Folder: Science P4-7
Topic: 'Energy 2' Sound
Level: C/D

LO11 Sound is produced by vibrations
LO12 Pitch is a measure of the type of sound (high pitch / low pitch)
LO13 Volume is a measure of the loudness of sound
LO14 High volume is a loud sound; low volume is a quiet sound
LO15 Pitch and volume are independent of each other

You will need:
LogIT Explorer datalogger

Experiment 1: String telephone
Source of steady sound, eg buzzer/timer

Experiment 2:
Pitched instrument, eg piano, chime bars

Tip:
A working buzzer from an electricity topic is ideal as a steady sound source for Experiment 1 below.

Background

Firstly, use the datalogger to help make children aware of the variety of sounds in everyday life and how we detect them. If a sound survey is being conducted round the school, the datalogger is ideal for measuring sound volume over time. See ideas for Remote Logging (setting LogIT Explorer to log data away from the computer) in the 'Introduction to datalogging' document, p10 - 11.

The datalogger can then be used in the two experiments below.

Important note

It is NOT necessary for pupils at this stage to understand decibels as a measure of sound. They are simply using the decibel readings to compare different sound levels. However, some pupils may be surprised to notice that when they measure a much louder sound, the scale does not register the large number they were expecting. That is because the decibel scale is logarithmic (ie 93 decibels is twice as loud as 90 decibels).

You can prove this to pupils, IF NECESSARY, by telling them that a typical sound level for a hair dryer is about 80dB, while a jet engine is only 140dB and a rocket launch would measure about 180dB.

Safe sound levels can be brought in here. How loud is safe? (Prolonged exposure to 90dB or more can cause permanent damage).

Experiment 1 – String Telephone
(See Joy Snape's Energy 2 topic, p19-20)

Summary of experiment:
This experiment shows that sound vibrations travel better through solid string than through the air. Pupils should make string telephones and test them out themselves. Observations that pupils have made when using their own senses can then be proved by setting up a fair test and using the datalogger to actually measure whether sound travels better (and therefore the volume of sound increases) through the telephone.
Note: You do not need a computer for this experiment.

Now here's what to do:

Step 1

Discuss the idea of a 'fair test'.

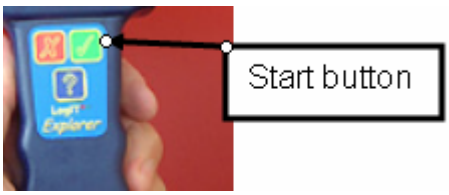
1. To prove that the sound travels better through the telephone, the volume should be measured first without the telephone and then with the telephone.
2. The sound and the datalogger should be the same distance away from each other both times.
3. The sound should be exactly the same each time – an electronic buzzer or timer sound is best.
4. There should be no other loud sounds which may distort the reading

Step 2

Set up the experiment and check that the buzzer is working. First measure the sound without the telephone. Stretch out the phone to find out how far apart the sound source and datalogger should be. Point the datalogger towards the sound.

Step 3

Press the green Start button to switch on the datalogger.



Step 4

Play the sound. You should see the dB number (on the right of the display) change and then become fairly constant. Take a note of the readings.

Step 5

Now set up the experiment again, this time with the sound as close to one end of the telephone as possible, and the sound sensor (on the end of the datalogger) as close as possible to the other end.

Step 6

The datalogger may have turned itself off to save batteries. Turn it on again with the green button.

Make sure the string is taut and nothing is touching it. Play the sound again. Make a note of the readings again. They should be noticeably higher. (If they are not, try re-running the experiment. The most likely problem is that the string is not tight enough or somebody is touching it.)

Experiment 2 – Volume and pitch do not depend on each other
(See Joy Snape's Energy 2 topic, p22-23)

Summary of experiment:
The purpose of this experiment is to show that sounds of the same pitch can be very loud or very quiet. Pupils can use the datalogger to measure the volume of low-pitched and high-pitched notes produced by the same musical instrument (for example the school piano, a guitar or chimebars). They can prove (by taking readings) that, regardless of the pitch, the volume can be changed. A low-pitched sound can be loud or soft, as can a high-pitched sound. As a result of the experiment, pupils should understand that volume is a measure of loudness, not of the type of sound.
Note: You do not need a computer for this experiment. You could just use the datalogger digital display to record readings, as in Experiment 1. However, using a computer gives you access to graphs of the data, which may help to explain the results more clearly.

Now here's what to do:

Step 1

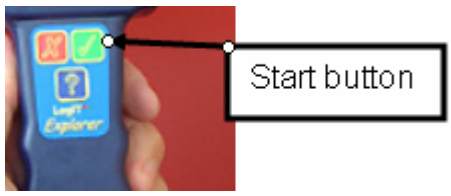
Get the pitched instrument ready (chime bars, piano, etc) and decide which 2 notes you are going to use. One should be high-pitched and one low-pitched. Discuss pitch and explain that now we are going to measure volume, which is independent of pitch. Practise striking the note softly, getting louder each time and then fading away again.

Step 2

Discuss how to make a 'fair test', for example the datalogger should be the same distance away from the sound source each time. The person striking the notes should try to apply the same pressure for the low-pitched and high-pitched notes.

Step 3

Press the green start button to switch on the datalogger



Step 4

Place or hold the datalogger the agreed distance from the low-pitched sound source and **press the green button again** to start datalogging. You will see a message saying "**Logging started**" and a square will flash in the bottom left corner of the digital display. Strike the note several times, getting louder and then getting softer. Then press the red stop button on the datalogger. You will see a message saying "**Logging stopped**".

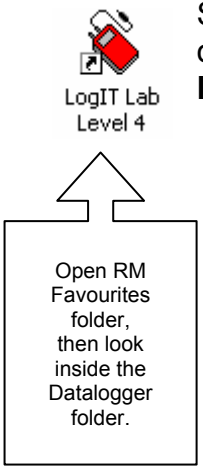
Step 5

You can log up to 4 lots of data on the datalogger at a time, so don't worry that logging more data will wipe out the previous measurements. Move to the high-pitched sound source and follow step 4 again. You now have 2 lots of data on the datalogger, ready to be sent to the computer.

Step 6

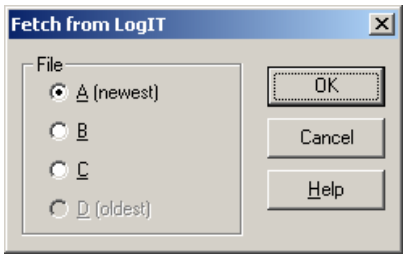
Switch off the datalogger to save batteries. You will need to retrieve the data from the datalogger before anyone else uses it. Connect the datalogger to the computer with the USB cable.

Step 7



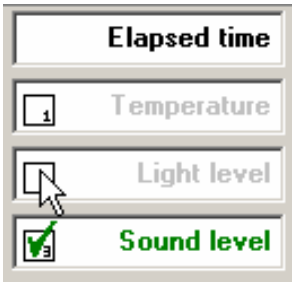
Switch on the datalogger with the green start button. Double click to open LogIT Lab Level 4. **Ask pupils to predict what the graph will look like.** Click the Fetch button.

Step 8



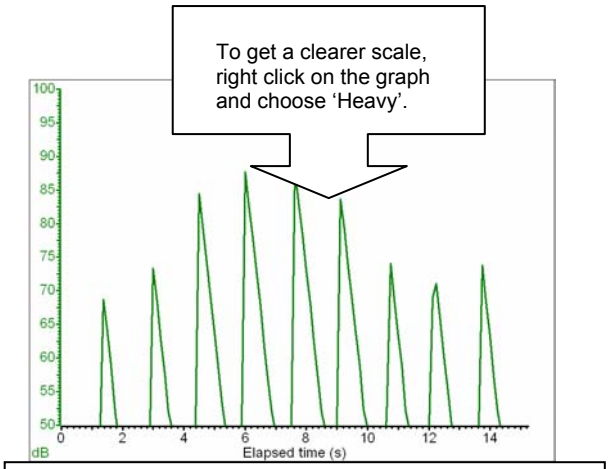
Because you have 2 lots of data saved, LogIT will ask you which one you want to look at first. You will see this screen. If you followed step 4 and 5, the newest (A) will be the high-pitched sound and B will be the low-pitched sound. Click on A and then OK.

Step 9



On the top right of the graph display, click to remove the tick from the light and temperature sensors.

Step 10



High-pitched sound played at different volumes

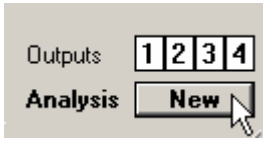
Now the graph will only display the sound data. Analyse the graph, which may look something like this:

Pupils should be able to see that the same high-pitched note has produced sounds of different volume.

If you want to keep this graph, you will need to do so before fetching the next lot of saved data. Either:

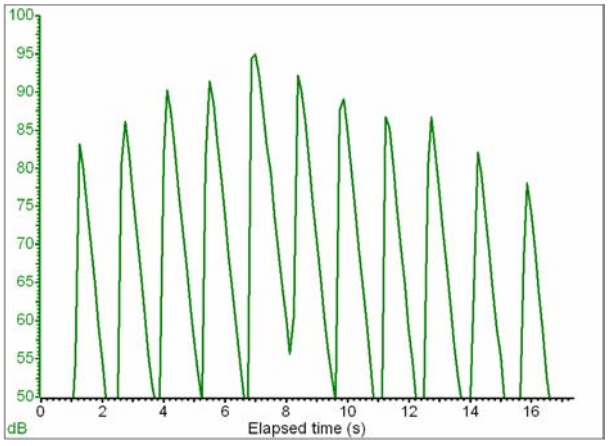
1. Print out the graph OR
2. Copy the graph, using the Edit menu – Copy Graph. Paste the graph into Word

Step 11



Now you need to retrieve the data from the low-pitched sound. Click on the New button at the bottom of the window, then click Fetch and follow steps 8-10 again, remembering to tell LogIT to fetch sound B this time.

The second graph should look remarkably similar to the first.



Low-pitched sound played at different volumes

Pupils should be able to see that the same low-pitched note has produced sounds of different volume.

They should also be able to compare the two graphs and see that volume and pitch are independent of each other. Volume is a measure of the loudness of sound and it does not matter whether that sound is low-pitched or high-pitched.

Step 11

This graph can be kept in the same way as in step 10. If the graphs are copied and pasted into Word, pupils can add text boxes to explain what is happening and show understanding of the difference between pitch and volume.