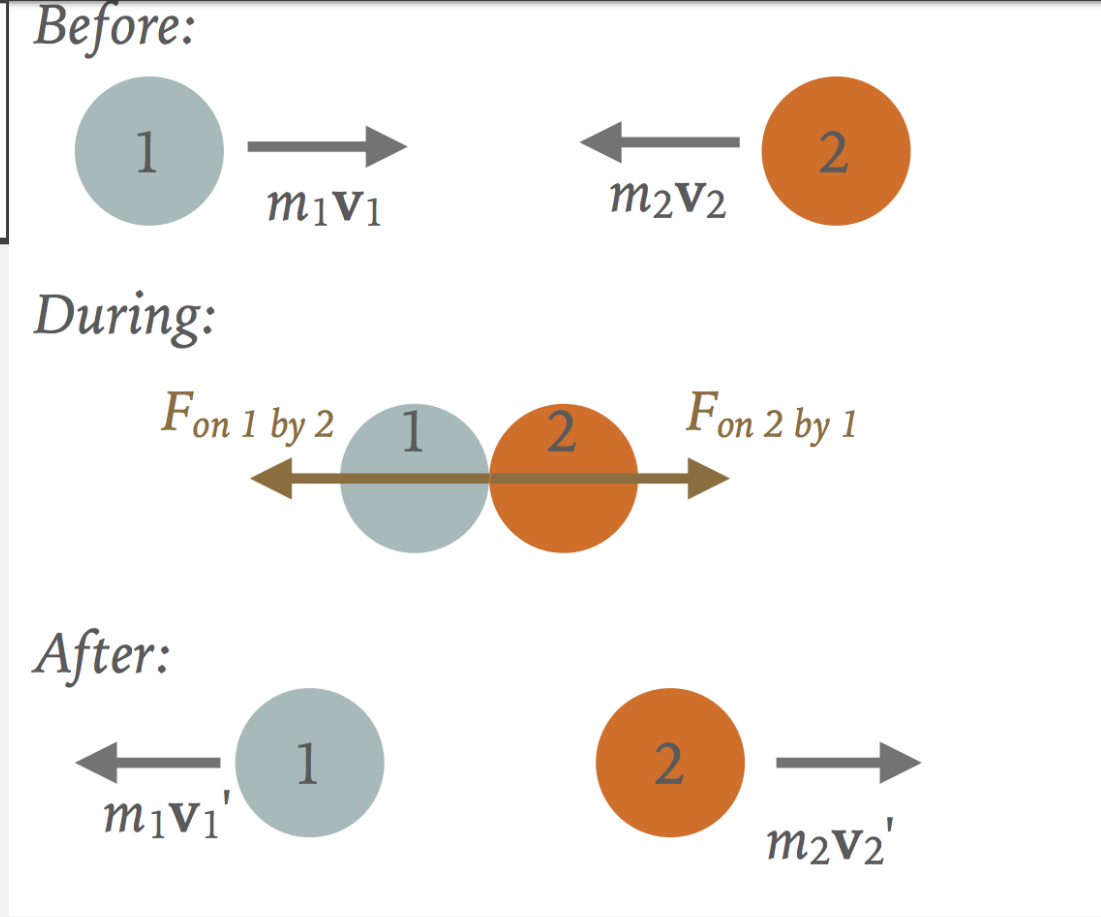
CONSERVATION OF MOMENTUM

- Picture 2 billiard balls set on a head-on collision (ignore any retarding forces)
- After collision, the two momentum of the balls will change
- But the **sum** of the momenta will be the same before and after the collision

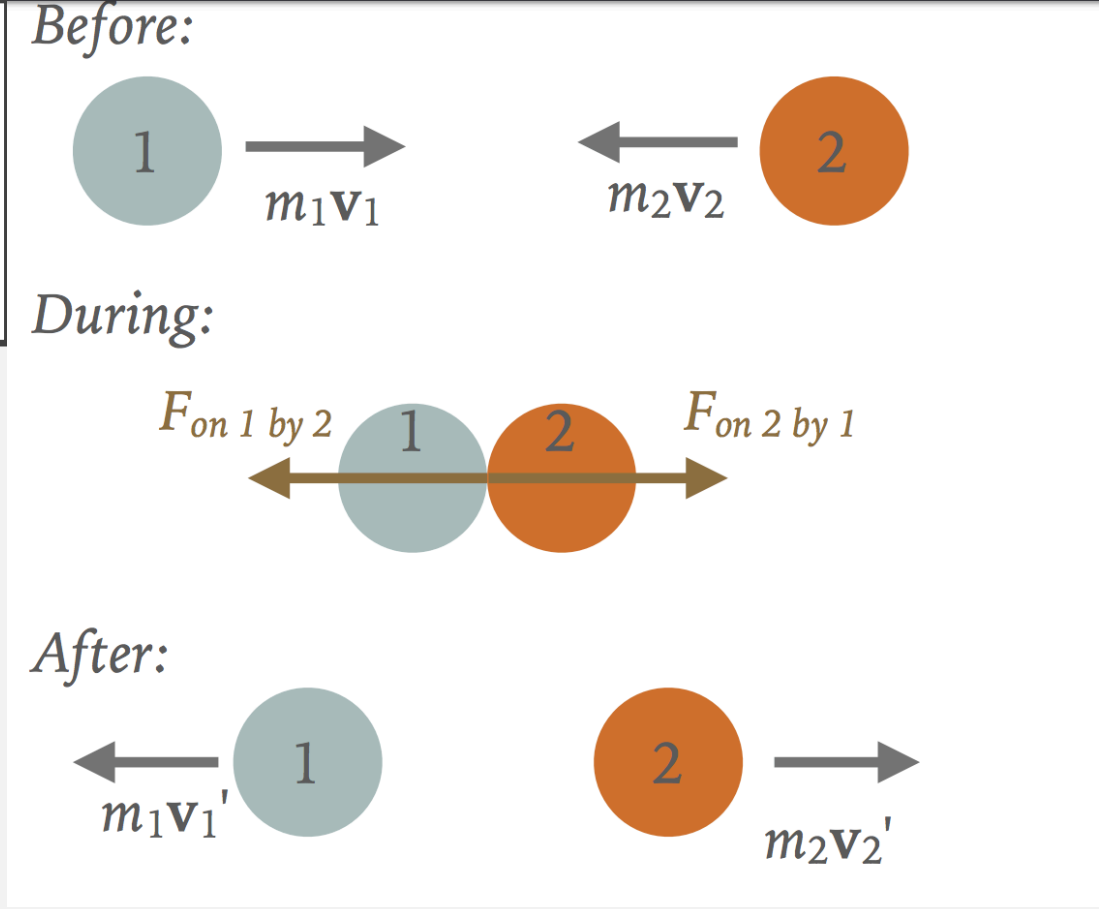


CONSERVATION OF MOMENTUM

$P_{before} = P_{after}$

$m_1v_1 + m_2v_2 = m_1v_1' + m_2v_2'$

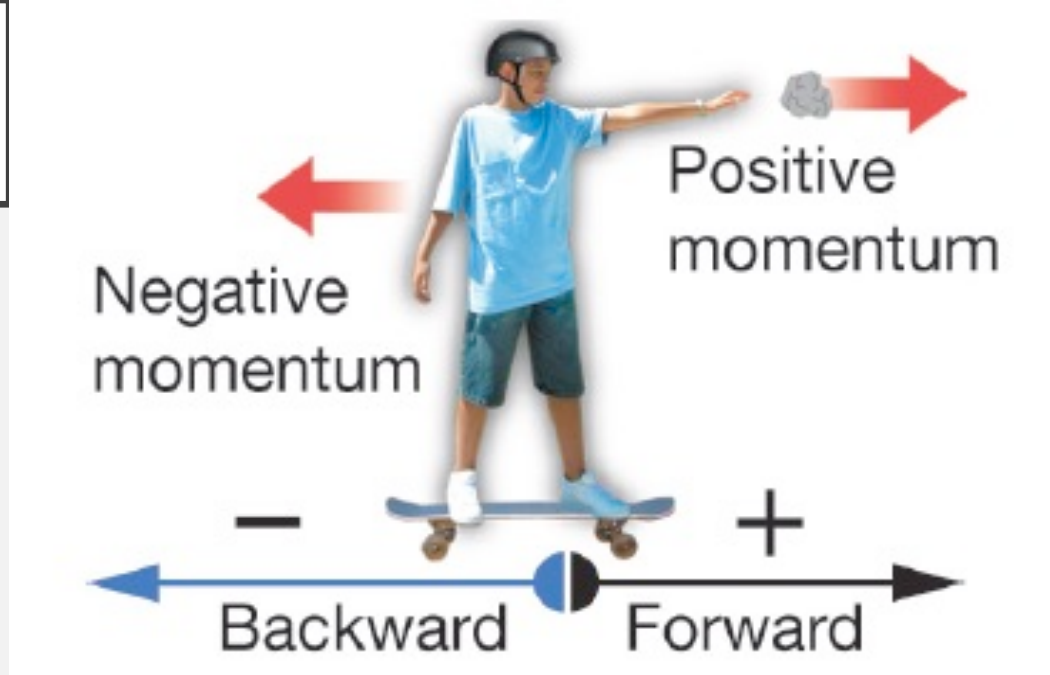
The total momentum of the two-ball system is **conserved**



LAW OF CONSERVATION OF MOMENTUM

The total momentum of an isolated system remains constant

- **System:** Set of objects that interact with each other
- **Isolated system**: system in which the only forces present are those between the objects of the system



If you throw a rock forward from a skateboard, you will move backward in response.

KIRBY TURNS INTO A ROCK AND FREE FALLS. IS MOMENTUM CONSERVED?

It is if you include the Earth in your system!

SYSTEMS

- Why would it be stupid to shoot a rifle with a loose arm instead of resting the butt of the rifle against your shoulder?
- Loose arm: system = arm + rifle, shoulder: system = whole body + rifle

CONSERVATION OF MOMENTUM AND ROCKETS

- Before the engines fire, the total momentum (rocket + fuel) is zero
- Backward momentum of expelled exhaust = forward momentum of rocket
- Similar to Newton's 3rd Law!

RECOIL

- Calculate the recoil velocity of a 5.0 kg rifle that shoots a 0.050 kg bullet at 120 m/s
- $m_B v_B + m_R v_R = m_B v_B' + m_R v_R'$ ($0 = 0.050kg \times 120m/s + 5.0kg + v_R'$)
- $v_R' = -1.2$ m/s
- What does the negative sign mean?