

Longitudinal & Transverse Waves

Simulation: edtechsims.com/longitudinal-transverse-waves

Name: _____ Class: _____ Date: _____



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By the end of this activity, you should be able to:

- describe how particles move in transverse and longitudinal waves relative to the direction of wave travel
- identify crests, troughs, compressions and rarefactions
- identify amplitude and wavelength on a wave diagram
- give examples of transverse and longitudinal waves
- apply the wave equation $v = f\lambda$

Part A: Transverse Waves

On the sim: Click Transverse. Tick both Show Particles and Show Wave Form. Leave the sliders at their starting values.

A1 Focus on ONE particle. Describe how it moves as the wave passes. [1]

.....

.....

A2 State the direction in which the wave travels across the screen. [1]

.....

A3 Using your answers to A1 and A2, complete the sentence:

In a transverse wave, the particles vibrate _____ to the direction of wave travel.

A4 Click Pause. Fig. 1 shows a transverse wave like the one on your screen.

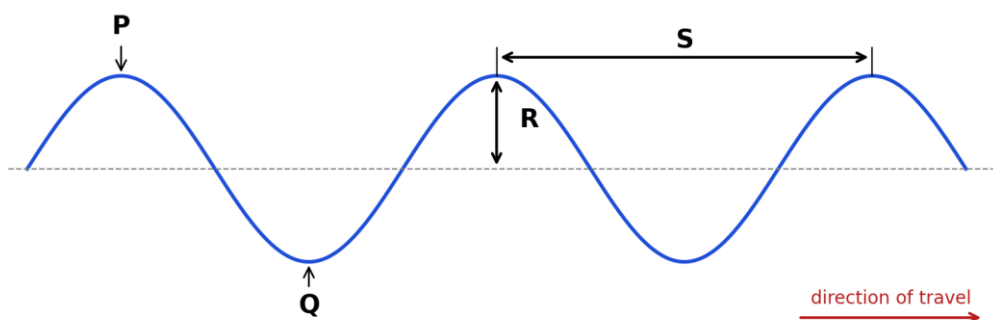


Fig. 1

State what is shown by each of the letters P, Q, R and S.

P:

Q:

R:

S:

A5 Click Play. Does any particle travel from the left side of the screen to the right side? What does the wave transfer from left to right? [2]

.....

.....

Part B: Longitudinal Waves

On the sim: Click Longitudinal. Keep both boxes ticked.

B1 Focus on ONE particle. Describe how it moves as the wave passes. [1]

.....

.....

B2 Complete the sentence:

In a longitudinal wave, the particles vibrate _____ to the direction of wave travel.

B3 Click Pause. Fig. 2 shows the particles in a longitudinal wave.

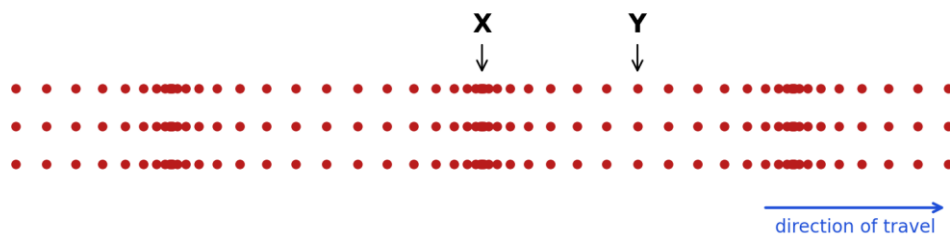


Fig. 2

(a) Name the regions labelled X and Y. [2]

X:

Y:

(b) On Fig. 2, draw a double-headed arrow to show one wavelength. Label it λ . [1]

(c) Describe, in terms of the spacing of particles, the difference between X and Y. [2]

.....

.....

Part C: Comparing the Two Waves

On the sim: Click Compare Both and watch both waves for about 30 seconds.

C1 Complete Table 1.

[4]

	Transverse wave	Longitudinal wave
Direction of particle vibration relative to wave travel		
Features formed		
Two examples		
Do the particles travel along with the wave?		

Table 1

C2 Open Check Your Understanding at the bottom of the sim. Answer all 5 questions and submit.
My score: _____ / 5. One thing I got wrong or was unsure about:

.....

Part D: Applying Your Knowledge

D1 Tick (✓) the correct column for each wave in Table 2.

[4]

Wave	Transverse	Longitudinal
Sound travelling through air		
Light		
Ripples on the surface of a pond		
Seismic P-wave		
Seismic S-wave		
A slinky pushed and pulled along its length		
A slinky shaken from side to side		
Radio waves		

Table 2

D2 A sound wave has a frequency of 440 Hz and a wavelength of 0.75 m. Calculate the speed of the sound wave.

[2]

speed = ... m/s

D3 Ripples on a pond travel at 0.24 m/s. The frequency of the ripples is 3.0 Hz. Calculate the wavelength of the ripples. [2]

wavelength = ... m

Part E: Practice Questions

E1 Fig. 3 shows the displacement–distance graph for a transverse wave at one instant.

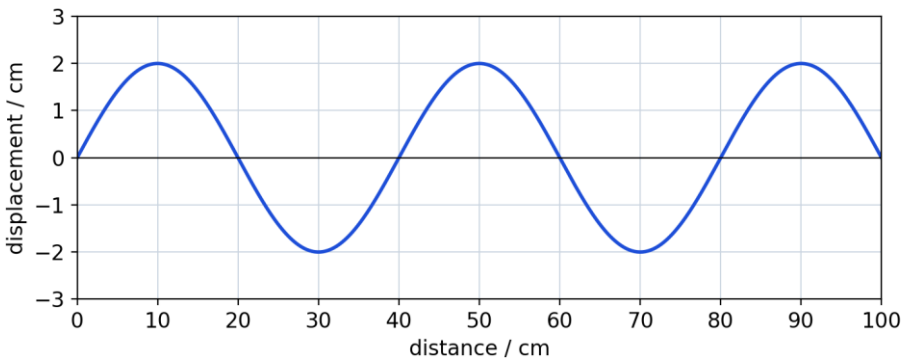


Fig. 3

(a) State the amplitude of the wave. [1]

amplitude = ... cm

(b) Determine the wavelength of the wave. [1]

wavelength = ... cm

(c) The frequency of the wave is 5.0 Hz. Calculate the speed of the wave in m/s. [2]

speed = ... m/s

E2 A loudspeaker produces a sound wave in air.

(a) Describe how the sound wave travels through the air. Refer to the air particles in your answer. [3]

.....

.....

.....

.....

(b) Explain why sound cannot travel through a vacuum. [1]

.....

.....

E3 A student produces a longitudinal wave on a slinky. Fig. 4 shows part of the slinky at one instant.

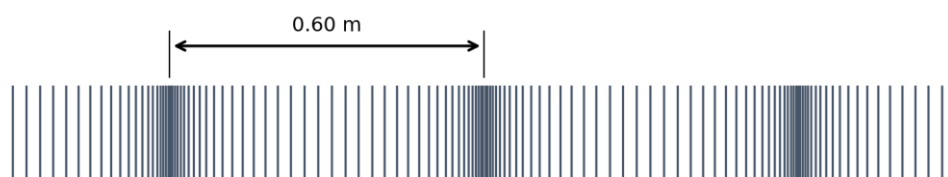


Fig. 4

The student counts 5 compressions passing a fixed point in 2.0 s.

(a) Calculate the frequency of the wave. [1]

frequency = ... Hz

(b) Calculate the speed of the wave along the slinky. [2]

speed = ... m/s

Answer Key: Longitudinal & Transverse Waves

Part A

- A1** The particle moves up and down (vibrates about a fixed rest position).
A2 From left to right.
A3 perpendicular (at right angles)
A4 P: crest. Q: trough. R: amplitude (maximum displacement from the rest position). S: wavelength (distance between two successive crests).
A5 No. Each particle only vibrates about its rest position. The wave transfers energy, not matter.

Part B

- B1** The particle moves back and forth (left and right) about a fixed rest position.
B2 parallel (along the same line as)
B3(a) X: compression. Y: rarefaction.
B3(b) Arrow from the centre of one compression to the centre of the next compression (or rarefaction to rarefaction).
B3(c) At X the particles are closer together; at Y the particles are further apart.

Part C

	Transverse wave	Longitudinal wave
Direction of particle vibration	Perpendicular to wave travel	Parallel to wave travel
Features formed	Crests and troughs	Compressions and rarefactions
Two examples	Light, water ripples, S-waves, EM waves	Sound, P-waves, slinky pushed along its length
Particles travel with wave?	No, they vibrate about fixed positions	No, they vibrate about fixed positions

- C2** Sim answers: 1 False, 2 False, 3 True, 4 False, 5 False.

Part D

- D1** Transverse: light, pond ripples, S-wave, slinky shaken side to side, radio waves. Longitudinal: sound in air, P-wave, slinky pushed and pulled.
D2 $v = f\lambda = 440 \times 0.75 = 330 \text{ m/s}$
D3 $\lambda = v / f = 0.24 / 3.0 = 0.080 \text{ m}$

Part E

- E1(a)** 2.0 cm
E1(b) 40 cm
E1(c) $v = f\lambda = 5.0 \times 0.40 = 2.0 \text{ m/s}$ [1 mark for converting 40 cm to 0.40 m]

E2(a) Any three: the loudspeaker cone vibrates; air particles vibrate back and forth parallel to the direction of wave travel; this produces a series of compressions and rarefactions; energy is passed from particle to particle (the particles themselves do not travel with the wave).

E2(b) Sound needs a medium (particles) to travel; a vacuum has no particles.

E3(a) $f = 5 / 2.0 = 2.5 \text{ Hz}$

E3(b) $\lambda = 0.60 \text{ m}$ (distance between adjacent compressions); $v = f\lambda = 2.5 \times 0.60 = 1.5 \text{ m/s}$