Lesson 4 – Why don't they just stop?

Lesson Overview	Investigate and calculate car-stopping distances; use this information in a real life context so students can further understand the distances involved.
Learning Outcomes	Students have a greater understanding of the stopping distances and why moving objects, especially cars, take so long to stop.
National Curriculum	Mathematics – reason mathematically; solve problems; ratio, proportion and rates of change

Time	Activity	Resources
	Starter	
10 min	Teacher led discussion about why cars are sometimes unable to stop to avoid a collision. When objects are travelling they have 'momentum' and this prevents objects stopping instantly. This can be demonstrated with any moving object, or explaining how they can't suddenly stop when they are running. The heavier and faster an object is, the longer it takes to stop. Cars can weigh anything from 1 tonne (super minis) to 3 tonnes (larger 4x4 vehicles) and can legally travelling up to 70 mph on motorways.	Optional object to demonstrate momentum
	Main	
15 min	Students complete the **Stopping distances** worksheet. A sheet can be given to each student, or the information can be displayed on a white board and written in their maths books.	**Stopping distances** worksheet
10 min	Can the group accurately visualise distances? Ask students questions about the distances in the school. E.g. how far is it to the toilets? How far is it to the front gate? If you have time as a group you can measure and check these distances.	Knowledge of distances around the school
15 min	Take the class on to the school-yard or playing field and pick a fixed object such as a wall or bin. Explain that this fixed object is going to represent a car that is travelling in a straight line, in good driving conditions and with the driver's full attention. The group are to imagine that the car is travelling at 30 mph and has just seen them in the road. The class is to stand in front of the fixed object where they think the car will come to a complete stop. Measure 75 ft (23m) away from the fixed object. Explain to all students that are within the stopping distance (75 ft) that they would have been hit by the car. Repeat the exercise with the car travelling at 40 mph. Offer a prize to the student who can get the closest to the true answer, so students aren't encouraged to go an unreasonably long distance away. This is also a good opportunity to point out how much the stopping distance increases with just a 10mph increase in speed.	Measuring tool either large tape measure or distance measuring wheel
	Review, reflect and assess	
10 min	Review the stopping distances and how careful they need to be when picking a safe time to cross the road.	

Stopping distances

When objects are travelling at speed they have momentum. The heavier and faster an object is, the more momentum it has and the longer it takes to stop.

Cars can weigh anything from 1 to 3 tonnes (about the same as a hippopotamus) and can be travelling between 20 - 70 mph ! This speed and momentum means it is impossible to suddenly stop, drivers need thinking and braking time.

Below is an equation to work out how far cars will travel before they can stop. Fill in the table below with the distances needed to stop, the answers in metres are already completed for you.

These distances are only a guide and apply when conditions are ideal (not raining or icy), the car is in good condition and the driver is paying full attention.

To work out thinking distance

The thinking distance in feet is the same as the mph you are travelling at, so 30 mph is 30 ft (foot) thinking distance, 40 mph is 40 ft thinking distance.

To work out the braking distance

overall stopping time - thinking distance

e.g. 75ft - 30 ft = 45 ft

To work out the overall stopping distance in feet use the following formula.

$$\frac{(\text{speed} \times \text{speed})}{20} + \text{speed} = \text{overall stopping distance in feet}$$

e.g. 30 mph

$$\frac{(30 \times 30)}{20} + 30 = \frac{900}{20} + 30 = 45 + 30 = 75 \text{ foot}$$

Speed	Thinking distance	Braking distance	Overall stopping distance
20 mph	(6m)	(6m)	(12m)
30 mph	30 ft. (9m)	45ft. (14m)	75ft. (23m)
40 mph	(12m)	(24m)	(36m)
50 mph	(15m)	(38m)	(53m)
60 mph	(18m)	(55m)	(73m)
70 mph	(21m)	(75m)	(96m)