

The Crossing Guard—Impulse and Momentum

In this short animated film, a frustrated crossing guard attempts to stop oncoming traffic, but there is only one problem: he's an armadillo.

Calculate the force imparted on the crossing guard when he is struck by the truck. The crossing guard goes from an initial velocity of zero to about 70 mph (~30 m/s) in an elapsed time of about 0.1 seconds. Then, the force is given as such:

$$F_{avg} = \frac{\Delta p}{\Delta t} = \frac{m(v_f - v_i)}{\Delta t} = \frac{5kg \left(30 \frac{m}{s} - 0 \frac{m}{s}\right)}{0.1 s} = 1500 N$$

Before the students complete this equation, ask them what happens to the force imparted when various physical parameters are altered. What if a Volkswagon instead of a big truck hits the crossing guard (no change)? What if the crossing guard were a donkey (much bigger force)?