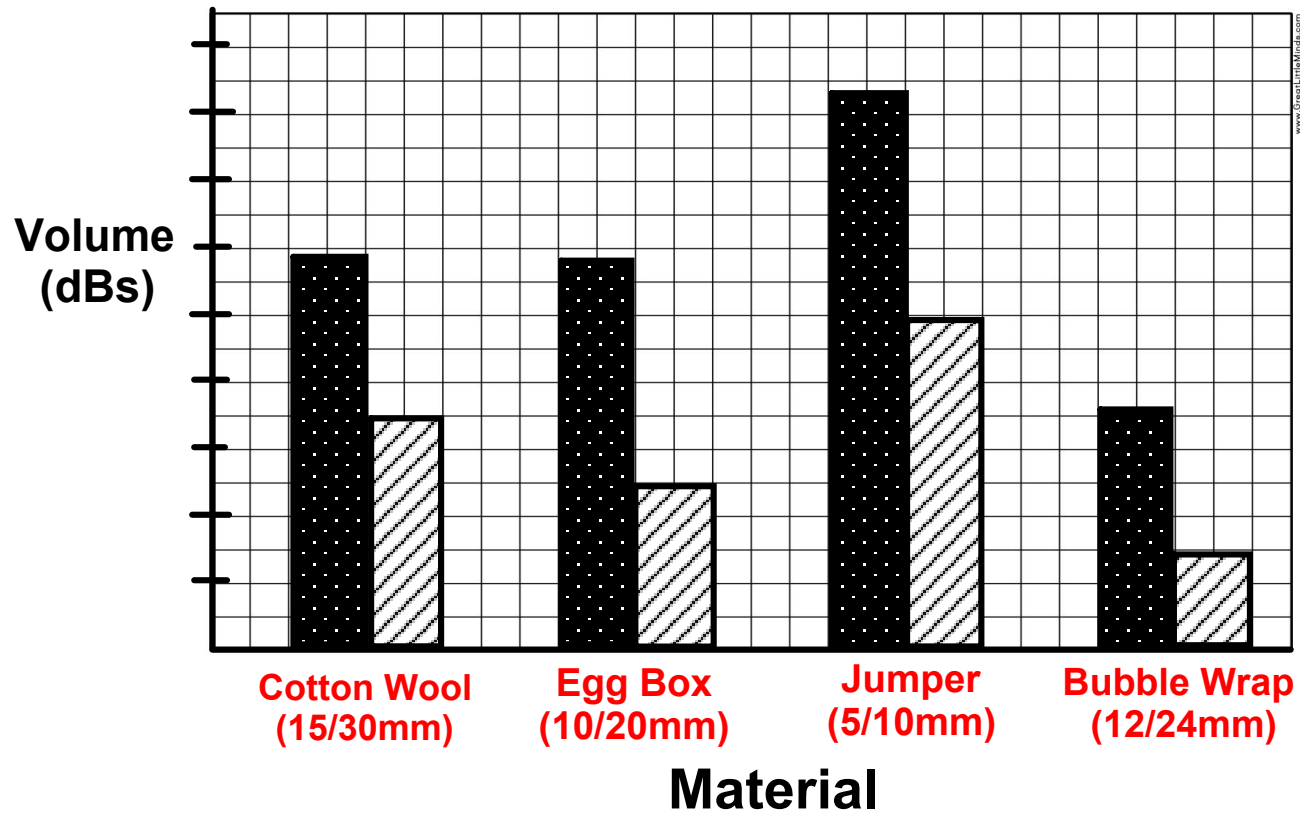
Table No. 2 - Thick Samples (double)

| | Test 1 | Test 2 | Test 3 | Average |
|-----------------------|--------|--------|--------|---------|
| Cotton Wool (30mm) | | | | |
| Egg Box (20mm) | | | | |
| Bubble Wrap (24mm) | | | | |
| Jumper (10mm) | | | | |



** all results are made up.
The dB should have numbers (values)*

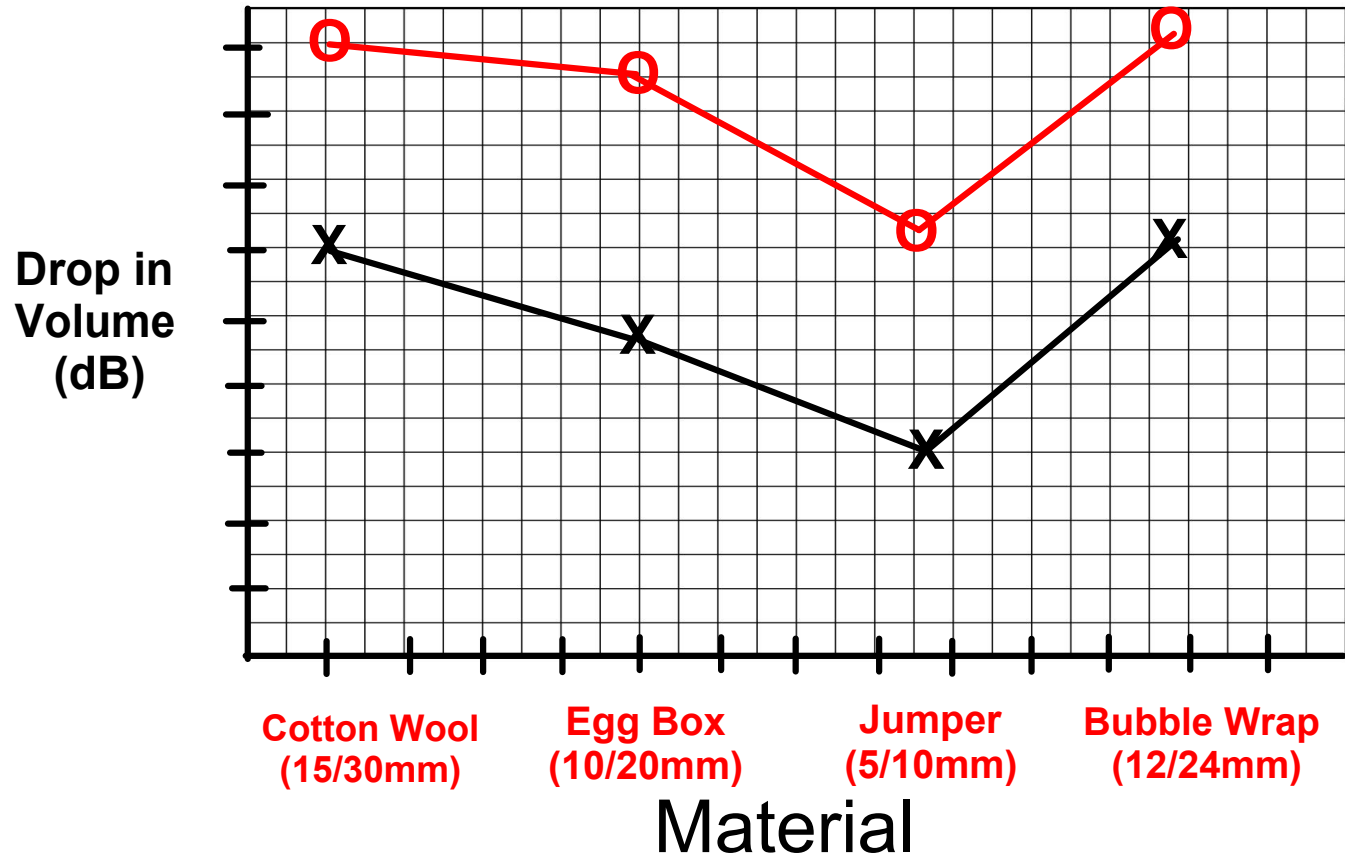
Graph No. 1 - Volume vs Sample Materials.



X = Thin Samples (Single)
O = Thick Samples (Double)

* all results are made up.
The dB should have numbers (values)

Graph No. 2 - Drop in Volume compared to control.



Analysis

Now, analyze your data, and see if you can figure out a correlation between the type of material and their ability to insulate sound.

Questions to think about...

Which material insulates sound better?

Does double the thickness double the insulation?

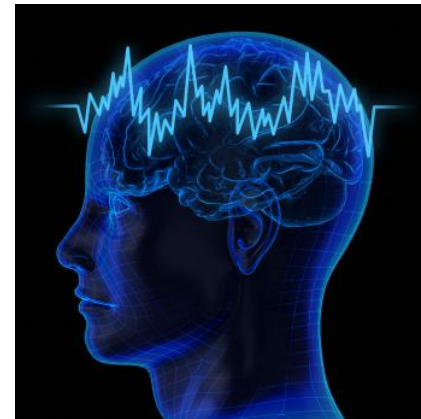
Can you explain your results?

Hint: Think about how much air is in the materials.

Do you think this affects the results?

Do you think other characteristics of the materials, such as their shape, may have also affected the insulation properties?

Can you think of any other questions?



Part 4 (Analysis)

(i) Calculations and Data Analysis -

Make sure you outline any calculations (e.g. finding averages)

- To find the average volume for each material for 2 thicknesses.
- To find the drop in volume compared to the control.



(ii) Conclusion and Evaluation of result

Some useful sentence starters in this section are:

- I can see from my results that
- When I changed, changed by.....
- From the graph I can see that

Answer some of the following questions in your written report.

- Do your results answer the question you were asking at the start?
- Were the results what you were expecting?
- Is there a trend in your results or did anything unusual happen?
- If you got an unusual result why do you think this happened?
- If you drew a graph did you get a straight line or a curve – what does this show?



Part 5 (Comments)

(i) Refinements, extensions and sources of error

- Do your results answer the what you were trying to find out
- Were you surprised by these results?
- Was there anything that might have affected your results.
- Are there any changes you would make if you did the experiment again?
.... for more accurate results.
- Is there any way of making it more accurate - do more repetitions
- Does your investigation have any real life applications.
- Could you develop your experiment further, how?

