Instruments

No.	Accessory	Qty	No.	Accessory	Qty
1	Soft spring	1	2	Flat spring	1
3	Wave driver	1	4	Pulley attached to a rod	1
5	C-clamp	1	6	Styrofoam ball and bracket	1
7	Metal base	1	8	Mallet	1
9	Tuning fork	2	10	Resonance box	2
11	Sonometer	1	12	Air-vibration tube	1
13	Slide whistle	1	14	Resonance tube stand	1
15	Test tube	6	16	Sound generator	1
17	Vacuum pressurized cabin	1	18	Pump	1
19	Silicone tube	1	20	Thermometer	1
21	Balloon	2	22	Hammer	1
23	Talkie tapes	2	24	Candle	1
25	Mass 5g	2	26	String	1
27	Power supply	1			

				
1	**2**	**3**	**4**	**5**
				
6	**7**	**8**	**9**	**10**
				
11	**12**	**13**	**14**	**15**

				
16	**17**	**18**	**19**	**20**
				
21	**22**	**23**	**24**	**25**
				
26	**27**			

Experiment I. Propagation of transverse and longitudinal waves

Purpose

Observe the difference between transverse and longitudinal waves and their propagation.

Instruments

No.	Accessory	Qty	No.	Accessory	Qty
1	Soft spring	1	2	Flat spring	1

Theory

Why do we hear the thunder in raining days? How do we hear the calling of our friends? Sound travels in the form of wave to our ears. In nature, there is a great amount of energy (sound, light and etc.) travel in the form of wave. According to the travelling direction and propagation, we can classify waves into two types.

Transverse Wave：A moving wave consists of oscillations occurring perpendicular to the direction of energy transfer. A transverse wave is also called shear wave.

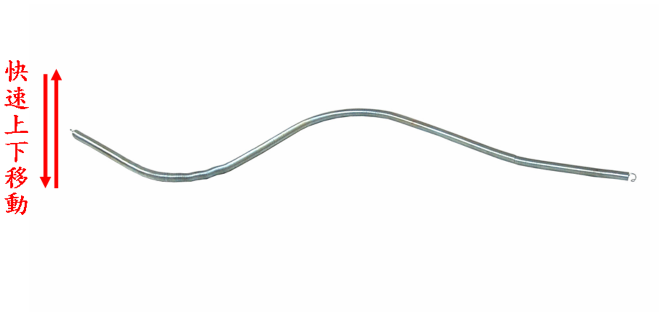
Longitudinal Wave：A wave in which the displacement of the medium is in the same direction as the direction of travel of the wave. A longitudinal wave is also called pressure wave or condensation and rarefaction wave.

In the experiment, we use springs to demonstrate and observe the propagation of transverse wave and longitudinal waves.

Procedure

1. Put the soft spring on the table and move one side of the spring up and down quickly. Observe the waveform of the spring, as shown in **Figure 1**.

2. Put the flat spring on the table and move one side of the spring back and forth quickly. Observe the waveform of the spring, as shown in **Figure 2**.



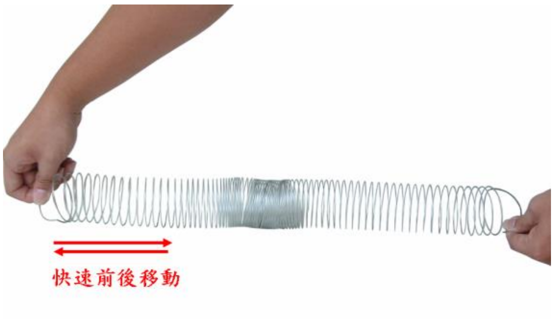


Figure1 **Figure 2**

Questions and discussions

1. Draw figures of longitudinal wave and transverse wave.

2. Based on this experiment, list examples of longitudinal wave and transverse wave from your experience.

Experiment II. Resonance of tuning forks

Purpose

Understand the theory and phenomenon of vibrating tuning forks producing sound.

Instruments

No.	Accessory	Qty	No.	Accessory	Qty
8	Mallet	1	9	Tuning fork	2
10	Resonance box	2			

Theory

When substances oscillate, they produce sounds. If we strike a tuning fork, it oscillates and produces sound. When putting a vibrating tuning fork on the resonance box, the box will vibrate and produce sound. When the sound travels to same-frequency tuning forks and resonance boxes, these forks and boxes will also vibrate and produce sounds. This demonstrates that energy (sound) can propagate through objects with same frequency.

Procedure

1. Mount tuning forks on the resonance boxes, as shown in **Figure 3**.

2. Face resonance boxes close end to close end, as shown in **Figure 4**. Strike tuning fork A with a tuning fork and observe tuning fork B and its resonance box.

Figure 3

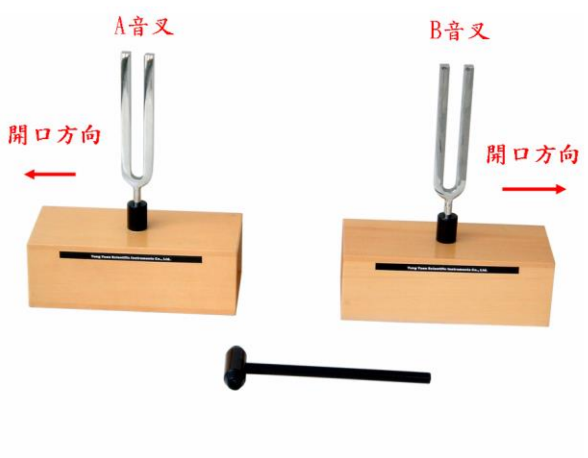


Figure4

3. Face the close end to the open end and repeat procedure 2.

4. Face the open end to the open end and repeat procedure 2.

Questions and discussions

1. Record the vibrating phenomenon of tuning fork B and its resonance box of three different positions.

2. Discuss resonance examples in our daily life.

Experiment III. Resonance experiment of air column and strings

Purpose

Understand different amplitudes and frequencies will result in different phenomena of sound.

Instruments

No.	Accessory	Qty	No.	Accessory	Qty
10	Resonance box	1	11	Sonometer	1
13	Slide whistle	1	14	Resonance tube stand	1
15	Test tube	6			

Theory

Sound is produced by the oscillation of objects. Take guitars as an example. By strumming strings of guitar, the guitar produces sound. The strumming strength, the length and tightness of strings result in different sounds of guitar. There are three main factors that influence the change of sound:

1. Pitch: Pitch is the high or low of sound. It is relevant to the oscillation speed which is the frequency of the object. Its unit is hertz (Hz).

2. Loudness: The loudness of an object is related to it vibration amplitude. When we strum the guitar string hard, the vibration amplitude of strings is large so the sound is large and vice versa. We use decibel (dB) to measure the loudness of sound. The greater the sound, the greater the number of dB. Every additional 10 dB means the sound is ten times louder than the previous sound.

3. Timber (tone color): Timber is the characteristic of objects producing sound. It is determined by the waveform of the object. The main reason that we are able to distinguish the voice of different people is because the timber of everyone is different. Different musical instruments have different timbers so they can produce their unique sound.

In the experiment, we will use sonometer and the movable plane to change the strumming strength, the length and tightness of strings to verify above theory. We will then fill six tubes with different water amount. Blow at the open end of tubes to observe their frequencies. Change the length of slide whistle to observe the relationship between length of air column and frequency of sound.

Procedure

1. Adjust the sonometer so the tightness of two strings are different. Strum the strings with same strength and observe their frequencies, as shown in **Figure 5**.

2. Use the movable plane to adjust the length of strings. Strum strings with same strength and observe their frequencies, as shown in **Figure 6**.

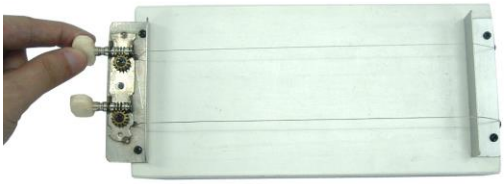


Figure 5

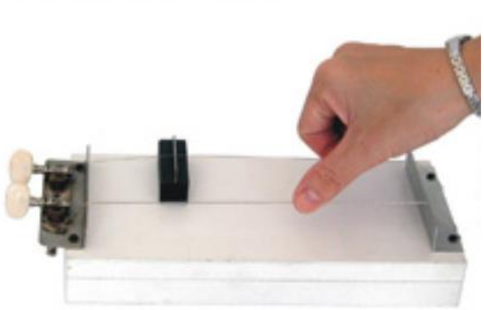


Figure 6

3. Choose one string on the sonometer and strum it with different strengths. Observe the change of sound.

4. Place six tubes on the resonance tube stand. Fill tubes with different water amount, as shown in **Figure 7**. Blow at the open end of tubes and observe their frequencies.

5. Change the length of slide whistle and observe the relationship between air column and frequency, as shown in **Figure 8**.

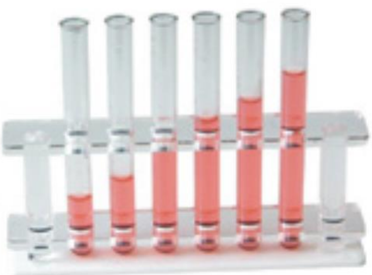


Figure 7

Figure 8