Demonstrating wave phenomena – transcript

Waves are an oscillation (regular movement back and forth) which transfers energy through a medium.

How waves are affected as they move will be demonstrated in this experiment.

Waves can be represented in many ways. In this example a spring has be used to demonstrate their different properties.

Here energy is being transferred from the left hand to the right. This causes the spring to bunch together in places and then spread out.

Although energy is being transferred along the length of the spring, each individual loop is just moving backwards and forwards. This back and forward motion is called an oscillation.

The number of oscillations that happen in a specific time is called the frequency.

Frequency is the number of waves that pass a point every second and is measured in Hertz.

If one wave passes in a second, the frequency is one Hertz.

The speed of a wave can be calculated using the equation speed = frequency times wavelength.

Where waves cluster, this is called compression.

Where they spread out, this is called rarefaction.

The distance between two successive compressions or two successive rarefactions is called the wavelength.

The distance a point moves on the wave from its position of rest is called the amplitude.

The larger the amplitude, the more energy the wave has.

When the energy transfer is parallel to the direction of oscillation this is called a longitudinal wave.

In this case energy is still being transferred from left to right.

However, each individual loop in the spring is moving perpendicular to the direction of energy. This is called a transverse wave.

The distance between two successive peaks or two successive troughs is called the wavelength.

The amplitude is the distance from equilibrium (the middle point) to a peak or a trough. When this distance is short, the wave is described as having a small amplitude.

Notice that as the number of oscillations increase, so does the amplitude.

As with the longitudinal wave, the number of waves that pass a fixed point in a second is called the frequency.

If one peak passed a point in one second this would be one hertz. If two passed in one second the frequency would be two hertz etc.

Note the differences and similarities between longitudinal and transverse waves.

In a longitudinal wave, the oscillations are parallel to the energy transfer.

In a transverse wave, the oscillations are perpendicular to the energy transfer.

Light is another example of a transverse wave. We can show how waves are reflected by a plane surface by showing how light is reflected by a mirror.

The light ray coming towards the mirror is called the incident ray. The angle this ray meets the normal is called the angle of incidence. It is shown by the letter i. The angle that the ray is reflected from the mirror, away from the normal, is the angle of reflection. The ray leaving the mirror is called the reflected ray. The angle of incidence and the angle of reflection are always equal.

No matter how the ray box is moved the angle of incidence always equals the angle of reflection.

This is called the law of reflection. Angle of incidence = Angle of reflection.

Waves are slowed when they travel through different substances. As the light ray travels through the glass block, the path it was travelling on changes. The light ray is bent at the boundary of the two substances. This is called refraction. It is caused because the light ray travels more slowly in glass, which is more dense than air.

If the angle of the incident ray and the refracted ray are measured it is clear they are different. The refracted angle is smaller. This shows that when light waves travel from a less dense medium such as air to a more dense medium, such as glass, the light is bent towards the normal.

When the light ray goes from the more dense medium to the less dense medium it then bends away from the normal.

Another wave phenomenon is called diffraction. This is the spreading out of waves. Here the water waves spread out in arcs as they pass through the gap.

As the gap widens, less diffraction takes place.

When the gap between the wavefronts is smaller than the gap the waves are passing through, not much diffraction takes place.

Now the distance between the wavefronts is closer to the width of the gap. This causes greater diffraction.

Waves also diffract when they meet the edge of a surface. How much they diffract is controlled by the wavelength and the width of the object the waves encounter.

As before, when the wavelength increases, so too does the amount of diffraction.

Examples of waves are all around us. For example, the waves we see in the open ocean are examples of transverse waves. The water moves up and down while the energy of the water is transferred towards the land.

Sound waves are examples of longitudinal waves. Energy is given to the air particles by your voice. The air particles transfer energy to their neighbours and energy moves in the same direction as the oscillation.

What other examples of waves have you observed?