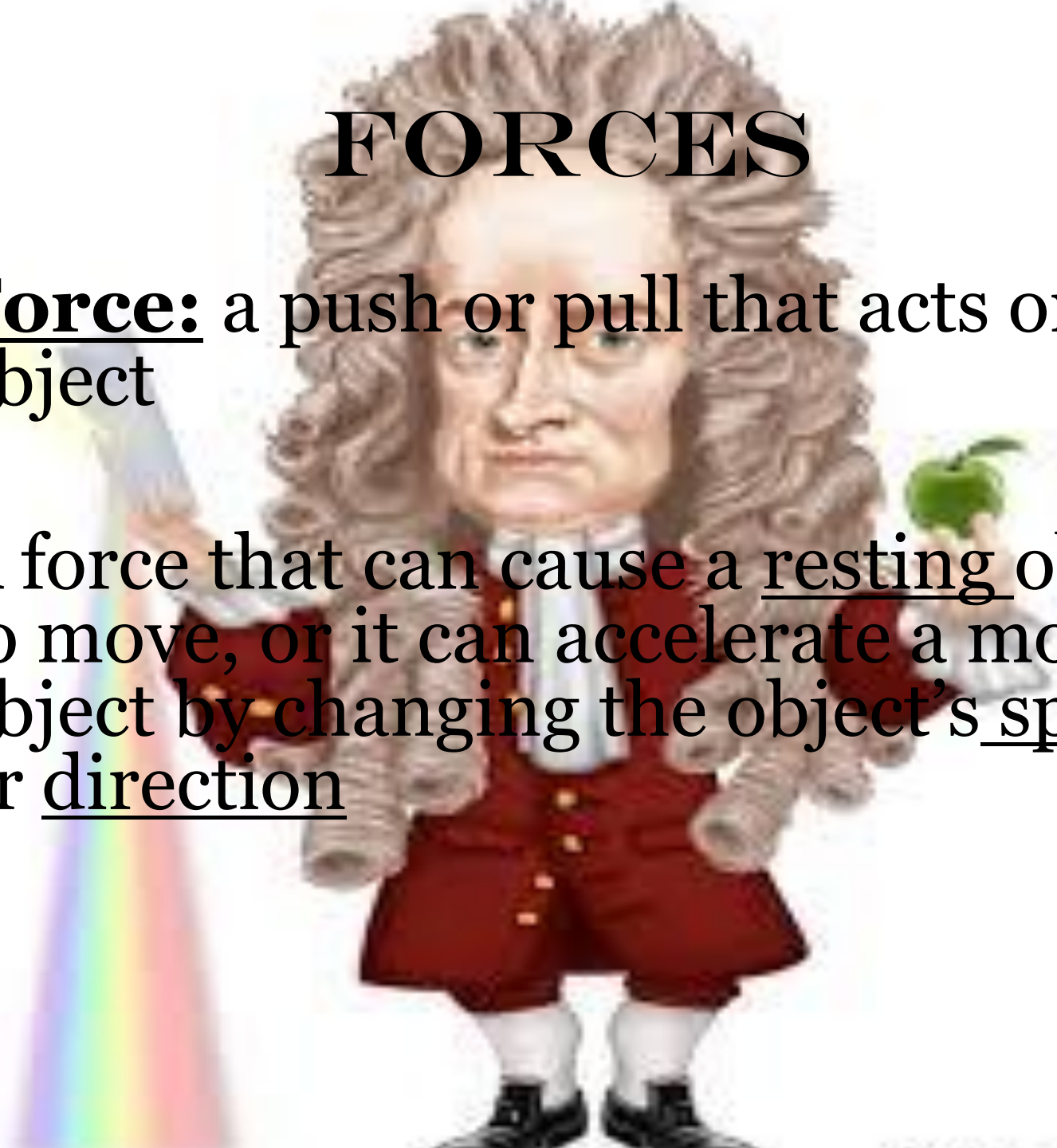




FORCES

FORCES

- **Force**: a push or pull that acts on an object
- A force that can cause a resting object to move, or it can accelerate a moving object by changing the object's speed or direction



NEWTONS



- Force is measured in **Newton (N)**
- Named after **Sir Isaac Newton**
- One Newton is the force that causes a 1kg mass to accelerate at a rate of 1m/s^2 . (**$1\text{N} = 1\text{ kg}\times\text{m/s}^2$**)

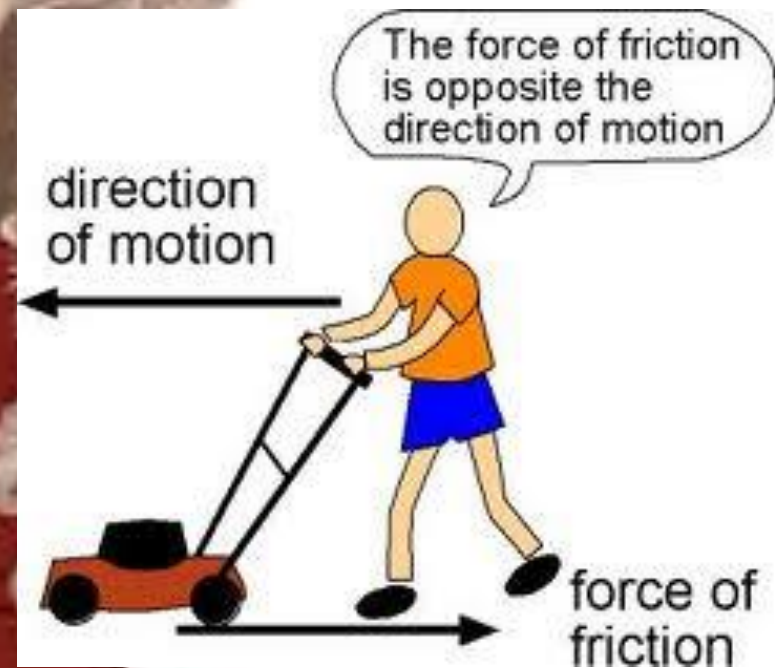
NET FORCE



- **Net force**: overall force acting on an object after all of the forces are combined.
- Forces in the same direction = **add together**
- Forces in opposite directions = **subtract from each other**

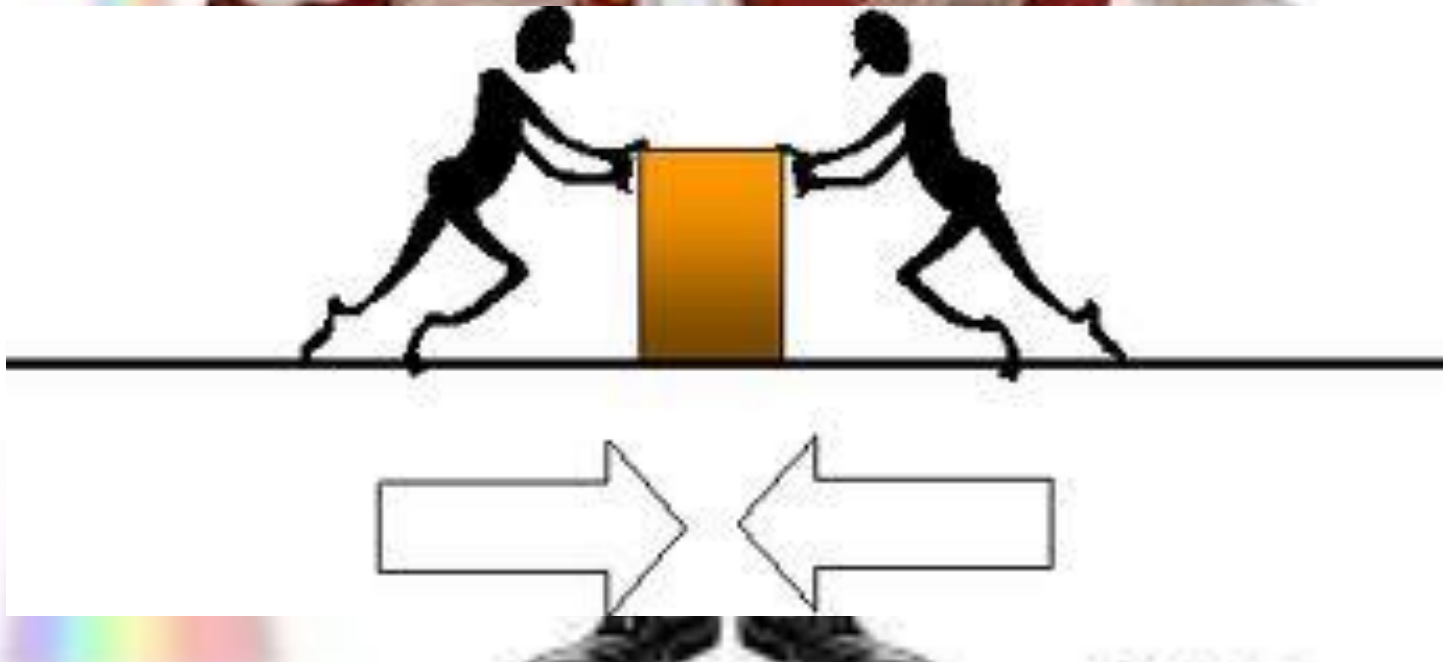
FRICTION

- All moving objects are subject to **friction**- a force that **opposes** the motion of objects that touch as they move past each other.
- Friction acts at the **surface** where object are in contact with each other.



BALANCED FORCES

- Forces that combine that produce a net force of zero and there is no change in the object's motion
- Ex: tug of war, arm wrestling



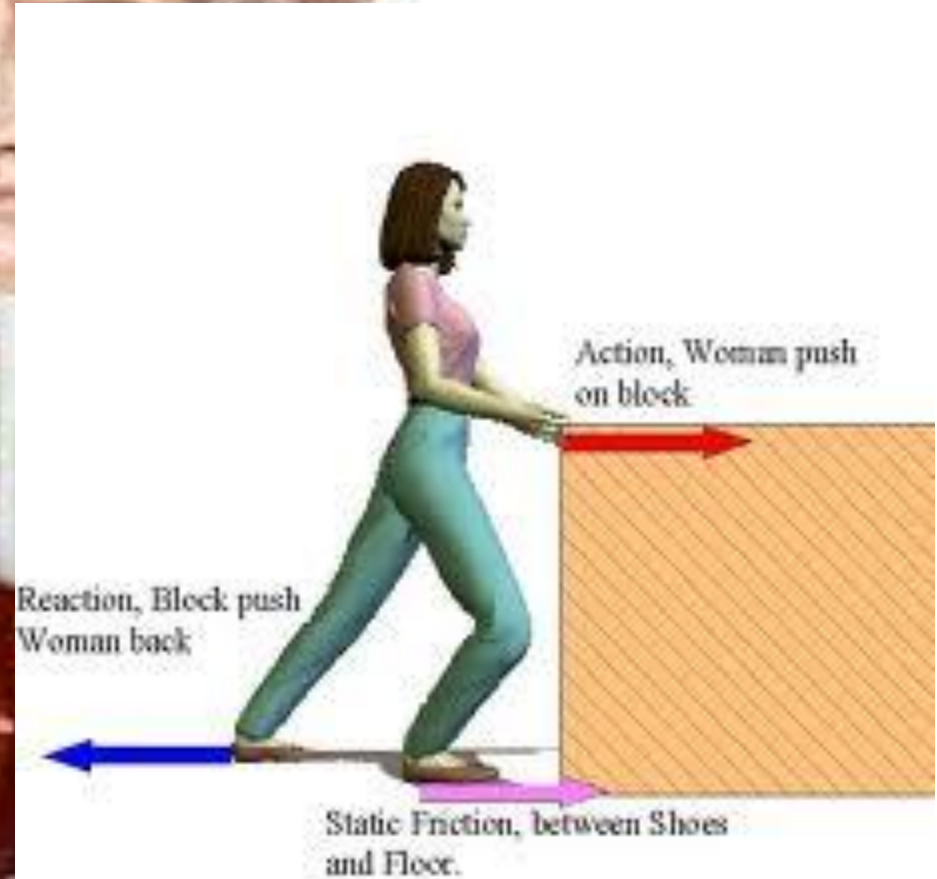
UNBALANCED FORCE

- Force that results when the net force acting on an object is not equal to zero, and it accelerates
- Ex: pushing a resting book on table, winner or loser in tug of war



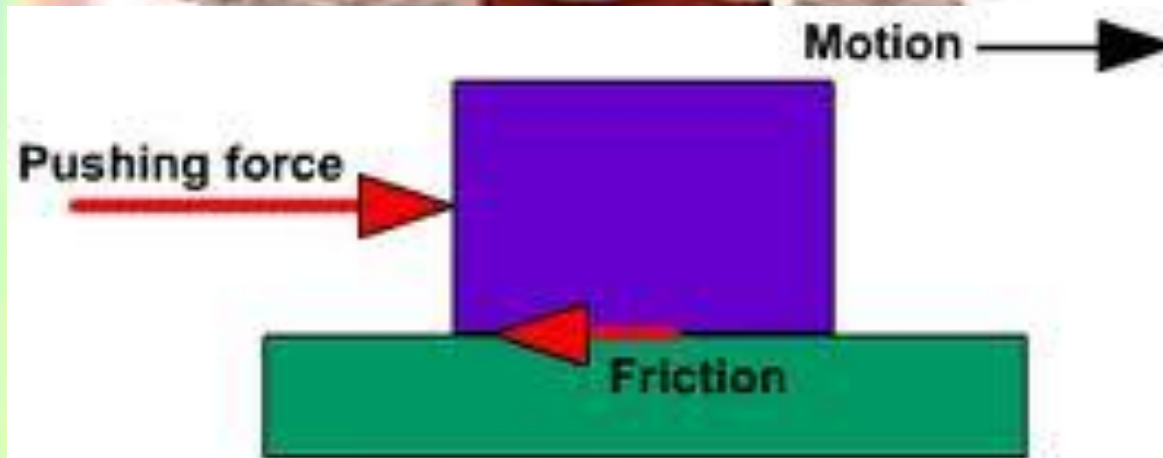
STATIC FRICTION

- The friction force that acts on objects that are not moving
- Always acts in the direction opposite of the applied force
- Ex: steps- friction between the ground and your foot keep your foot from slipping



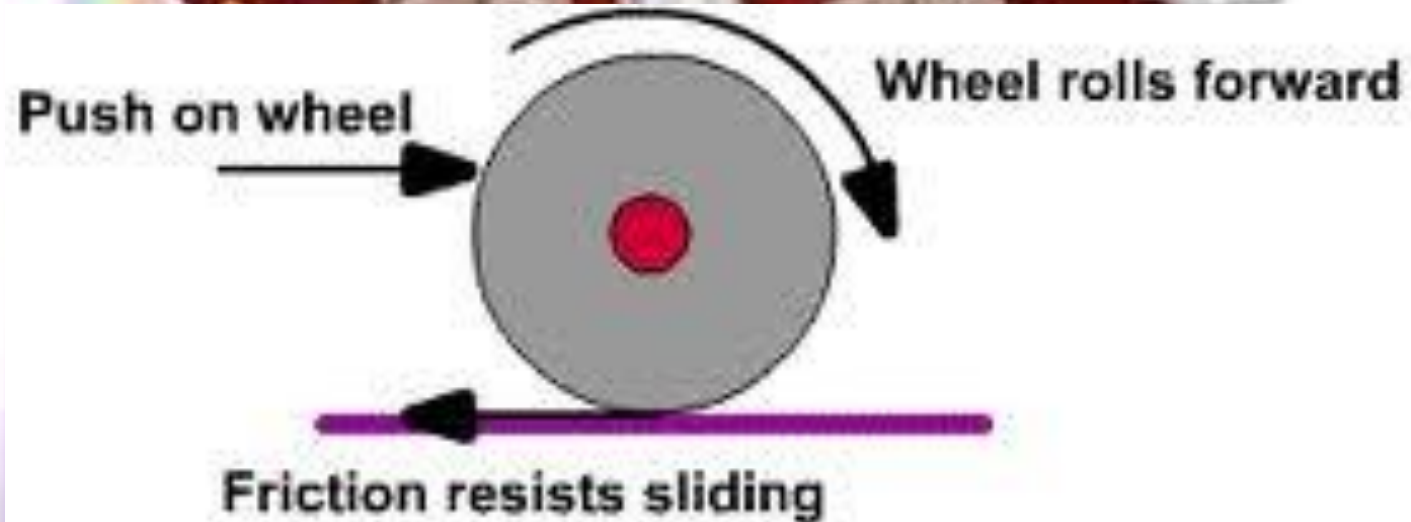
SLIDING FRICTION

- Force that opposes the direction of motion of an object as it slides over a surface
- Sliding friction is less than static friction, so less force is needed to keep an object moving than to start it moving
- Ex: moving a box across the floor



ROLLING FRICTION

- Friction force that acts on rolling objects
- This is about 100-1000 times less than the force of static or sliding friction
- Ex: Moving dollies, ball bearings



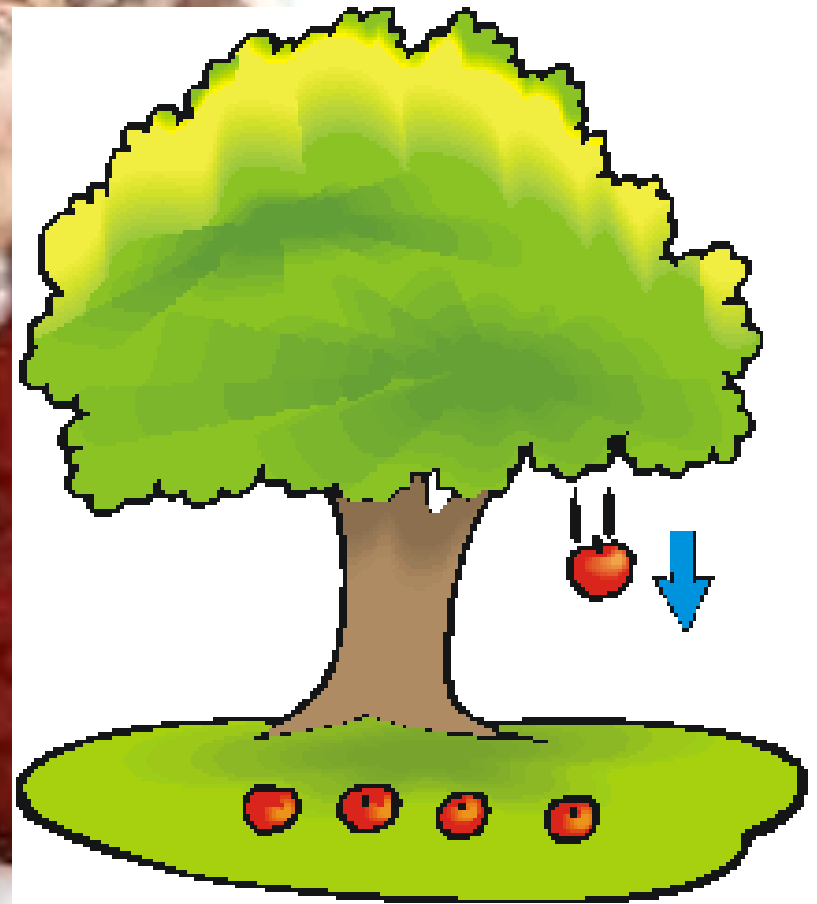
FLUID FRICTION

- Force that opposes the motion of an object through a fluid
- Fluid friction acting on a object moving through air is known as air resistance
- Ex: stirring cake batter



GRAVITY

- **Gravity**- force that acts between any two masses.
- Attractive force pulling objects together
- Ex: Earth's gravity acts downward toward the center of Earth



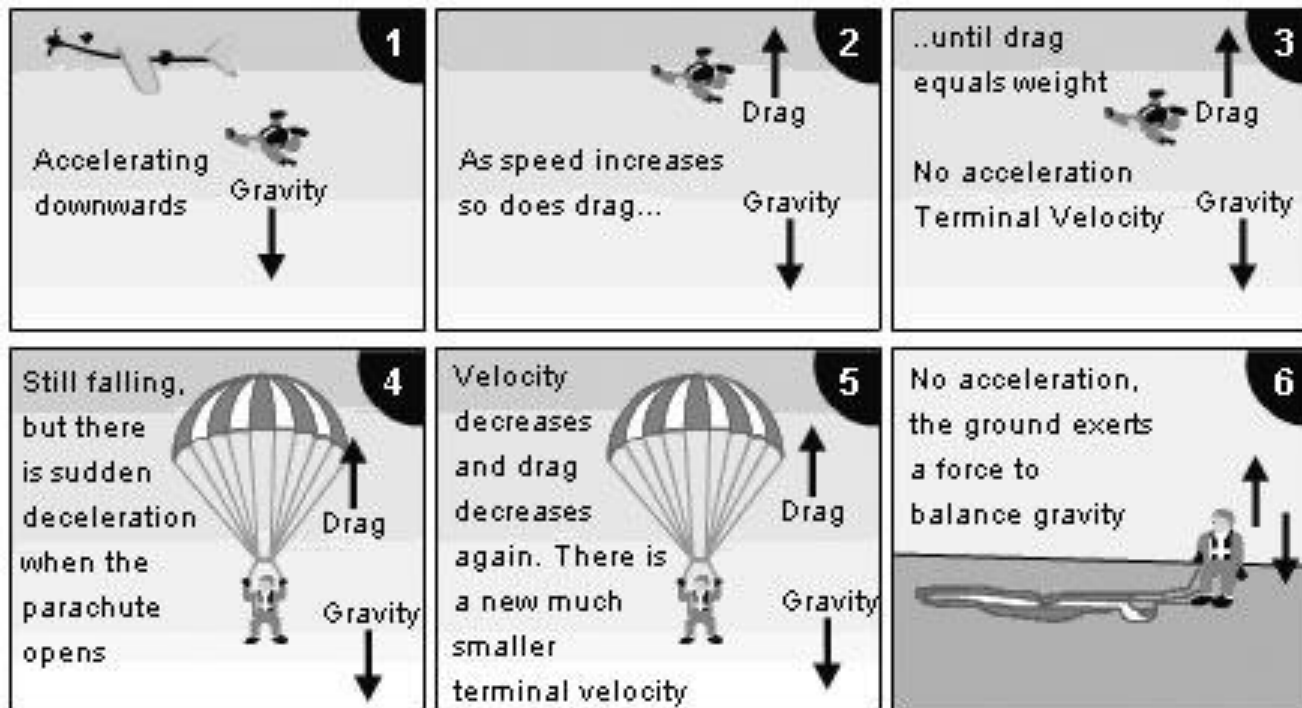
GRAVITY

- Both gravity and air resistance affect the motion of falling object
- Gravity causes objects to accelerate downward, whereas air resistance acts in the direction opposite to the motion and reduces acceleration.



TERMINAL VELOCITY

- **Terminal velocity**- constant velocity of a falling object when the force of air resistance equals the force of gravity.





NEWTONS LAWS OF MOTION

FIRST LAW



- The state of motion of an object does not change as long as the net force acting on the object is zero
- An object in motion will remain in motion, and an object at rest will remain at rest unless acted on by an outside force.
- Sometimes called the law of inertia
 - Inertia is the tendency of an object to resist change in its motion

FIRST LAW

With no outside forces,
this object will
never move



With no outside forces,
this object will
never stop



<https://www.youtube.com/watch?v=OHw80HXSuAQ>

SECOND LAW

- Acceleration of an object is equal to the net force acting on it divided by the objects mass
- Mass is the measure of inertia of an object and depends on the amount of matter the object contains

$$\mathbf{A=F/ m}$$

- a=acceleration F= net force m= mass

SECOND LAW

$$F=ma$$

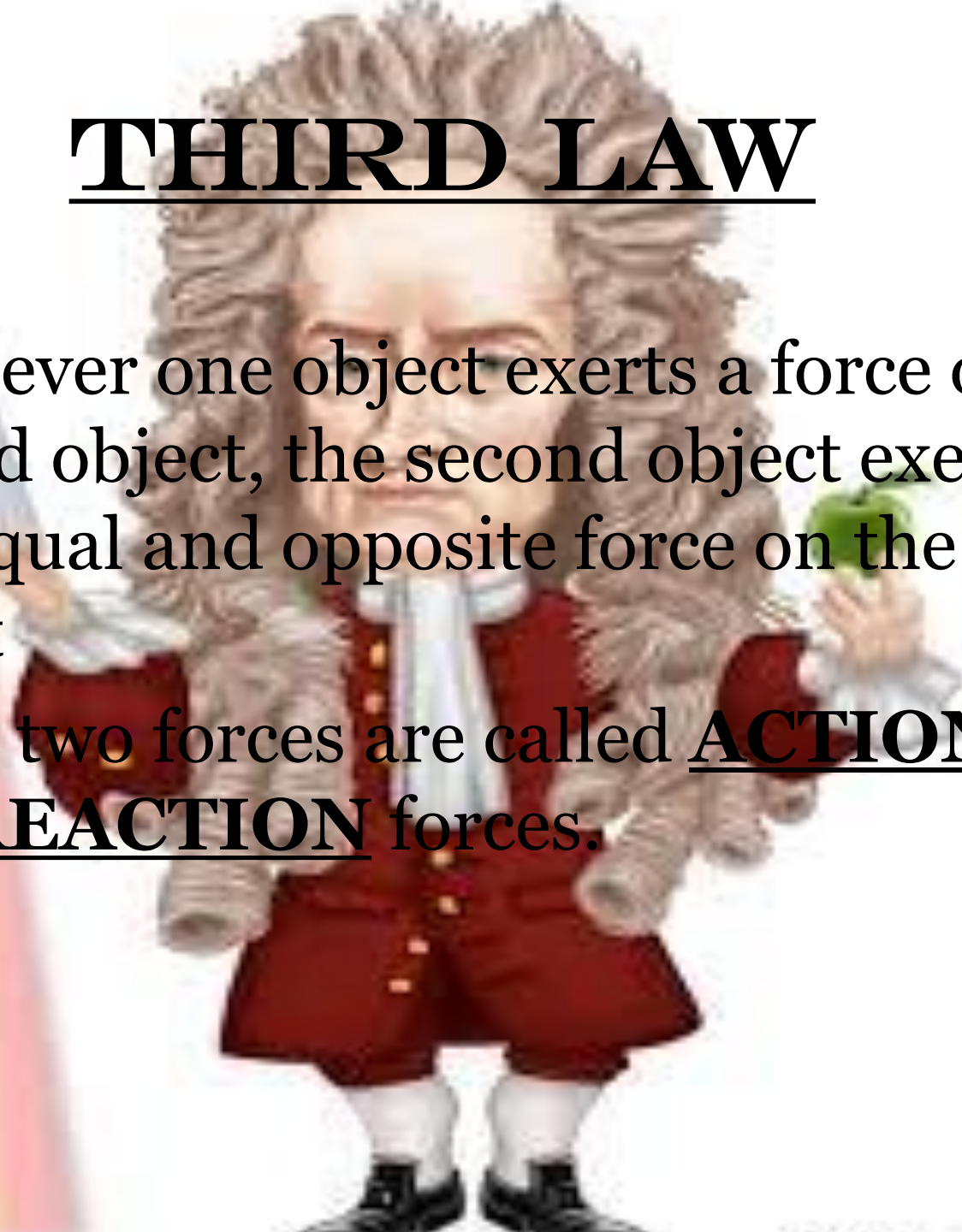


THE MORE FORCE...
THE MORE ACCELERATION



THIRD LAW

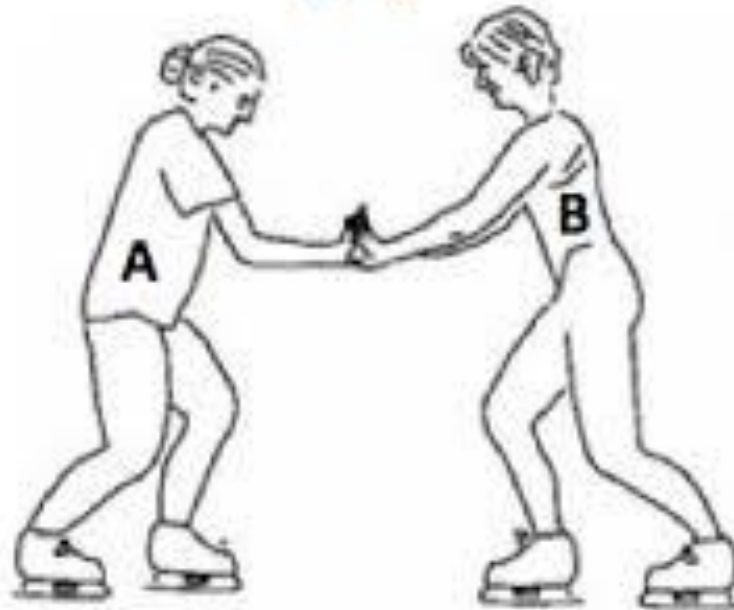
- Whenever one object exerts a force on a second object, the second object exerts an equal and opposite force on the first object
- These two forces are called ACTION and REACTION forces.



THIRD LAW

Force of A on B

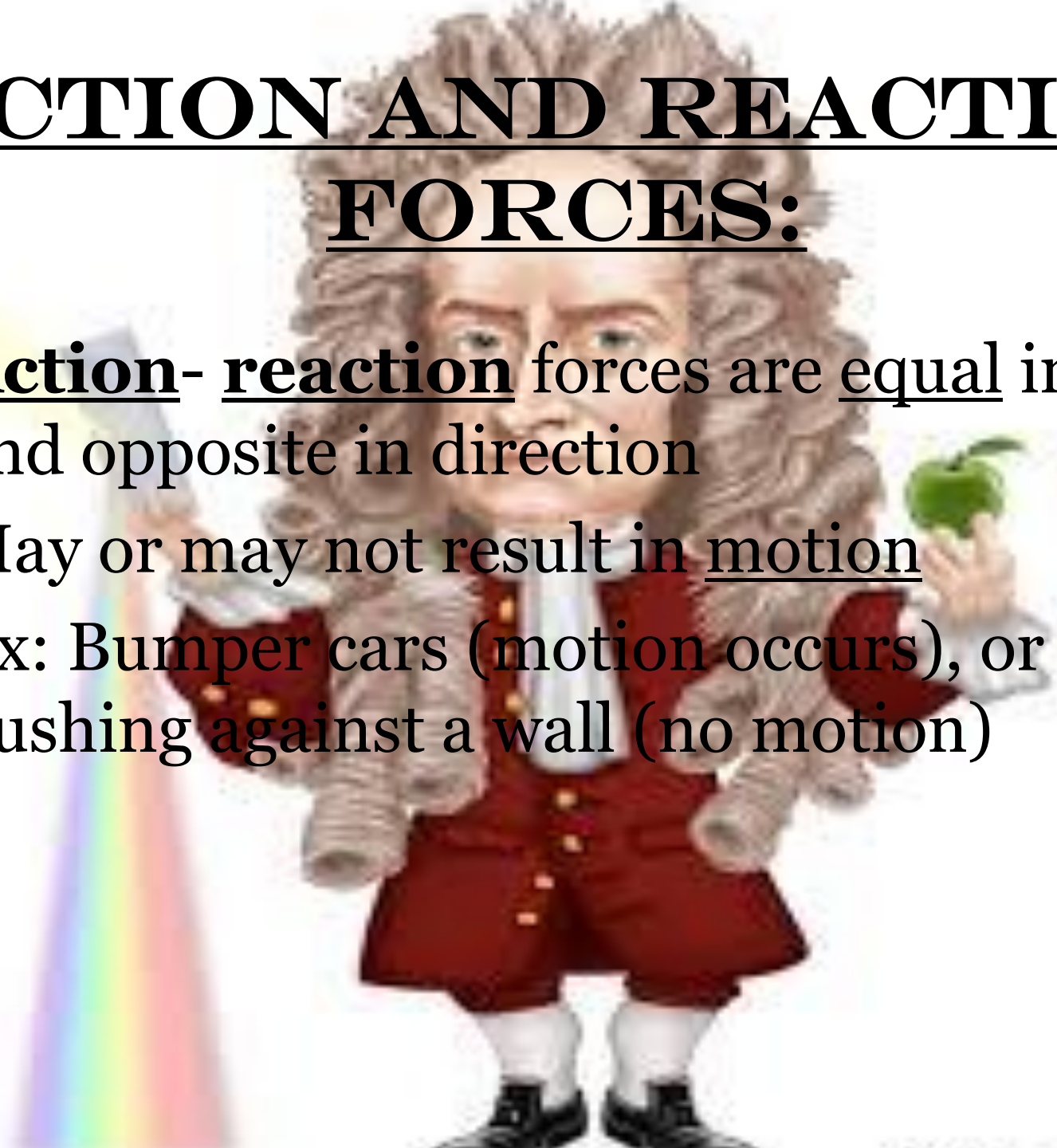
Force of B on A



<https://www.youtube.com/watch?v=MUGFT1hRTE4>

ACTION AND REACTION FORCES:

- Action- reaction forces are equal in size and opposite in direction
- May or may not result in motion
- Ex: Bumper cars (motion occurs), or pushing against a wall (no motion)



MASS V/S WEIGHT

- Weight and mass are NOT the same thing.
- Weight is the force of gravity acting on an object
- Mass is the measure of inertia of an object and depends on the amount of matter the object contains
- $W = \text{mass} \times \text{acceleration due to gravity}$

$$W = mg$$

DO YOU WEIGHT MORE ON EARTH OR THE MOON?

- Mass is the same in both locations
- Acceleration due to gravity on Earth is 9.6 m/s^2 , and the moon's acceleration due to gravity is $1/6^{\text{th}}$ that on Earth
- So, you weigh only $1/6^{\text{th}}$ as much on the moon as on Earth!

MASS V/S WEIGHT



<http://www.youtube.com/watch?v=-F5nmIJOF4U>

MOMENTUM

- Momentum- is the product of an object's mass and its velocity
- Momentum (**p**) = **m x v**
- Momentum units = **kg x m/s**



MOMENTUM

- An object has large momentum if the product of its mass and velocity is large
- An object with large momentum is hard to stop
- Momentum for any object at rest is zero.

<http://www.youtube.com/watch?v=y2Gb4Nlv0Xg&safe=active>



Momentum

Your truck has brakes...the massive hunk of stone doesn't