Stopping distance and reaction-time evidence

Student activity • investigation and reasoning

YEAR 10 / LESSON 17 / PHYSICS + SCIENCE (DOUBLE AWARD)

The question

How does reaction time contribute to a vehicle’s stopping distance?

Use an optional seated ruler-drop model, then calculate thinking distance using a stated vehicle speed. This is not a driving or medical test.

Equipment

- Lightweight smooth ruler, booklet and calculator
- Stable seated workspace and optional practice data

Remain seated; keep the ruler away from faces and use a lightweight smooth-edged ruler. No caffeine, medication, sleep deprivation, road tests or startling stimuli are part of this activity. Participation is optional and results remain private.

Course coverage: Shared Physics / Double Award: 1.19–1.20. Thinking distance and braking distance.

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

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1. Work seated at a bench with a lightweight, smooth-edged ruler. A partner holds it vertically with zero level with the catcher's open finger and thumb; keep faces clear.

2. Release without a push after an unpredictable short wait. Catch the ruler and record the drop distance at the same edge of the fingers each time. Do not deliberately distract or startle anyone.

3. Take three practice trials, then five recorded trials with the same hand and posture. Record a missed catch as missing, not as zero; repeat it with a note.

4. Convert each distance d in metres to an estimated time using $t = \sqrt{(2d/9.8)}$. Calculate the mean of the five times. An observer role and labelled practice data are available.

5. Use an invented vehicle speed of 15 m s^{-1} and reaction time 0.80 s to calculate thinking distance. Add a stated braking distance of 18 m to find total stopping distance.

6. Discuss speed, road grip, brake condition, load and reaction time. Explain why a ruler-catching time does not measure the full decision-and-braking response in real traffic.

Cleanup

- Return rulers and keep individual records private.

Record your evidence

Blank spaces are for your own work

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Reference and task data

Stopping distance = thinking distance + braking distance. Thinking distance = speed × reaction time. The ruler model assumes near-free fall from rest and a consistent catch position. Practice conversion: a 0.20 m drop corresponds to about 0.20 s. Do not compare pupils as a league table or draw conclusions about health or fitness.

Recorded trial	Drop distance / m	Estimated time / s
1		
2		
3		
4		
5		

Show your calculations, labelled model or correction here.

Explain and evaluate

Use evidence and show calculation steps where relevant

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1. What two distances make up stopping distance?

2. Find thinking distance at 15 m s^{-1} for 0.80 s.

3. Add 18 m braking distance.

4. What happens to thinking distance if speed doubles at fixed reaction time?

5. Does a ruler-drop test reproduce real driving decisions?

6. Why not record a missed catch as zero?