## 9.5 Investigating Sound Waves

## A. Producing Sound

**Aim** to produce sounds from various sources and examine the waves produced.

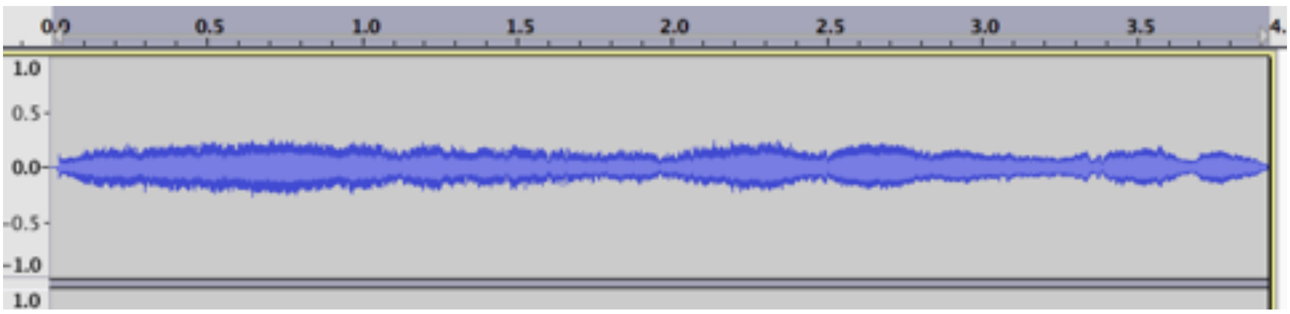
**Equipment**
- wave analysing software (e.g. Audacity, Garage Band, Wavepad)
- microphone and computer/Iphone.

**Instruments**
1. Wind instrument (e.g. whistle, recorder. test tubes)
2. Stringed instrument (e.g. guitar, sonometer or box with wires or nylon)
3. Percussion (drum kit or various tom-toms, sticks or clackers, triangle, tambourine, bells)
4. Tuning forks

**Method**

**1.** Give students some numbered printouts or screen shots of prepared waves from each of the four categories to see if they can match instrument to wave.

e.g. High pitch whistle waveform over 4.0s

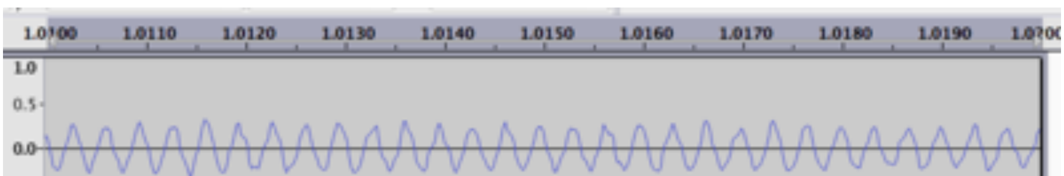



**2.** For each instrument record at least two different pitches if possible or use two different instruments of the same type (e.g. large and small drum)

**3.** Look at the overall waveform for quality (smooth curves) and timbre (repetitive patterns) and record in the results table.

**4.** Measure the average frequency for a small section. You will need to zoom in on the wave graph to see individual waves. (An interval of 1/100th of a second should be sufficient).

*A high pitched whistle zoomed in*




$$Frequency = \frac{1}{Time\ between\ waves}$$

Results Table

| Instruments | Match predicted wave # | Wave form quality | Wave form timbre | Wave frequency (give average or say variable) | Overall Wave patterns - draw sketch |
|---|---|---|---|---|---|
| **Wind 1:** | | | | | |
| **Wind 2:** | | | | | |
| **String 1:** | | | | | |
| **String 2:** | | | | | |
| **Percussion 1:** | | | | | |
| **Percussion 2:** | | | | | |
| **Tuning Fork 1:** | | | | | |
| **Tuning Fork 2** | | | | | |

## Questions

1. Generally are waveforms smooth and repetitive ?
2. Do instruments vary waveforms from one type to another?
3. What ways can you change the pitch on one instrument
4. What instrument had the lowest pitch? Highest pitch?
5. Also try your voice speaking the O sound. How pure was this sound.

**B. Sound Travel**

**Aim To investigate sound travel in solids, liquids and gases.**

**Equipment**
1. desk and ruler
2. bucket and small tin, ruler
3 High brick or concrete wall measuring tape or wheel. Thermometer
3a stopwatch
3b sound sensor and data logging equipment or microphone and audio suite

**Method**
1. **Compare sound in air with sound in a solid:**
   - tap desk lightly with ruler and listen to sound.
   - Lie ear on desk. Plug other ear with finger. Have partner tap desk with ruler. Compare this sound for loudness and pitch.

2. **Compare sound in air with sound in liquid:**
   - tap tin and listen to sound in air
   - put tin in a bucket of water. Now tap and listen with your ear underwater. Compare this sound for loudness and pitch.

**3 Measure speed of sound in air using clappers**
You need to be outside in a quiet area near a high wall. If you can hear the echo of two bits of wood clapped together from about 10m away, y

**Method A using synchronised clapping**
- Clap your hands so the clap corresponds with the echo of your previous clap.
- Get your partner to measure the time (T) for 10 claps.
  Q. How do you use this time(T) to find the time for a wave to travel there and back (t)
- use the formula speed = distance/ time (the distance will be twice your distance from the wall)

**Method B using a sound sensor or microphone and graph**
- Clap your hands every second for 10 seconds.
- Have partner using software with the sensor that plots the graph in real time (or use a microphone and a computer with audio software like audacity)
- On the graph look for a small peak between each pair of large ones. The time between small and large peak is the time for the sound to travel to the wall and back.
- Again use the formula speed = distance/ time (the distance will be twice your distance from the wall)

**Results**

| | listening medium | Loudness | Pitch |
|---|---|---|---|
| **Exp 1. tapping desk** | air | | |
| | solid- | | |
| **Exp 2. tapping tin** | air | | |
| | water | | |

| | Distance to wall | Time between clap and echo | Speed |
|---|---|---|---|
| **Exp 3A Synchronised Clap** | | | |
| **Exp 3B Graph measurement** | | | |
| **Air Temp** | | | |

**Questions**

1. **Compare air, water and solids for loudness and quality of sound.**

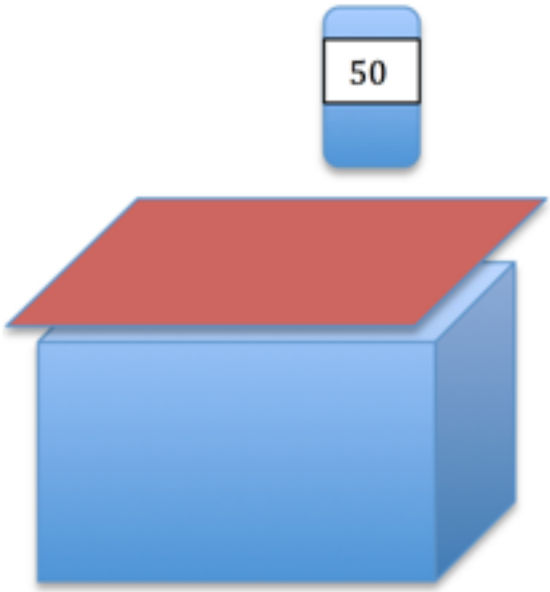
**2. How close to actual speed of sound did you get?**

Speed of sound in air:

V= 331 + 0.6T (V = velocity, T= temperature of air in degrees celsius)

**C. Sound Absorption**

**Aim Compare materials for sound transmission vs sound absorption**




**Equipment**

- an open plywood or thick cardboard box. (you can line it with further material if you want)
- various solids of even thickness large enough to cover the box ( wood, plastic, glass and metal)
- sound generator e.g. electric bell, siren or mobile phone ringer tone
- sound level (Decibel) meter

**Method**

1. First measure the sound level of the generator through air (put generator into the box without a cover) at a distance equal to the height of the box. Record level.
2. Now cover the box with your first material.
3. When ready turn on the sound generator in the box and measure the sound just above the material (not touching!!)

Results

| Material | Sound level |
|---|---|
| **Air** | |
| | |
| | |
| | |
| | |

Questions

1. What material is the greatest absorber of sound?
2. What material is the greatest transmitter of sound?
3. What other factors might affect this?