Teacher and Technician Sheet

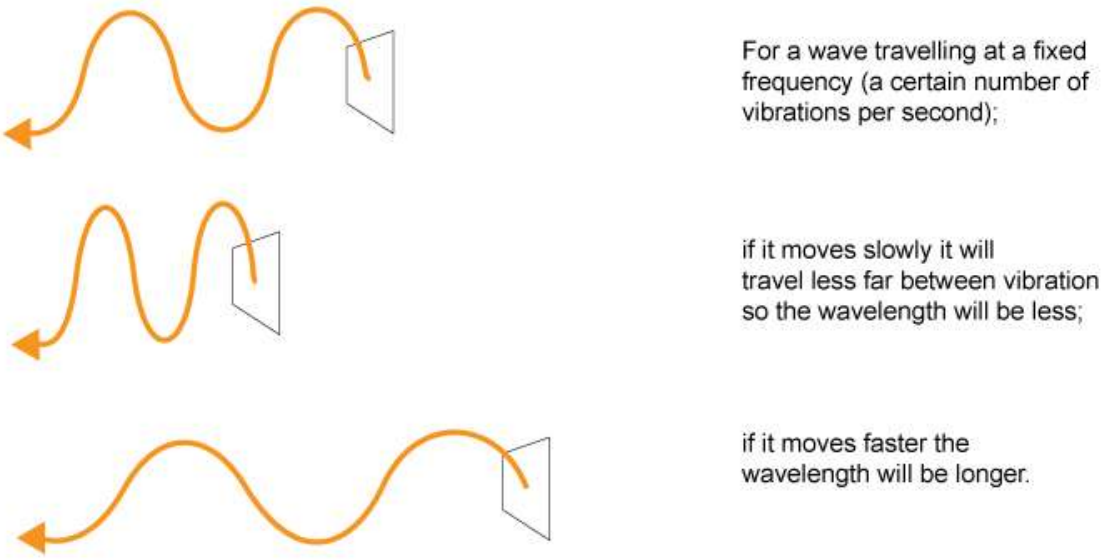
In this practical students will:

- Carefully measure and record the findings of the experiment.
- Calculate the speed of light using recordings of their experiment.
- Analyse the method for the experiment in order to improve the accuracy of calculated value.

Introduction:

Most homes have a **microwave oven**. Students will be very aware of them for cooking. However, they can also be used as a science instrument to gain some measure of the **speed of light**.

A microwave oven works by producing microwaves, which are a type of **electromagnetic wave** just like radio waves, infrared or visible light. A wave has a **peak** and a **trough**.

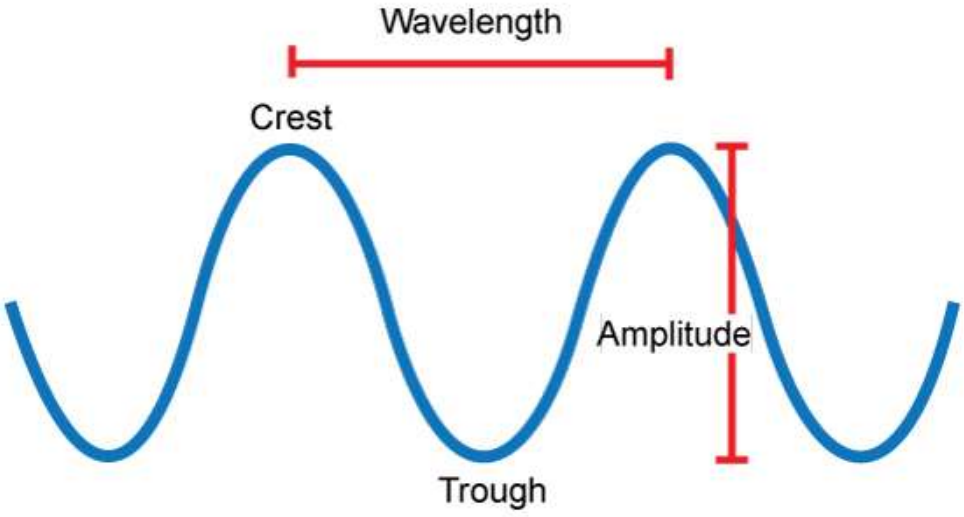


What this means in terms of **energy** can be discussed with the help of a diagram, similar to the one below. At the same time you can introduce the students to the terms **amplitude, wavelength,** and **frequency.**

Amplitude is the maximum distance the material through which a wave travels moves away from its rest position. The higher the wave moves up-and-down as it vibrates, the larger the amplitude of the resulting waves.

The distance between two consecutive (one after another) crests or troughs of a wave is called the **wavelength (λ)**. The wavelength can be measured from any point on a wave as long as it is measured to the same point on the next wave.

The number of complete waves, or complete cycles, per unit of time is called the ***frequency***. Because every complete wave has one crest and one trough, you can think of the frequency as the number of crests or troughs produced per unit time. The unit used to measure wave frequency is called the hertz (Hz). The frequency of a wave depends on the frequency at which its source is vibrating.



Curriculum range:

This activity is designed for secondary age students investigating light and waves. It links with:

- reporting on findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions;
- using simple mathematics to calculate a physical quantity;
- using straightforward scientific evidence to answer questions or to support their findings; and
- building a more systematic understanding of materials by exploring and comparing the properties of a broad range of materials;

Going further:

Discuss why the microwave oven needs to have a rotating base. Discuss if one result is enough and how could you improve the accuracy of your result.

Hazard warnings:

Make sure there is no metal on the bread when put into the microwave oven and be careful of the butter or margarine since it can get very hot.

An alternative to bread and butter is to use a large flat square of chocolate. Again there is a lot of heat and the molten chocolate can be difficult to remove from the microwave.

Take care when moving the microwave oven around.

Equipment:

- Access to a microwave oven
- 1 large plate or shallow bowl
- 1 flat, non-metal plate or board
- 4 approximately equally thick slices of bread from a rectangular loaf
- A knob of butter or margarine
- 1 dinner knife
- 1 ruler (30 cm long)
- Calculator
- Paper towelling

Technical notes:

This is works well as a home experiment, but as a school experiment it's restricted by access to an available microwave oven. It is therefore reasonable to suppose that it would be carried out only as a demonstration in a school lab.

This experiment is easy to set up and carry out, even if it can get a little messy.

It may take a few attempts to get the timing right. I obtained another result from the same bread by buttering the other side (once it was room temperature) and using it again. The results were the same.

It's clear to see melted and non-melted parts on the bread although it isn't too clear where to measure, with different possible parts measuring a different amount.

It is difficult to get the results accurately to the actual speed of light so this would probably have to be discussed with the students'. The discussion would be about where we could

measure from and too, how many samples we would need to carry out to get a set of results and how we could get an average result from the samples.

The results allow a good visual representation to consolidate the notes on how a microwave oven works.