Lesson LD03

Newton's Laws of Motion

Issac Newton

- **Sir Isaac Newton** was an English physicist, mathematician, astronomer, natural philosopher, and alchemist.
- In 1666, he witnessed an **apple** fall from its tree and he began to ponder why it fell down.
- This led to his **Three Laws of Motion**.

FIRST LAW OF MOTION

THE LAW OF INERTIA

Lex I: *Corpus omne perseverare in statu suo quiescendi vel movendi uniformiter in directum, nisi quatenus a viribus impressis cogitur statum illum mutare*.

Every body perseveres in its state of being at rest or of moving uniformly straight forward, except insofar as it is compelled to change its state by force impressed.

FIRST LAW OF MOTION

THE LAW OF INERTIA

Lex I: *Corpus omne perseverare in statu suo quiescendi vel movendi uniformiter in directum, nisi quatenus a viribus impressis cogitur statum illum mutare*.

Objects at rest will stay at rest (inertia) and objects in motion will stay in motion in a straight line unless acted upon be an unbalanced force.

What Does This Mean?

There is a **natural tendency** of objects to keep on doing what they're doing. All objects **resist changes** in their state of motion. In the absence of an **unbalanced** force, an object in motion will maintain this state of **motion**.

SECOND LAW OF MOTION

THE LAW OF FORCE

Lex II: *Mutationem motus proportionalem esse vi motrici impressae, et fieri secundum lineam rectam qua vis illa imprimitur.*

The change of momentum of a body is proportional to the impulse impressed on the body, and happens along the straight line on which that impulse is impressed.

Second Law of Motion

Acceleration is produced when a force acts on a mass. The greater the mass (of the object being accelerated) the greater the amount of force needed (to accelerate the object).

$$F = MA$$

Force = Mass times Acceleration

Second Law in Action

- **A car that weighs 1,000 kg runs out of gas. The driver pushes the car to a gas station at a speed of 0.05 meters per second. How much force is the driver applying to the car to go that speed?**

F = 1,000 kg x 0.05 m/s/s

F = 50 Newtons of force

What the heck is a Newton?

- The Newton is a unit of force.
- It is equal to the amount of force required to accelerate a mass of one kilogram at a rate of one meter per second per second.

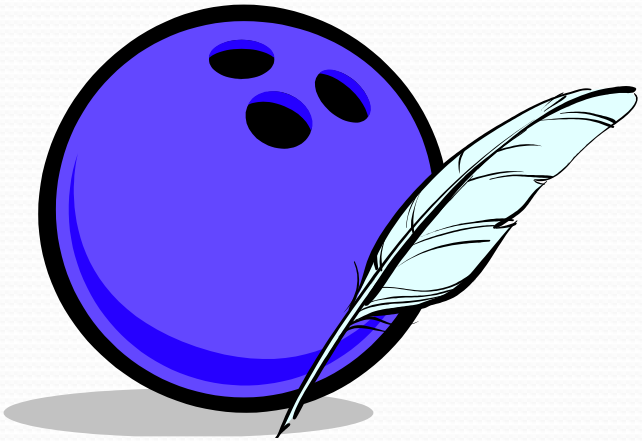
$$1N = 1\ \frac{kg \cdot m}{s^2}$$

What the heck is a kilogram?

1 kilo = 2.2 pounds

You Know The 2nd Law Already!

- **Everyone knows** the Second Law: heavier objects require **more** force to move the same distance as lighter objects.
- We know that we don't need the same amount of force to lift a **feather** that what is needed to lift a **bowling ball**.



THIRD LAW OF MOTION

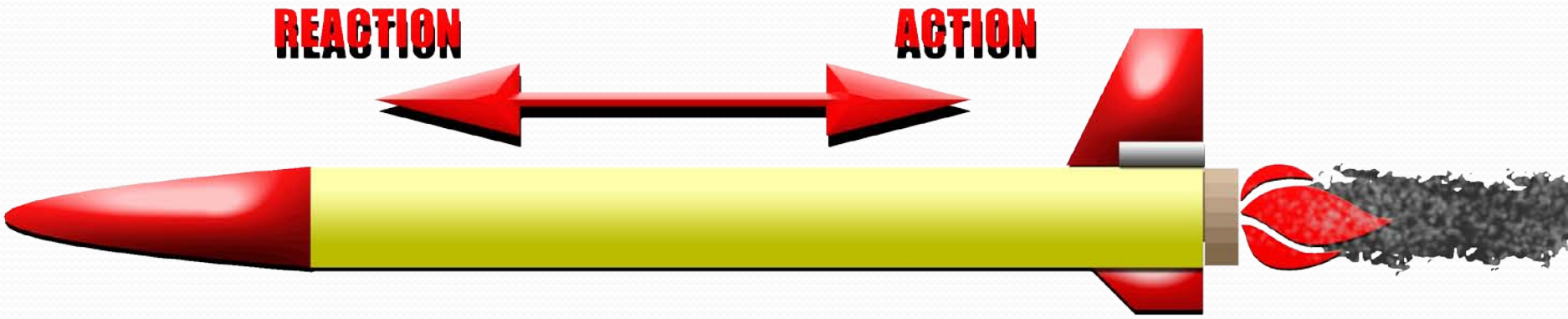
THE LAW OF RECIPROCAL ACTIONS

Lex III: Actioni contrariam semper et æqualem esse reactionem: sive corporum duorum actiones in se mutuo semper esse æquales et in partes contrarias dirigi.

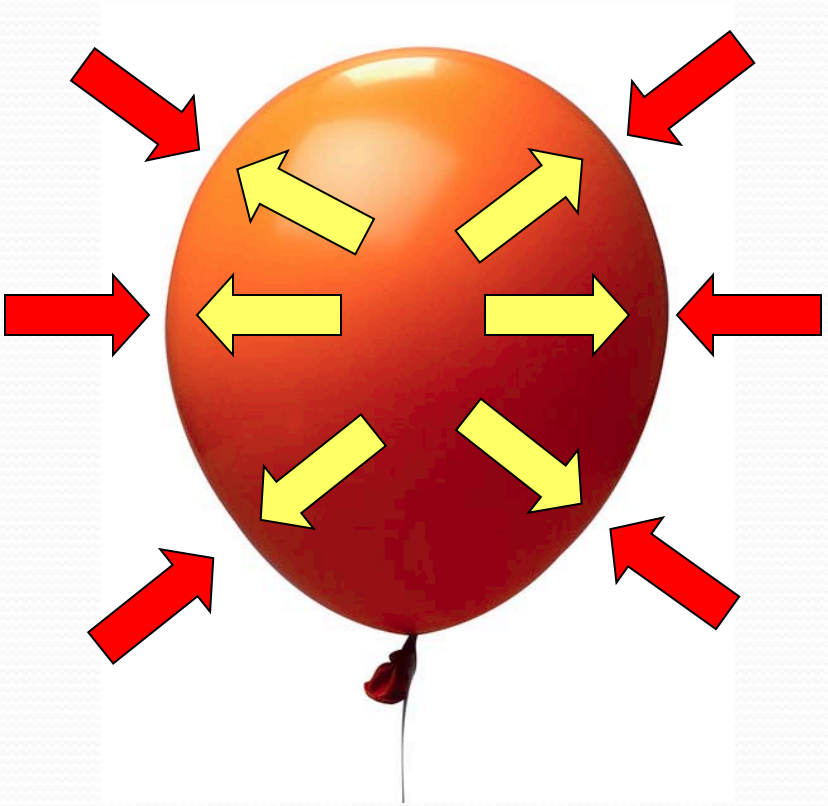
For a force there is always an equal and opposite reaction: or the forces of two bodies on each other are always equal and are directed in opposite directions.

Third Law of Motion

- For every action, there is an equal and opposite reaction.



Third Law of Motion



What Does This Mean?

This means that for every **force** there is a **reaction force** that is equal in size, but **opposite** in direction. Whenever an object pushes another object it gets pushed back in the opposite direction with **equal force**.