Chapter Title: Center of Mass and Linear Momentum

Sections: Center of Mass, Newton's Second Law for a System of Particles, Linear Momentum, Collision and Impulse, Conservation of Linear Momentum

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Center of Mass

The center of mass (COM) of a *system of particles* is the point that moves as though:

1. All of the system's mass were concentrated there and
2. All external forces were applied there

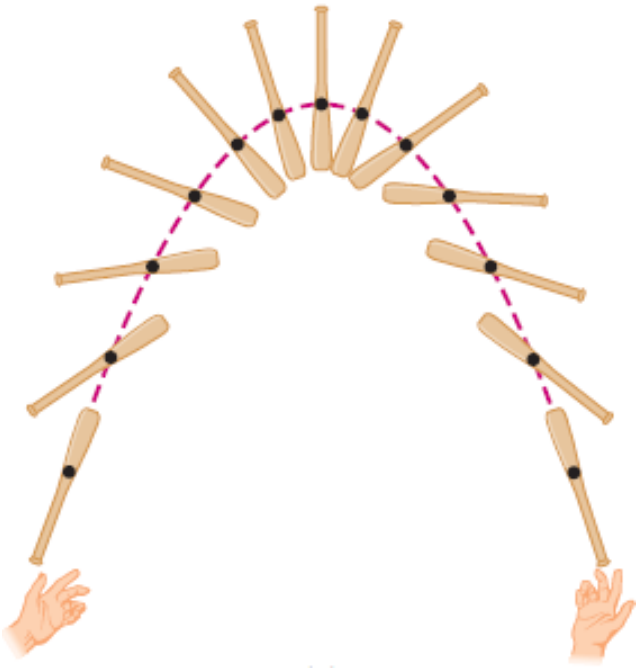
$$\vec{r}_{com} = \frac{1}{M}\sum_{i=1}^{n} m_i \vec{r}_i$$

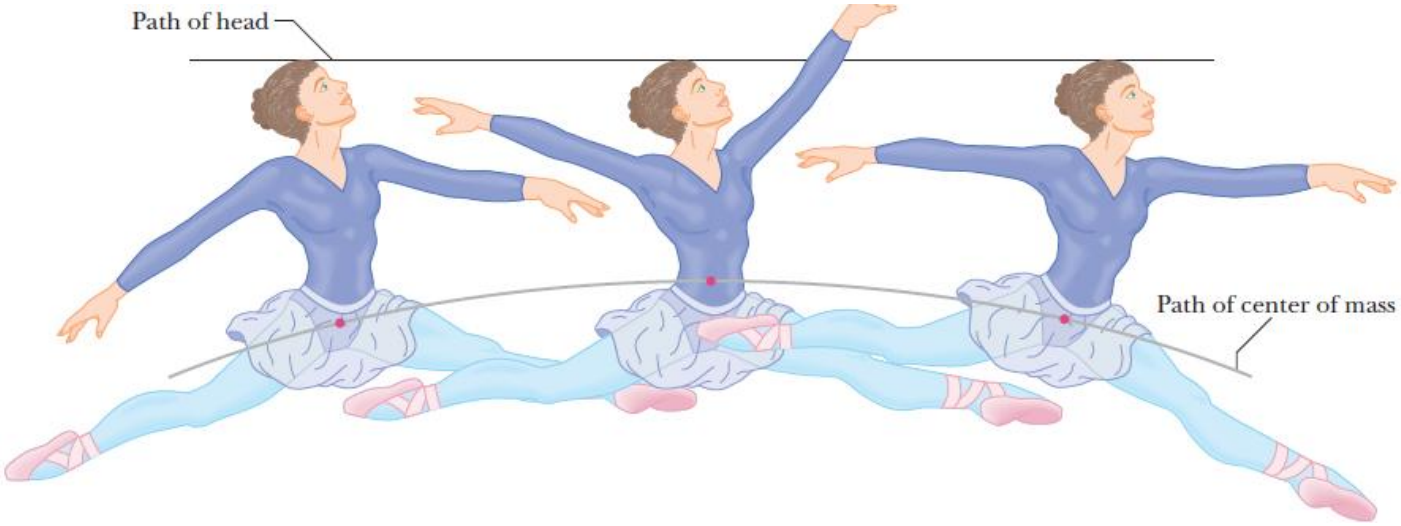
Newton's Second Law: System of Particles

$$\vec{F} = m\vec{a}$$

$$\vec{F}_{net} = \vec{F}_1 + \vec{F}_2 + \vec{F}_3 + \cdots + \vec{F}_n = M\vec{a}_{com}$$

$$F_{net.x} = Ma_{com.x},\ F_{net.y} = Ma_{com.y},\ F_{net.z} = Ma_{com.z}$$





Linear Momentum: System of particles

Total linear Momentum, $\vec{P} = \vec{p}_1 + \vec{p}_2 + \vec{p}_3 + \cdots + \vec{p}_n$

$$\vec{P} = M\vec{v}_{com}$$

Conservation of Linear Momentum

$$\vec{P}_i = \vec{P}_f$$

Total linear momentum at some initial time, t_i = total linear momentum at some later time, t_f