Let us play with Newton's 2nd Law

1. ***Recall 2nd law of motion:***

$F_{net} = ma$

2. ***Definition of acceleration:***

$$\vec{a} = \frac{\Delta \vec{v}}{\Delta t}$$

3. ***Combine (1) & (2)***

$$\vec{F}_{net} = \frac{m\Delta \vec{v}}{\Delta t} = \frac{\Delta m\vec{v}}{\Delta t} = \frac{\Delta \vec{p}}{\Delta t}$$

momentum

4. New expression of Newton's Second Law

$$\boxed{\vec{F}_{net} = \frac{\Delta \vec{p}}{\Delta t}}$$

5. Impulse –change in momentum theorem

$$\boxed{\vec{F}_{net}\,\Delta t = \Delta m\vec{v}}$$

Question: ***For a given*** $\Delta m\vec{v}$, ***relate Fnet and Δt***

$$\boxed{\vec{F}_{net}\,\Delta t = \Delta m\vec{v}}$$

$$\boxed{\vec{F}_{net}\,\alpha\,\frac{1}{\Delta t}}$$

For Fnet = 0 then…?

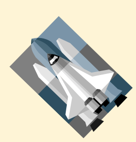
$$\boxed{\Delta m\vec{v} = 0}$$

$$\boxed{\Delta \vec{p}_{system} = 0}$$

No change in momentum;
Momentum is conserved.

Law of Conservation of Momentum

If the net force acting on a system is zero, the total momentum of the system remains the same.



$$\Delta \vec{p}_{system} = 0$$

$$\vec{p}_{system-initial} = \vec{p}_{system-final}$$

For two- body system (A & B):

$$\vec{P}_{Ai} + \vec{P}_{Bi} = \vec{P}_{Af} + \vec{P}_{Bf}$$

$$m_A\vec{v}_{Ai} + m_B\vec{v}_{Bi} = m_A\vec{v}_{Af} + m_B\vec{v}_{Bf}$$

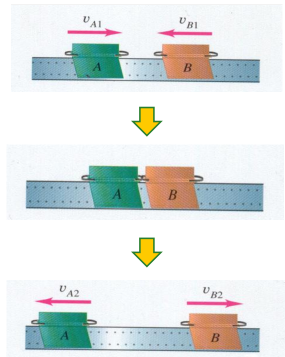
How are you able to walk?

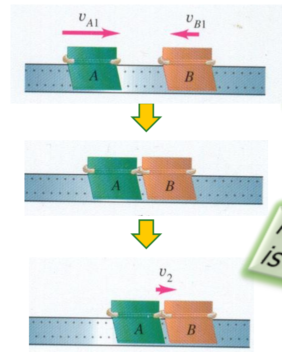
How are you able to swim?

Elastic collisions

•MOMENTUM IS CONSERVED!

•KE IS CONSERVED!





Inelastic Collisions

momentum is conserved!