Investigating motion on a ramp

Student activity • investigation and reasoning

YEAR 10 / LESSON 2 / PHYSICS + SCIENCE (DOUBLE AWARD)

The question

How does ramp height affect a trolley's mean speed between two fixed points?

Use the school's trolley, ramp and paired photogates. Keep the run distance and release point fixed while changing the ramp height.

Equipment

- Trolley and ramp with stable supports and padded end stop
- Two photogates, compatible logger/device and timing connection
- Metre rule, set square and optional measured card flag
- Booklet, calculator and graph paper

Secure supports and gates; keep hands out of the trolley path. Use the padded stop so the trolley cannot fall from the bench. Keep feet and bags clear. Do not raise the track above the staff-approved height or 0.30 m, whichever is lower.

Course coverage: Shared Physics / Double Award: 1.3–1.5. Measuring speed and analysing changing motion.

Plan, model or apparatus sketch

Draw a labelled setup or force diagram; include the measured quantities.

Method and reasoning

Read the whole sequence before starting

YEAR 10 / LESSON 2 / PHYSICS + SCIENCE (DOUBLE AWARD)

1. Staff secure a ramp, supports, two photogates and a padded end stop. Set the gates 0.80 m apart along the track. Keep the trolley fully supported throughout its run.

2. Measure ramp height vertically at the raised end. Staff select five stable heights after a pilot; do not exceed 0.30 m or the lower limit needed for a controlled stop.

3. Use the same trolley, fixed release position and gate spacing. Release from rest without a push. Record elapsed time between the matching leading-edge events at the two gates.

4. Repeat three times at each height, checking alignment and the stopping area before every run. Investigate unusual readings and repeat where justified; retain the original record.

5. For each run calculate mean speed between gates using 0.80 m divided by elapsed time. Calculate a mean of the three speeds at each height and plot it against ramp height.

6. Optional staff-set single-beam mode: measure a flag length and divide it by its beam-block time to estimate local speed. Do not confuse that time with the travel time between gates.

Cleanup

- Switch off and return sensors; remove trolley and supports before carrying the ramp.

Record your evidence

Blank spaces are for your own work

YEAR 10 / LESSON 2 / PHYSICS + SCIENCE (DOUBLE AWARD)

Reference and task data

Mean speed = gate separation / travel time. Practice example: 0.80 m in 1.25 s gives 0.64 m s^{-1}. This is not the speed at every instant. Go Direct Photogates also have an internal double-gate mode; the software's selected mode determines which length/time calculation is valid. The method here uses two externally separated timing positions.

Height / m	Time 1 / s	Time 2 / s	Time 3 / s

Show your calculations, labelled model or correction here.

Explain and evaluate

Use evidence and show calculation steps where relevant

YEAR 10 / LESSON 2 / PHYSICS + SCIENCE (DOUBLE AWARD)

1. Identify the independent and dependent variables.

2. Why fix gate spacing and release position?

3. Calculate mean speed for 0.80 m in 1.25 s.

4. Does mean speed between gates equal final speed?

5. Why repeat each height?

6. How would pushing on release affect the comparison?