This 1936 cartoon, “Play Safe,” stars a little boy who is continually protected by his St. Bernard. In this clip, the boy is sleeping on the train tracks, and the dog breaks free from his tether to rescue the boy. The dog tries to outrun the train, but, at 0:46, the train hits the dog. The dog is propelled forward and he saves the boy from certain demise.

Assume that the train is moving at a constant velocity with no forces applied (neither propulsive or resistive). The mass of the train might be 100,000 kg, and its velocity could reasonably be 70 mph (about 30 m/s). The dog is around 100 kg and is traveling a bit slower than the train, say 28 m/s. After the collision, the dog’s speed is slightly more than the train, say 32 m/s. What is the train’s new speed?

Apply the law of conservation of momentum:

$$P_i = P_f$$

The two bodies in this system include the train and dog, so the equation becomes:

$$m_{train}v_{0,train} + m_{dog}v_{0,dog} = m_{train}v_{f,train} + m_{dog}v_{f,dog}$$

$$(10^5 kg)\left(30\frac{m}{s}\right) + (100kg)(28\frac{m}{s}) = (10^5 kg)\left(v_{f,train}\right) + (100kg)(32\frac{m}{s})$$

Then, the final velocity of the train is 29.96 m/s (disregarding significant figures).

This is a nice problem because both bodies keep going in the same direction, which is not common in many collision problems, and the masses of the two bodies are so different. In this way, the students can see the miniscule, but not zero, effect of the collision on the train.