Waves

Key stage 4 science

Lesson plan

Learning outcome: I can describe wave motion using amplitude, wavelength, frequency, and period.

Learning cycles

1. Identify and define amplitude, wavelength, frequency, and period of waves
2. Explain how these parameters affect wave motion
3. Apply these concepts to solve problems involving wave motion

Key learning points

1. Amplitude is the maximum displacement of a wave from its rest position
2. Wavelength is the distance between consecutive points of the same phase on a wave
3. Frequency is the number of waves passing a point per second
4. Period is the time taken for one complete wave to pass a point

Misconceptions & common errors

1. Waves transfer energy through a medium without moving the matter itself. Demonstrate this using a slinky or water waves.
2. Explain that electromagnetic waves do not require a medium and can travel through a vacuum.
3. Clarify that amplitude does not affect the speed of a wave; speed is determined by the medium and type of wave.

Suggested prior knowledge

Basic understanding of energy transfer
Knowledge of the electromagnetic spectrum
Familiarity with wave concepts such as frequency and amplitude

Keywords

amplitude	the maximum displacement from the rest position in a wave
wavelength	the distance between two consecutive points in phase on a wave
frequency	the number of waves that pass a point in one second
period	the time taken for one complete wave to pass a point
medium	the substance through which a wave travels

Prior knowledge starter quiz

1. What is the basic form of energy waves transfer?
   A. Energy ✓
   B. Mass
   C. Volume

2. Which part of the electromagnetic spectrum is visible to the human eye?
   A. Infrared
   B. Ultraviolet
   C. Visible light ✓

3. What is frequency measured in?
   A. Hertz (Hz) ✓
   B. Joules
   C. Seconds

4. What does amplitude measure in a wave?
   A. Distance between wave peaks
   B. Maximum displacement from rest position ✓
   C. Speed of the wave

5. How is wavelength defined in wave terms?
   A. Distance between consecutive points of the same phase ✓
   B. Number of waves per second
   C. Time for one complete wave

6. What is the role of a medium in wave propagation?
   A. Substance through which a wave travels ✓
   B. The direction of a wave
   C. The speed of a wave

Learning cycles

Explanation	Checks for understanding	Practice	Feedback
Identifying and defining wave parameters			
* Introduce the concept of wave parameters: amplitude, wavelength, frequency, and period. * Explain amplitude as the maximum displacement from the rest position, using diagrams of transverse and longitudinal waves. * Define wavelength as the distance between two consecutive points that are in phase on a wave. * Discuss frequency as the number of waves passing a point per second, measured in Hertz. * Clarify the period as the time taken for one complete wave cycle to pass a given point. * Use visual aids to demonstrate these concepts,	What does amplitude represent in a wave? A. The distance between wave peaks B. The maximum displacement from rest position ✓ C. The speed of the wave How is frequency measured? A. In Hertz (Hz) ✓ B. In Joules C. In Seconds	Label a diagram of a transverse wave with the terms amplitude, wavelength, frequency, and period. Then, calculate the frequency if 10 waves pass a point in 2 seconds.	Model answer: Amplitude is the height of the wave crest, wavelength is the distance between two consecutive crests, frequency is 5 Hz (10 waves/2 seconds), and period is 0.2 seconds (1/frequency).

such as wave diagrams and animations.

Explaining the effect of wave parameters on wave motion

* Discuss how amplitude affects the energy carried by a wave; higher amplitude means more energy.

* Explain that wavelength affects the wave's speed; longer wavelengths travel slower in certain mediums.

* Describe how frequency relates to energy; higher frequency waves carry more energy.

* Clarify that period is inversely related to frequency; shorter periods mean higher frequencies.

* Use visual examples of sound waves and water waves to illustrate these effects.

What happens to energy when amplitude increases?

A. The frequency decreases
B. The wave carries more energy ✓
C. The wave travels faster

How does wavelength affect wave speed in a medium?

A. Longer wavelengths always travel faster
B. Longer wavelengths travel slower ✓
C. Wavelength has no effect on speed

Analyse a set of wave diagrams showing different amplitudes and wavelengths. Determine which waves carry the most energy and which travel the fastest.

Model answer: Waves with higher amplitude carry more energy. Longer wavelengths typically travel slower in a given medium, affecting the wave's speed.

Applying wave concepts to solve problems

* Discuss how amplitude affects the energy carried by a wave; higher amplitude means more energy. * Explain that wavelength affects the wave's speed; longer wavelengths travel slower in certain mediums. * Describe how frequency relates to energy; higher frequency waves carry more energy. * Clarify that period is inversely related to frequency; shorter periods mean higher frequencies. * Use visual examples of sound waves and water waves to illustrate these effects.	Which formula relates wave speed, frequency, and wavelength? A. Wave speed = amplitude × period B. Wave speed = frequency ÷ amplitude C. Wave speed = frequency × wavelength ✓ How does increasing frequency affect wave period? A. Decreases the period ✓ B. Has no effect on period C. Increases the period	Solve a series of wave problems calculating wave speed, frequency, and wavelength. Use given parameters and ensure unit consistency.	Model answer: Calculate wave speed using the formula: wave speed = frequency × wavelength. Check units for consistency, ensuring frequency is in Hz and wavelength in metres.

Assessment exit quiz

1. What is the relationship between wave speed, frequency, and wavelength?
   A. Wave speed = amplitude × period
   B. Wave speed = frequency ÷ amplitude
   C. Wave speed = frequency × wavelength ✓

2. What effect does increasing the amplitude have on wave energy?
   A. Decreases energy
   B. Increases energy ✓
   C. No effect on energy

3. How does wavelength affect wave speed in a medium?
   A. Longer wavelengths travel faster
   B. Longer wavelengths travel slower ✓
   C. Wavelength has no effect on speed

4. What happens to the period when frequency increases?
   A. The period decreases ✓
   B. The period increases
   C. The period stays the same

5. Which of these is a unit for measuring frequency?
   A. Hertz (Hz) ✓
   B. Joules
   C. Metres

6. What does amplitude measure in a wave?
   A. Distance between wave peaks
   B. Maximum displacement from rest position ✓
   C. Speed of the wave