Waves Basics

Waves transfer energy

- Waves transfer **energy without** transferring **matter**
- **Example**: For sound waves, this means it is the **wave** and not the **air molecules** (the matter) itself that travels.
- Objects floating on water is the best way to show that waves only transfer energy and **not** matter. It is possible to see objects on the surface of the water bob up and down but not change their position. Because the **wave** and not the **water** (the matter) itself that travels.
- Waves are

" Oscillations or vibrations about a fixed point"

- **For example, ripples** cause particles of water to oscillate up and down.**Sound** waves cause particles of air to vibrate back and forth

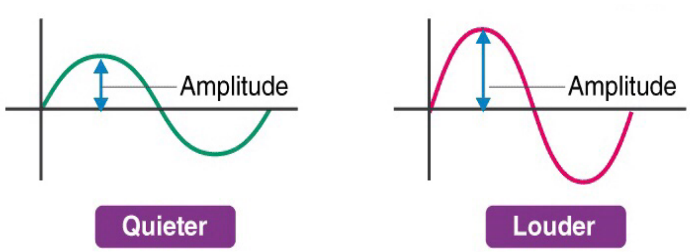
Properties of Waves

When describing wave motion, there are several terms which are important to know, including:

1. Wavelength
2. Frequency
3. Crest (peak)and Trough
4. Amplitude
5. Wave speed

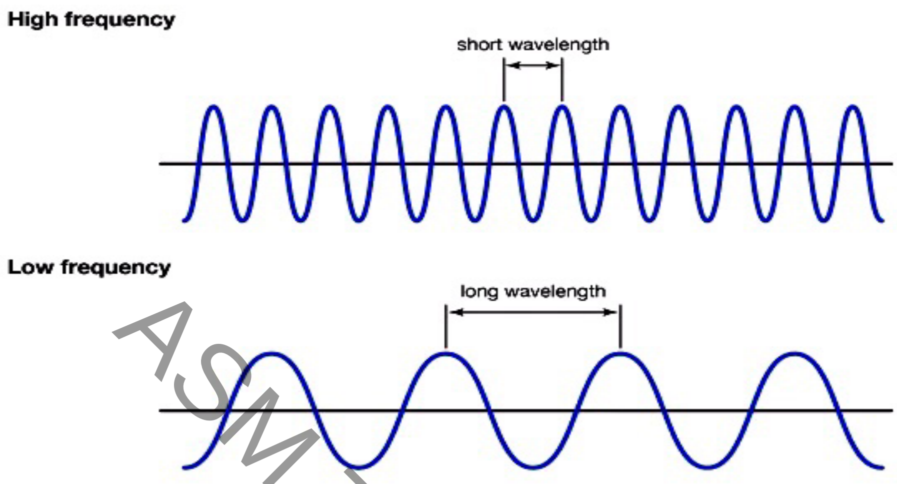
1. Amplitude

- The **amplitude** of a wave is the distance from the midpoint of the wave all the way to the crest of the wave.
- Alternatively, the amplitude of a wave can be measured as the distance from the midpoint of the wave all the way to the trough of the wave.
- The amplitude of a wave is the **maximum displacement** (crest or trough) of a point on a wave away from its undisturbed position (the midpoint).



2. Frequency

The **frequency** can be measured by looking at how many complete waves go past a certain point in one second. It is measured in Hertz, Hz.



3. Period

- The **'period'** of a wave is more commonly known as the '**time period**'. This is the amount of time it takes for a complete wave to occur.

- **Calculate the Frequency and Time Period**

We can calculate frequency of waves using the following formula.

$$\text{Period} = 1 / \text{frequency}$$

$$T = 1/f$$

Where:

- **period**, T, in seconds, **s**
- **frequency**, f, in hertz, **Hz**

Question: A sound wave has a time period of 0.005 seconds. What is its frequency?

Solution:

Time period= 0.005 sec so the Formula is

$$T = 1/f$$

$$f = 1 \div T$$
$$f = 1 \div 0.005\ s$$
$$f = 200\ Hz$$

4. Wave Speed

- Wave speed tells us how fast the wave is moving. It also tells us how fast energy is being transferred through a substance.

- **Formula for Wave Speed**

We can calculate speed of waves using the following formula.

$$\boxed{\text{Wave speed} = \text{frequency} \times \text{wavelength}}$$

$$\boxed{v = f\,\lambda}$$

Where:

- **wave speed**, v, in meters per second, **m/s**
- **frequency**, f, in hertz, **Hz**
- **wavelength**, λ, in meters, **m**

Question: What is the speed of a wave with a frequency of 50 Hz and a wavelength of 2m?

Solution :

Equation for wave speed is

$$v = f\lambda$$

put the values in formula

$$v = 50 \times 2$$
$$v = 100\ m/s$$

5. Wavelength

- Wavelength is defined as:

"The distance from one point on the wave to the same point on the next wave"

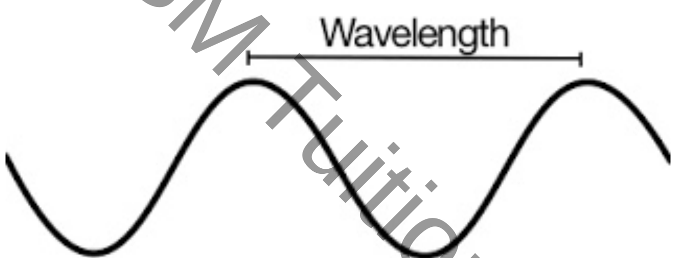
- **In a transverse wave:**

The wavelength can be measured from one peak to the next peak

- **In a longitudinal wave**

The wavelength can be measured from the centre of one compression to the centre of the next

- The wavelength is given the symbol λ (lambda) and is measured in **metres (m)**



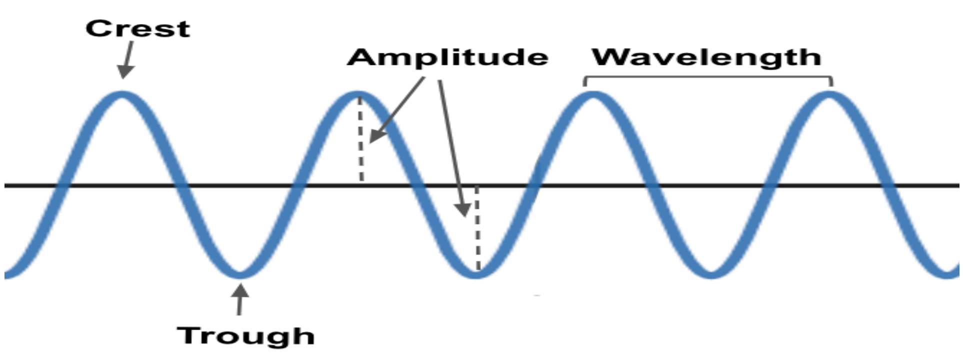
6. Crests & troughs

- A crest, or a peak, is defined as:

"The highest point on a wave above the equilibrium, or rest position"

- A trough is defined as

"The lowest point on a wave below the equilibrium, or rest, position"



Types of Waves

➤ There are 2 types of waves

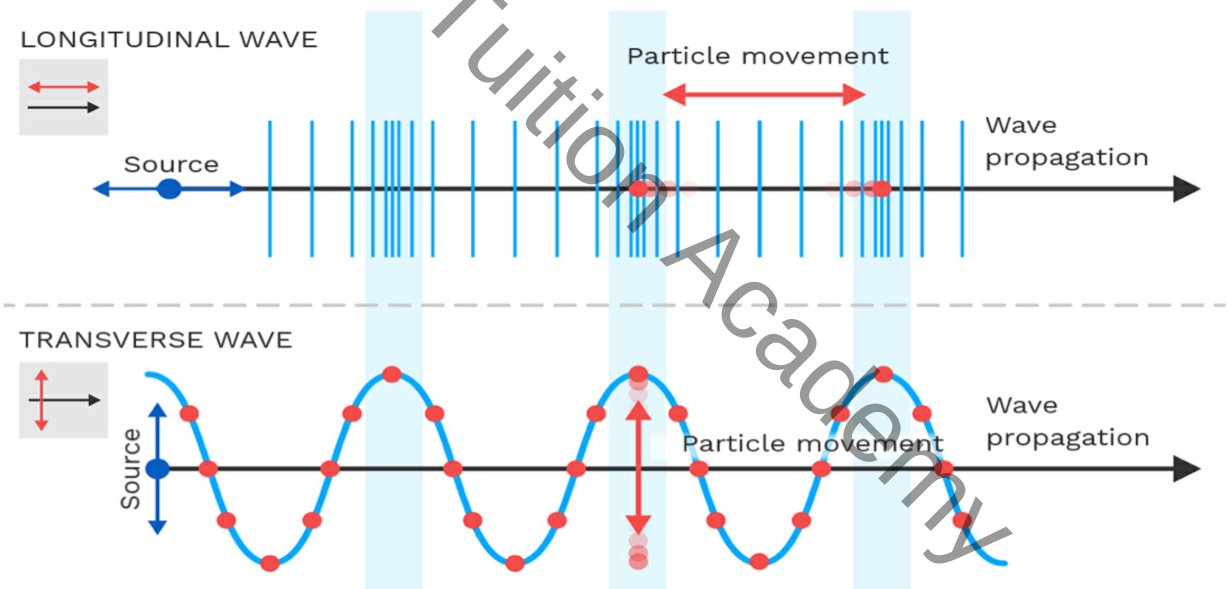
1. Transverse waves
2. Longitudinal waves

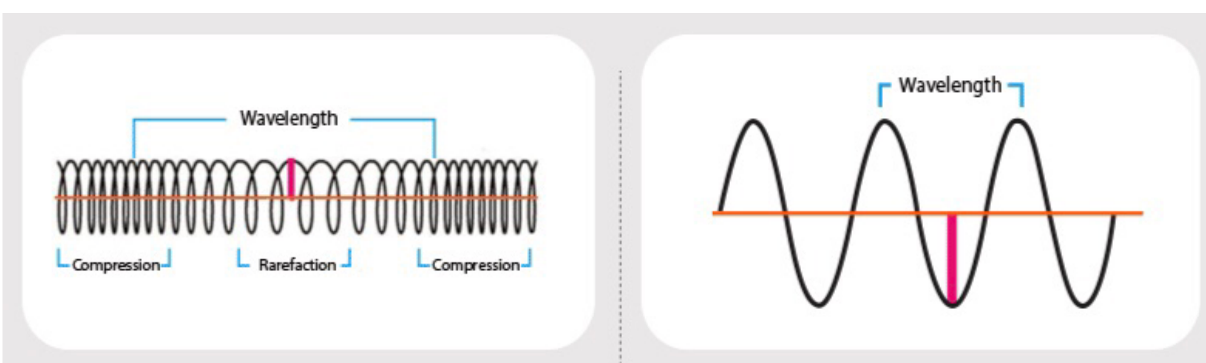
1. **Transverse waves:**

   In transverse waves, the vibrations are at right angles to the direction of wave travel.

2. **Longitudinal Waves:**

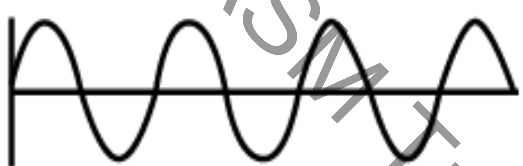
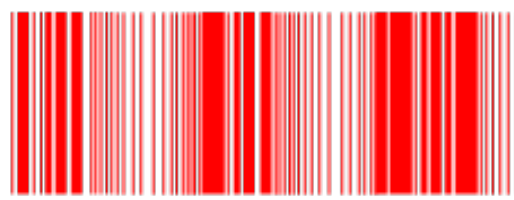
   In longitudinal waves, the vibrations are parallel to the direction of wave travel.





- To remember these oscillations, use the letters **'t'** and **'l'**. If a wave is transverse, remember the letter 't', since the direction of the wave is perpendicular to the oscillation.
- If a wave is longitudinal, remember the letter 'l', since the direction of the wave is parallel to the oscillation. Let's look at the following diagram.

Difference between Transverse and longitudinal waves

Transverse waves	Longitudinal waves
1. 	1. 
2. Particles vibrate in a direction perpendicular to the direction of propagation of the wave.	2. Particles vibrate in a direction parallel to the direction of propagation of the wave.
3. Crests and troughs are formed	3. Compression and rarefa-cations are formed.
4. Formed on the surface of solids and liquids	4. Formed in solids,liquids and gas
5. May be elastic waves or non elastic waves eg.light wave,radio wave	5. Only elastic waves (mechanical)eg.sound wave,seismic wave.
6. Do not create pressure difference in the medium	6. Creates pressure difference in the medium