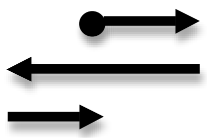
Part 1: Wave types

Mechanical waves can be either transverse, longitudinal or a mixture of both.

- Transverse waves have particles that move at right angles to the direction the wave moves.
- Longitudinal waves have particles that move backwards and forwards in the same direction that the wave moves.

Locate and open the interactive program, *Wave explorer*. Select **Start**, then use tabs at the top of the screen to scroll through animations of waves. Select **Show particle** to highlight an individual particle as it is affected by the wave.

1. Draw the motion of a particle during one cycle for each of the different waves.

slinky 	*rope*	*sound*
Mexican	*sonar*	*water*
P-wave	*S-wave*	*Rayleigh*

2. For each wave write **L** (longitudinal), **T** (transverse), or **M** (mixed) in the table below to indicate the type of wave.

slinky	*rope*	*sound*
Mexican	*sonar*	*water*
P-wave	*S-wave*	*Rayleigh*

Part 2: Amplitude

The amplitude of a wave is the maximum displacement of particles from their rest position

Locate and open the interactive program, *Wave explorer*. Select **Start**, then select **Next**. You will see a slinky spring animation, with sliders and check boxes that allow you to adjust features of the wave. The spring's motion forms longitudinal waves. Notice that sections of the spring move along in the same direction as the waves.

1. Describe what happens to the wave when the amplitude is changed.

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2. Select **Show graph** and describe the change to the graph when the amplitude is changed.

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3. What does the line on the graph represent?

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4. Sound is also a longitudinal wave. How does a speaker from a sound system increase the amplitude of sound waves? (Hint: go back and look at the sound wave animation if you need to).

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5. How could you tell if the amplitude of sound from a speaker had increased?

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- Select the **Rope** tab, then select **Play** to start making waves.

6. How is the motion of this wave different to that of a slinky?

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7. What happens to the wave when the amplitude is changed?

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8. Select **Show graph**. What do you notice about the line produced?

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9. What does this graph represent?

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Notice that as the wave travels from left to right, the particle moves up and down across the wave. This is an example of a transverse wave.

10. Name another example of a transverse wave.

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Part 3: Frequency

The frequency of a wave is the number of cycles or to and fro movements in a second. The frequency is equal to one divided by the period of the wave: frequency = 1 ÷ period or $f = 1/T$.

The period of a wave is the time taken for one complete cycle, or to and fro movement. It is equal to one divided by the frequency (period = 1 ÷ frequency or $T = 1/f$).

The wavelength of a wave is the distance between two identical points on successive waves. Wavelength is given the symbol λ (lamda).

Open the interactive program *Wave explorer*. Select **Start**, then select **Next**. Select the **Rope** tab from the top of the screen. Select **Show ruler**, pause the wave and use the ruler to make the following measurements.

11. Measure the distance between two consecutive crests:

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12. Measure the distance between two consecutive troughs:

    ………

13. Measure the distance between identical points on the wave:

    ………

14. Repeat this process with at least two other frequency settings and observe what happens to the wavelength and frequency. What did you observe?

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Select **Show timer**, then use the timer to find the actual frequency of the waves at the three different frequency settings listed below. (HINT: You will need to measure the period of the wave and divide it into one).

15. What is the frequency when the slider is set to the middle setting?

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16. What is the frequency when the slider is dragged to the far left?

    ………

17. What is the frequency when the slider is dragged to the far left?

    ………

18. Use the timer and ruler to observe what happens to wavelength and frequency as either are changed. Record results in the table below, considering these issues:

- You will need enough readings to construct a graph that can be used to work out any pattern in the results.
- You will need to decide what to record in columns and rows in the table, or use a spreadsheet program such as Excel.
- Leave the last column of your table free to calculate values for frequency × wavelength.

Results table

						$= f \times \lambda$

19. Draw a graph of wavelength against frequency. Describe the shape of the graph.

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20. Describe what happens to wavelength as frequency increases, and vice versa.

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21. What do you notice about frequency × wavelength for all of your results?

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22. Your results should show that the velocity of a wave = frequency × wavelength ($v = f \times \lambda$). It is also said to be the distance travelled by a wave in one second ($v = s/t$). Explain the relationship between these two statements.

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Part 4: Interference

Interference occurs when two waves interact.

- When movement of particles oppose one another, **destructive interference** occurs and waves cancel out one another.
- When movement of particles add to (reinforce) one another, **constructive interference** occurs and the amplitude of the resultant wave increases.

Open the interactive program *Wave explorer*. Select **Start**, then select **Next** twice. The phase explorer animation is now displayed. Two rope waves (**A** and **B**) combine to make a third wave at the bottom of the screen (**A** + **B**). There are sliders to control **Wavelength** and **Amplitude** of the two waves, as well as a slider to control the **Phase** of the waves.

23. Make sure that waves **A** and **B** have the same wavelength and amplitude. Slide the **Phase** control all the way to the left. Describe what happens to the combination wave.

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24. Now shift the **Phase** slider into the middle of its range. Describe what happens to the combination wave.

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25. Slide both wavelength controls all the way to the left. Then adjust one of the waves so that it has a slightly longer wavelength than the other. If these were sound waves, what type of sound would it make? *(HINT: think about the consistent rhythm of the combination wave).*

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