

## Chapter 8 The Laws of Motion

Force - a push or a pull on an object

A contact force - a push or pull on one object by another that is touching it.

- These can be weak: touching a keyboard
- ... Or Strong: Football

A noncontact force - a push or pull on one object by another without touching it

- Examples: gravity, magnetism, electricity.

Forces have both strength and direction

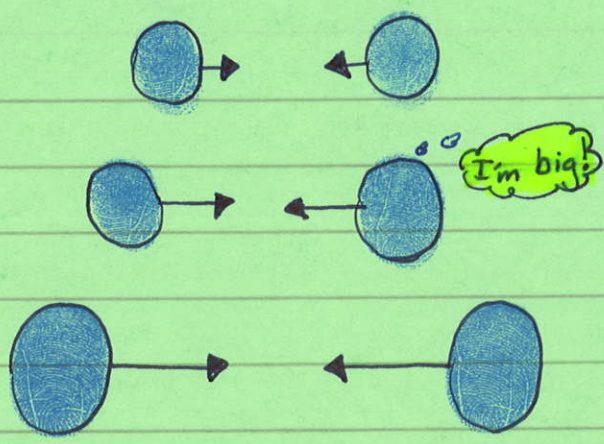
- The length of the  $\rightarrow$  indicates its strength.
- The arrow points in the direction of the force.

The unit for Force is N, for Newton

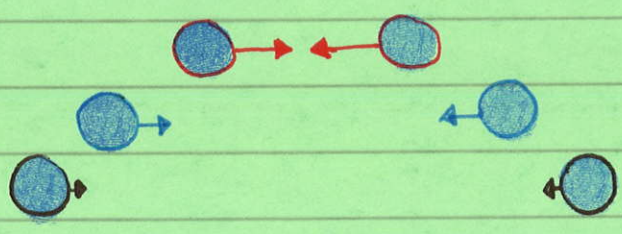
Gravity - the attractive force that exists between all objects that have mass  
Mass is the amount of matter in an object.

- All objects are attracted to each other by a gravitational force ... whose strength depends on the mass of each object and the distance between them.

Thank you Isaac



When the mass of one or both objects increases, the gravitational force increases. The force between the objects is the same... even when one object is smaller.



As the distance between the objects increases, the attraction decreases.

Weight is the gravitational force exerted on an object. Because weight is a force, it is measured in Newtons.

\* Weight is proportional to mass.

$$\frac{W}{m} = \frac{2W}{2m}$$

If the mass of an object is on a cliff on Mars is 30 kg and the weight is 75 N;... what would be the weight of a 96 kg object on the same cliff?

<u>75 N</u>	<u>?</u>	$75 \cdot 96 = 30 \cdot ?$	
30 kg	96 kg	$\frac{7200}{30} = \frac{30 \cdot ?}{30}$	240 N
		$240 = ?$	

8-1 cont.

**Friction** - the force that resists the motion of two surfaces that are touching.

- Static friction - when the friction between the sliding objects is strong enough to prevent motion
- Sliding friction - when the applied force is strong enough to move an object, but it slows down the motion
- Fluid friction - (water and air are fluids) is friction between a surface and a fluid
  - \* surface area plays a big part in this

## 8-2 Newton's 1st Law

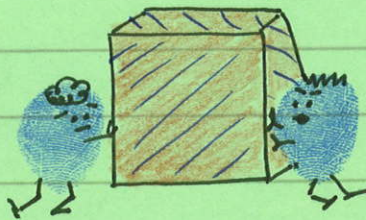
**Net force** - the combination of all the forces acting on an object



\* Remember that force is measured in Newtons  
AND requires direction!

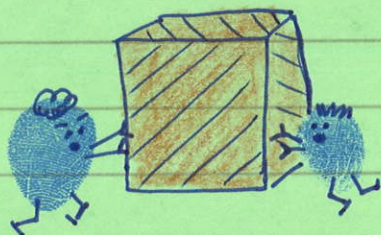
$$200 \text{ N (to the R)} + 100 \text{ N (to the R)} = 300 \text{ N (to the right)}$$

Balanced forces combine to form a net force of zero.



$$200 \text{ N (R)} + 200 \text{ N (L)} = 0 \text{ N}$$

If the forces acting on an object do not combine to form zero, they are unbalanced forces.



$$200 \text{ N (R)} + 100 \text{ N (L)} = 100 \text{ N (R)}$$

## Newton's 1st Law - Law of Inertia

An object at rest stays at rest and an object in motion stays in motion with the same speed and in the same direction unless acted upon by an unbalanced force.

The tendency of an object to resist a change in its motion is called inertia.

## 8-3 Newton's 2nd Law

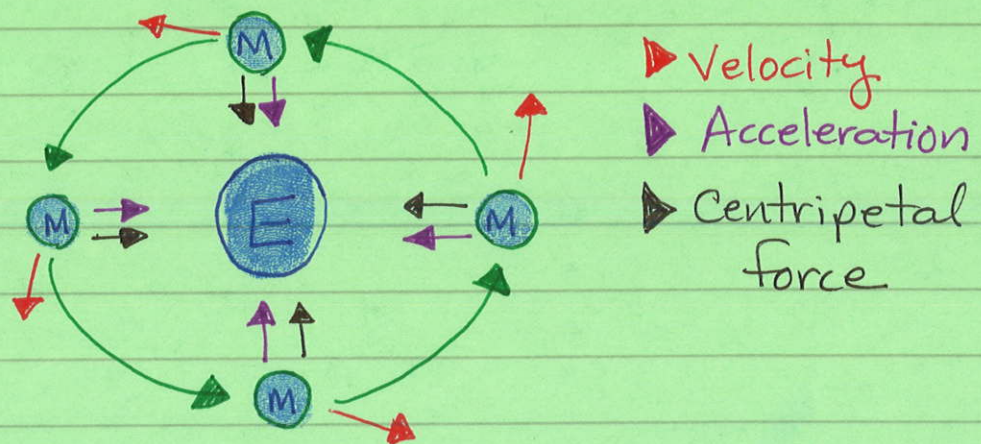
The acceleration of an object is equal to the net force acting on the object divided by the object's mass.

$$\text{Acceleration} = \frac{\text{Force (N)}}{\text{mass (kg)}}$$

\* Acceleration is  $\text{m/s}^2$  so...

Newton is the same as  $\text{kg} \cdot \text{m/s}^2$

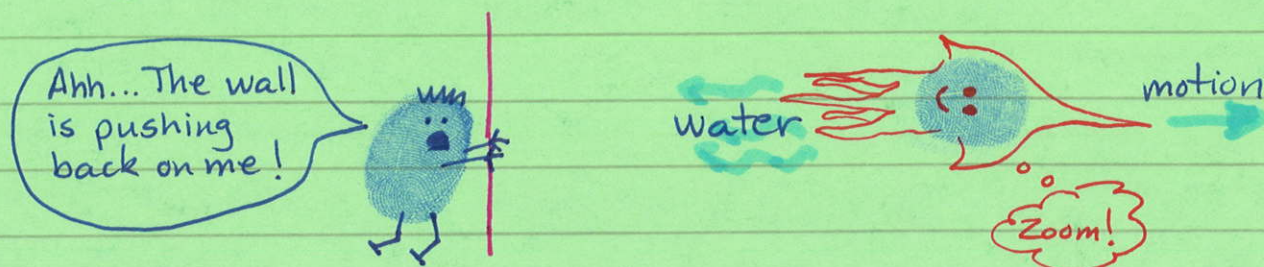
Centripetal force - a force acting perpendicular to the direction of motion (in a circular path), toward the center of the curve.



Earth's gravity constantly changes the moon's direction

## 8-4 Newton's 3rd Law

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



A force pair is the forces two objects apply to each other.

\* These forces don't equal a net force of zero because they are each acting on a different object!

Because action and reaction forces do not cancel each other out, they affect the motion of objects.

Momentum is a measure of how hard it is to stop a moving object.

$$\text{Momentum} = \text{mass (kg)} \times \text{Velocity (m/s)}$$