Measuring wave speed in a ripple tank

Student activity • investigation and reasoning

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The question

How can frequency and wavelength give an estimate of wave speed?

Use staff-recorded ripple-tank video with a scale in the water plane. Measure cycles and wavelengths without mistaking a projected image scale for the actual water scale.

Equipment

- Staff ripple tank, dipper, continuous light and suitable isolated low-voltage supplies
- Camera, in-plane waterproof scale and display
- Booklet and calculator

Staff alone handle water and electrical setup. Keep mains equipment dry, raised and away from spills; use the tank's specified isolated low-voltage equipment. Switch off before adjustments. Mop up spills immediately. No flashing strobe is used.

Course coverage: Shared Physics / Double Award: 3.1, 3.3, 3.5–3.7. Wave speed and frequency–period relationships.

Plan, model or apparatus sketch

Draw the apparatus and wave or ray directions; label the normal or equilibrium position where relevant.

Method and reasoning

Read the whole sequence before starting

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1. Staff set up a level ripple tank with shallow uniform water, a straight dipper and continuous low-voltage illumination according to its manual. Keep mains supplies on a dry raised bench away from the tank.

2. At three steady dipper settings, record a short overhead video including a waterproof length scale in the water plane. Record frame rate and retain the original files. Avoid stroboscopic lighting.

3. For each setting, replay the video and time ten complete cycles at one fixed point, from one crest arrival to the eleventh. Use video timestamps, accounting for any slow-motion playback factor.

4. Pause a clear frame and measure the distance across four complete wavelengths, from one crest to the fifth. Divide by four. Use the in-plane scale, not screen dimensions alone.

5. Repeat each timing and spacing measurement from a second section of the same recording. Calculate $f = 10/t$, $T = t/10$ and $v = f\lambda$ in SI units.

6. Compare the estimates and explain resolution, reflections and depth as limitations. Do not assume exact agreement or constant speed at every frequency: water waves can be dispersive.

Cleanup

- Switch off and disconnect before draining. Dry the tank and bench and retain the recordings with the measurements.

Record your evidence

Blank spaces are for your own work

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Reference and task data

Practice only: ten cycles in 4.0 s gives f = 2.5 Hz and T = 0.40 s. Four wavelengths spanning 0.12 m give λ = 0.030 m and v = 0.075 m s^{-1}. These are not expected experimental results. The period relation also applies to sound and electromagnetic waves.

Setting / repeat	10 cycles / s	4λ / m	v / m s^{-1}
Low / 1			
Low / 2			
Middle / 1			
Middle / 2			
High / 1			
High / 2			

Show your calculations, labelled model or correction here.

Explain and evaluate

Use evidence and show calculation steps where relevant

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1. How many crest arrivals bound ten complete cycles?

2. Why measure four wavelengths?

3. Convert 3.0 cm to metres.

4. Calculate the practice frequency.

5. Calculate the practice speed.

6. Why include a scale in the water plane?