

In this classic 1936 Popeye cartoon, Popeye and Bruno are both trying to join the army to impress Olive Oyl. Early in the clip (at about 0:07), Bruno throws a rifle at Popeye, and Popeye is forced backwards. Using the law of conservation of momentum, calculate the speed with which Bruno throws the gun.

First, let's make some assumptions:

- The mass of the rifle is about 5 kg.
- The mass of Popeye is about 70 kg.
- Popeye covers about 2 meters in 1 second after the rifle hits him, so his speed is 2 m/s.

Now the law of conservation of momentum says that the initial momentum is equal to the final momentum.

$$P_i = P_f$$

The two bodies in this system include the rifle and Popeye, so the equation becomes:

$$m_{rifle}v_{0,rifle} + m_{popeye}v_{0,popeye} = m_{rifle}v_{f,rifle} + m_{popeye}v_{f,popeye}$$

$$0 = (5kg)(v_{f,rifle}) + (70kg)(-2\frac{m}{s})$$

Then, solve for the final velocity of the rifle, and it is 28 m/s, which is about 60 mph.