Waves

4. Wave Properties

CONCEPT 3

LESSON GUIDE

WAVE SPEED

PRECISE LEARNING POINTS

KNOW

I know that speed is the distance covered by a moving object in a certain time (same as 1.1.1).

APPLY

I can apply my knowledge of speed to the motion of waves.

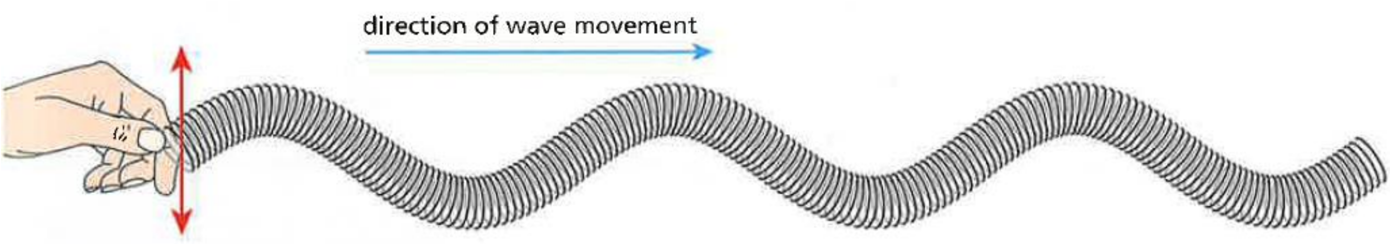
EXTEND

I can extend my knowledge to calculate the speed of a wave.

NOTES

A property of a wave is **wave speed**. This is how much distance a point of a wave will travel in a given time.

If we look at a transverse wave on a slinky as an example we see the a waggle up and down produces a crest and a trough. This oscillation travels along the length of the slinky.



If you were to measure the distance one of these crests travelled in one second then you could calculate the speed of the wave. It is how quickly the oscillation travels.

The equation for speed is

speed = distance ÷ time or **v = d ÷ t**

A perfect illustration of this is to consider thunder and lightning. During a storm a spark of lightning strikes. The noise that the lightning makes as it strikes is the thunder clap. So both the flash and the bang happen at the same time. The flash travels towards our eyes as light waves with large amplitude – it is very bright! The bang travels towards our ears with large amplitude – it is very loud!

The transverse wave of light travels at around 300 000 000 metres per second through the air.

The longitudinal wave of sound travels at around 340 metres per second through the air.

If we were right next to the lightning strike we would not notice a delay between seeing the flash and hearing the sound.

If we were at a distance of around 1 km (1000m) then we would notice a delay between seeing the flash and hearing the bang.

But, just how long is the delay?

We can rearrange the equation above to calculate the time it takes for each wave to travel to us.

Lightning:	time	=	1000 ÷ 300 000 000
		=	0.0000033 seconds
Thunder	time	=	1000 ÷ 340
		=	2.94 seconds

The time is so short for the flash to get to our eyes that we perceive it as happening instantly. But, the sound will reach us 2.94 second later.

If we were 3km (3000m) from the lightning strike then:

Lightning:	time	=	3000 ÷ 300 000 000
		=	0.00001 seconds
Thunder	time	=	3000 ÷ 340
		=	8.82 seconds

We assume that even for large distances that light will reach us instantly because light waves travel so quickly. But as you can see, because sounds waves travel almost one million times slower than light waves, that there is a delay, between seeing the flash and hearing the thunder, that increases with distance from the lightning strike.