Forces

Forces come in pairs!

Balanced Forces
(no motion)

5 N force   5 N force

Unbalanced Forces
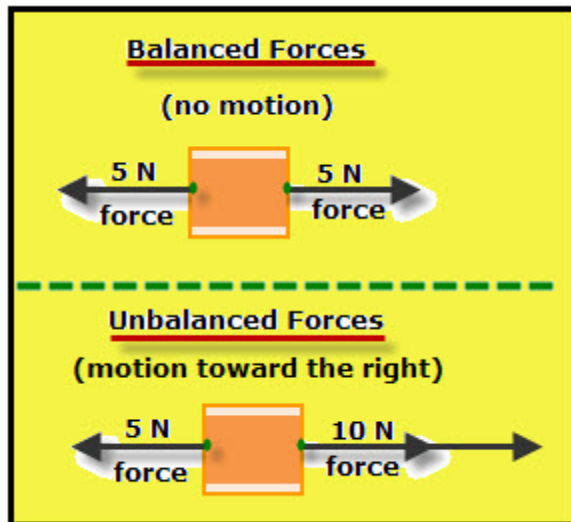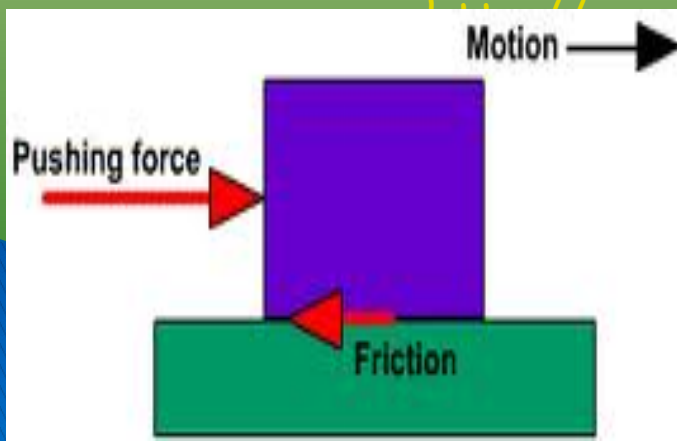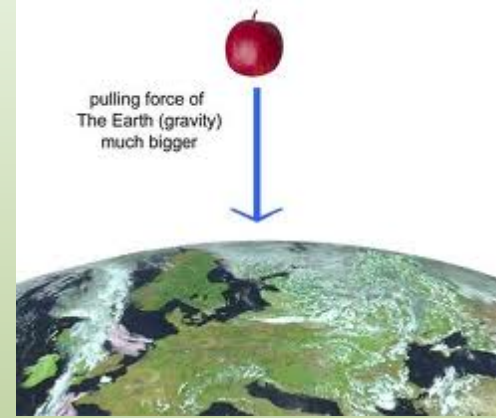(motion toward the right)

5 N force   10 N force

Force = 15 Newtons

What is a force?

- either a push or a pull
- are drawn as <u>vectors.</u> →
  Example:
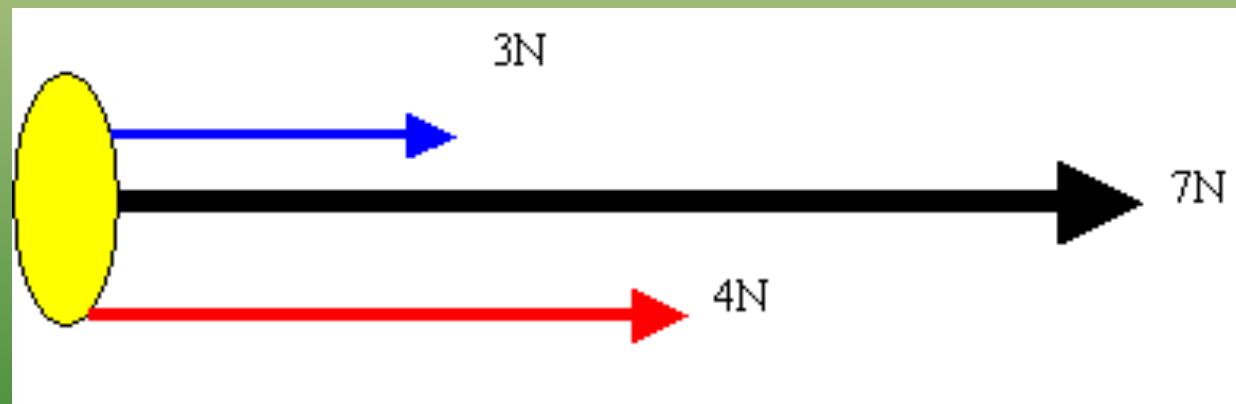 ◦ Draw arrows to represent two forces
    - Longer arrow= greater force

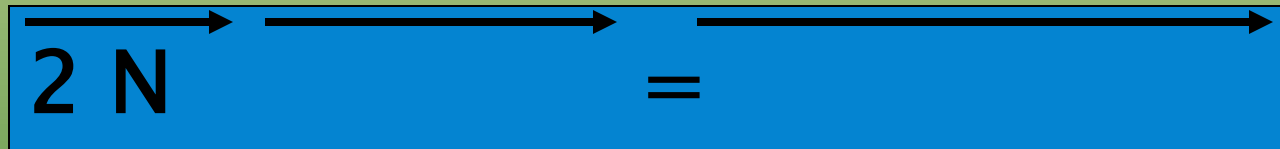pulling force of
The Earth (gravity)
much bigger

Motion

Pushing force

Friction

Push and pull forces

Newton

- The SI unit for force

- Unit = N (Newton)

Force = 15 Newtons

3N

7N

4N

3.Net Force

▸ <u>total amount of all forces added up together.</u>

2 N = Same direction, <u>ADD</u>
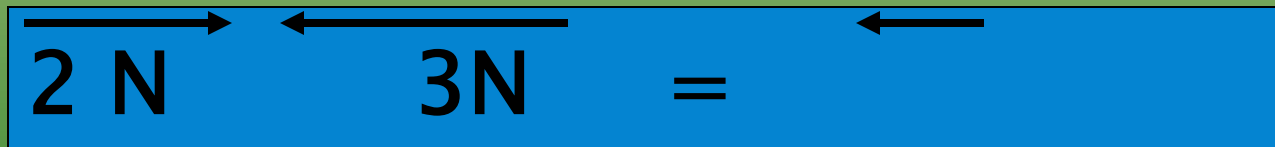
2 N   3N = Opposite direction, <u>SUBTRACT</u>

Practice
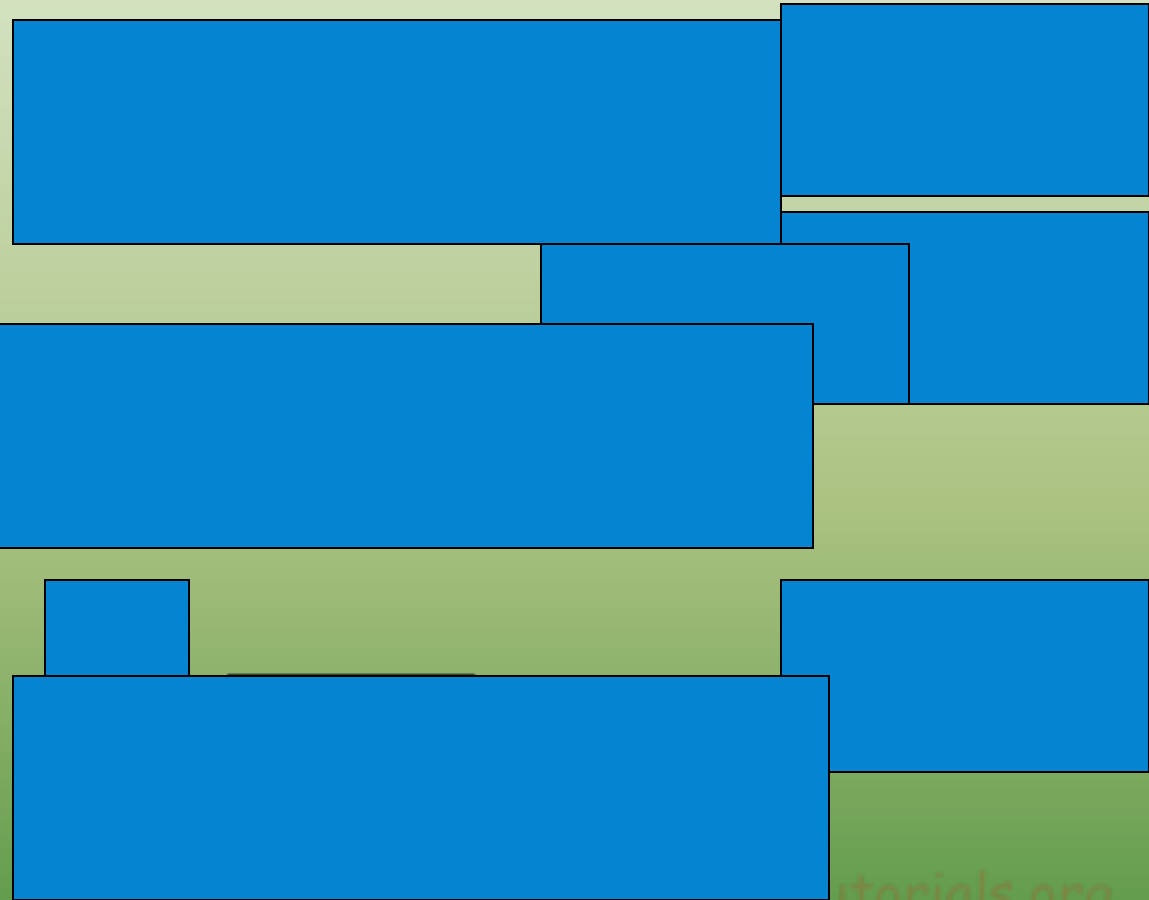
NET Force

4. Balanced Forces
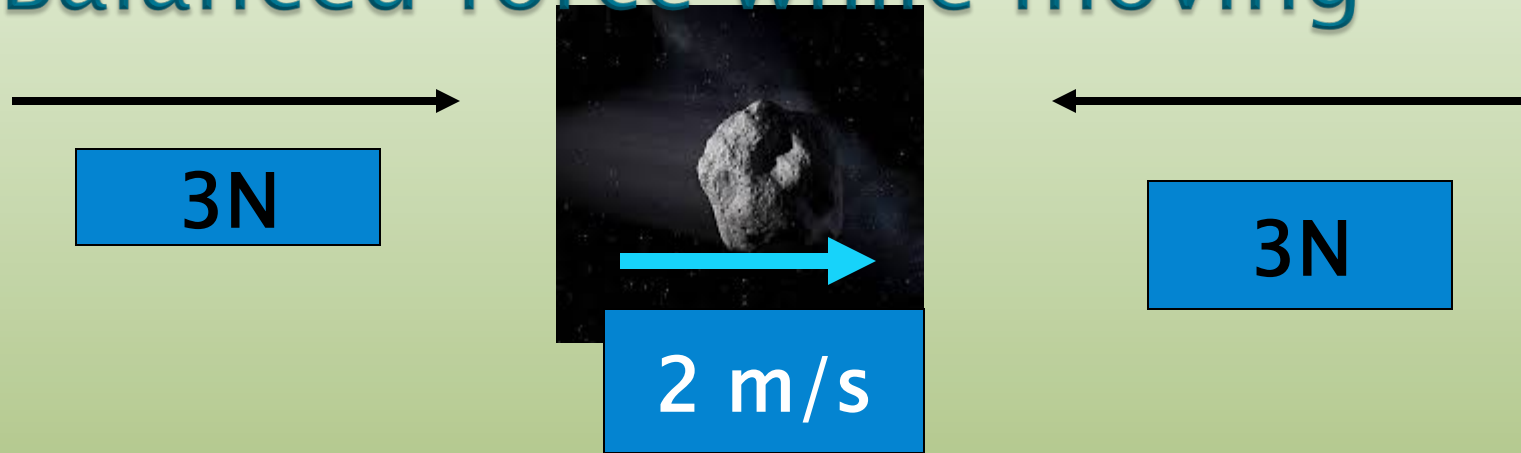
- When there is <u>no net force</u>. Then the forces are <u>balanced</u>
- Does not change object's velocity
  - Motion remains <u>unchanged</u>
  - it will keep doing whatever it was doing

Balanced Forces in Opposite Directions
When two equal forces act in opposite directions, they cancel each other out. The box doesn't move.

Balanced force while moving

3N

2 m/s

3N

If it is moving, then a balanced force won't change the way its moving.

Asteroid moving to the right at **2 m/s**

2 opposite forces are on the ball

Net force =

So, motion remains unchanged

5. Unbalanced Forces

▶ When there <u>is a net force</u>, then the forces are <u>unbalanced</u>

▶ <u>Causes velocity to change</u>
  ◦ <u>Speed up</u>
  ◦ <u>Slow down</u>
  ◦ <u>Change direction</u>

Individual forces

200 N -100 N

Unbalanced Forces in the Opposite Direction
When two forces act in opposite directions, the net force is the difference between the two individual forces. The box moves to the right.
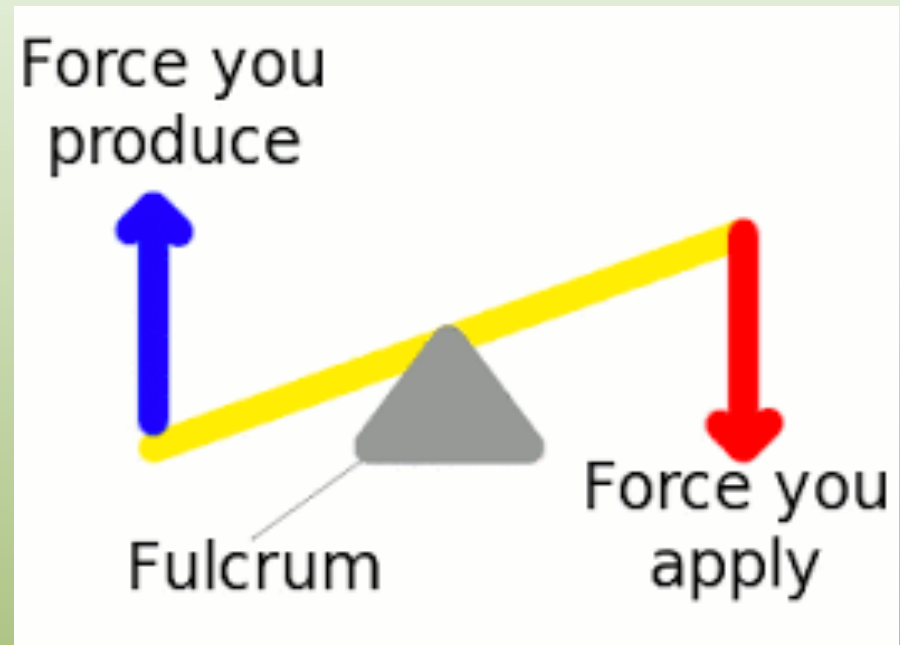
▸ 15) Unbalanced forces

▸ If it is not moving, then an unbalanced force will cause it to move.

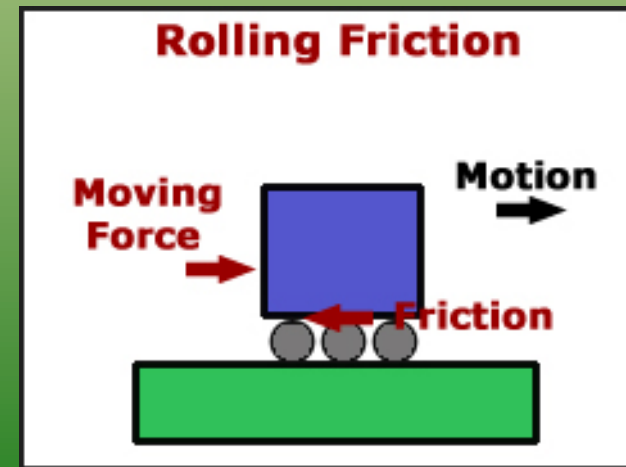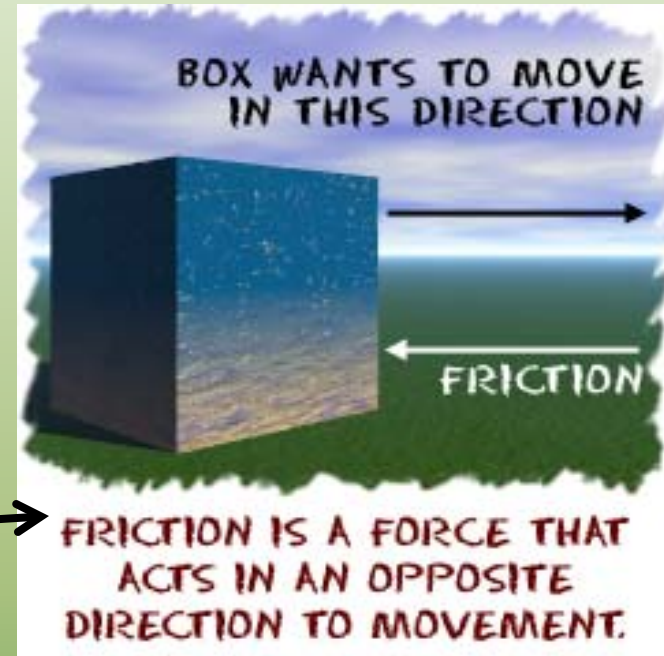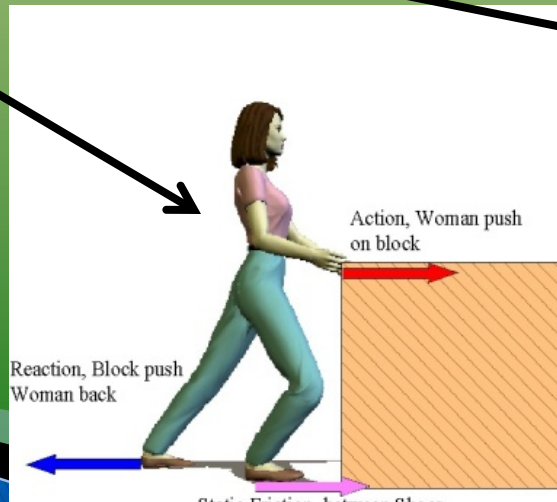▸ If it is moving, then it will cause the moving object to change is motion.

Truck speed up in this direction

Bigger force
100N

Unbalanced forces

Smaller force
60N
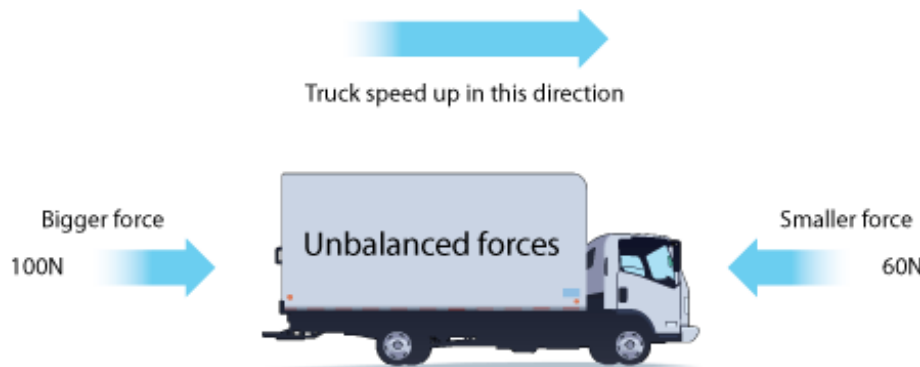
6) Fulcrum

- The point on which a <u>lever rests</u> – and on which it <u>pivots</u>.
- <u>"Pivot Point"</u>

Force you produce

Force you apply

Fulcrum

7) Friction – force exerted when two surfaces rub against each other Direction of fricton is <u>opposite</u> to direction of <u>movement</u>)

ex: sliding
        rolling
          static
          fluid

BOX WANTS TO MOVE IN THIS DIRECTION

FRICTION

FRICTION IS A FORCE THAT ACTS IN AN OPPOSITE DIRECTION TO MOVEMENT.

Rolling Friction

Moving Force

Motion

Friction

Action, Woman push on block

Reaction, Block push Woman back

7) Friction (continued)

▸ The strength of friction depends on:

▸ 1. Types of _____ SURFACES involved
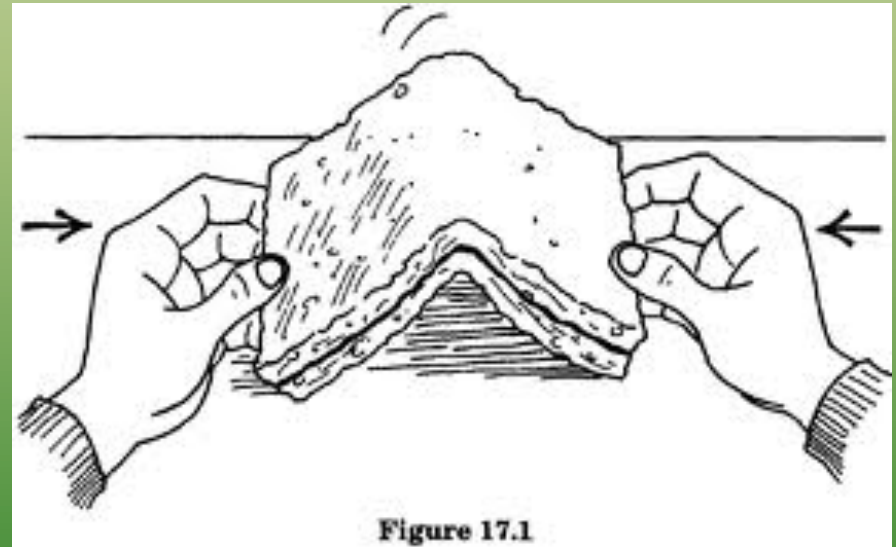
▸ 2.How _____ HARD the surfaces push together.

8) Elastic Forces

- Matter is considered elastic if it returns to its original form after it squeezed or stretched

- Compression – pushing or squeezing matter together

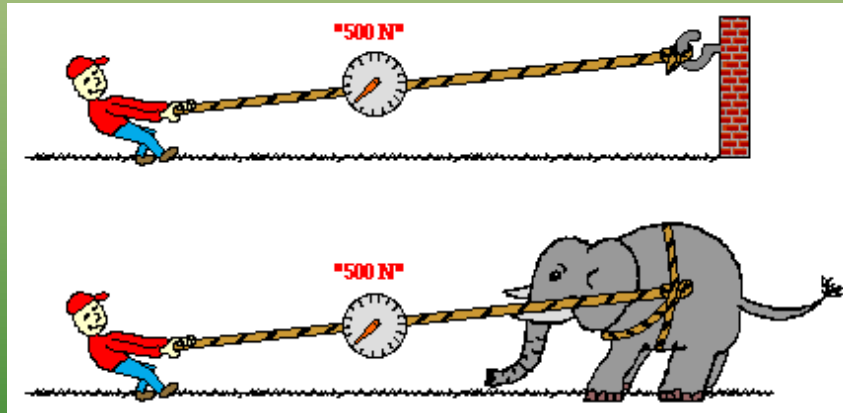- Tension – stretching or pulling apart

Compressional force(exapmles)

pushing together

example: squeezing

Figure 17.1

Tensional forces (examples)

▸ **Tensional elastic force**   pulling apart

Examples - Forces

10 N   10 N

- Balanced or unbalanced? [ ]
- Direction of the movement? [ ]
- The net force is _____ [ ]
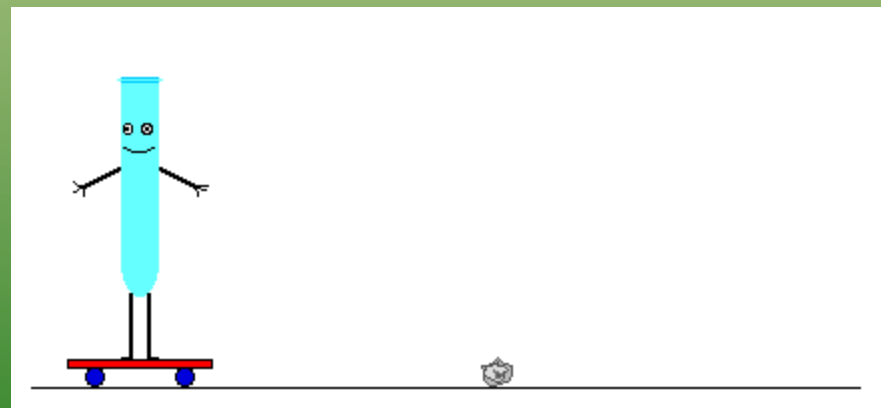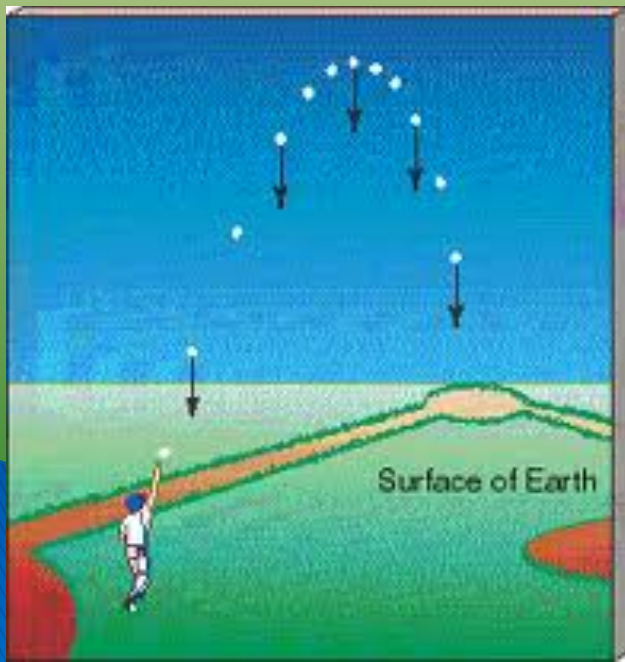- Is it compressional or tensional? [ ]

Example #2

3 N   10 N

=

- Balanced or unbalanced?
- The net force is:
- Is it compressional or tensional?
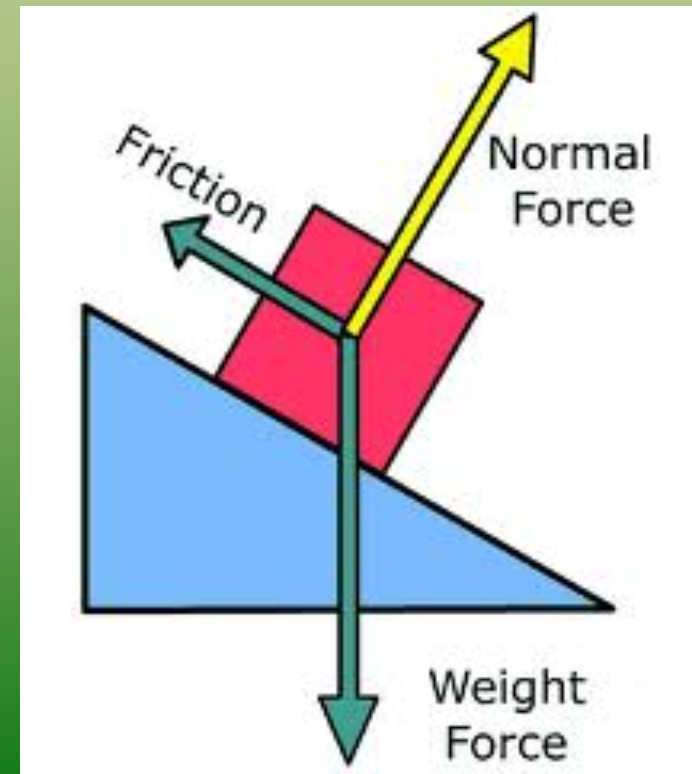
- Unbalanced
- 7N right
- Tensional

4N + 10 N

+

=
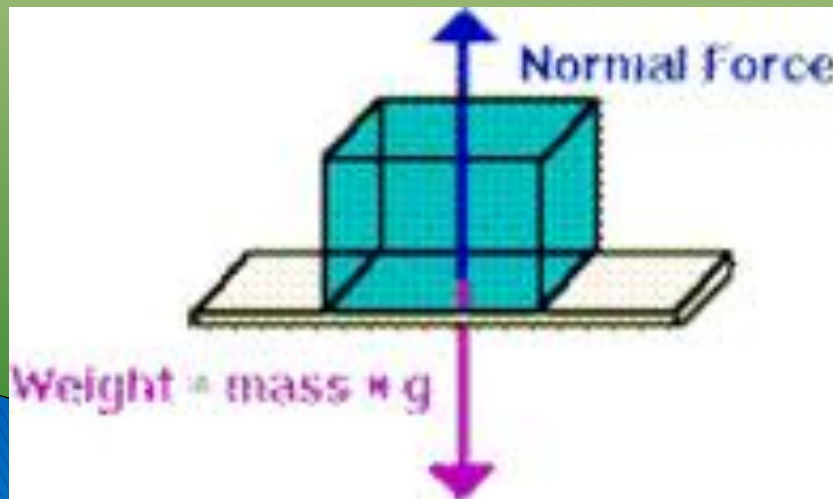
- Balanced or unbalanced?
- The net force is:
- Is it compressional or tensional?

- Unbalanced
- 14N right
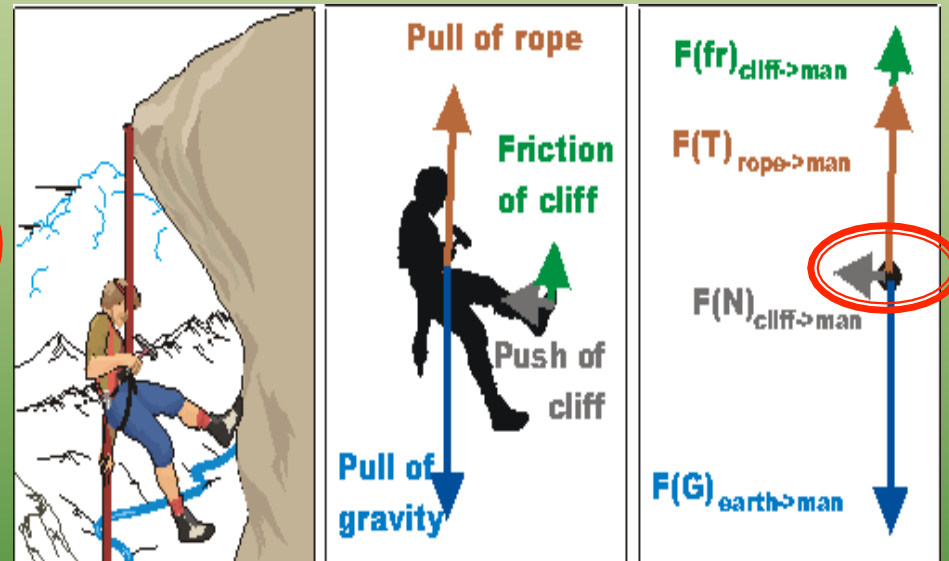- Neither

Which forces are present in theses pictures?

Surface of Earth

9) Normal force – perpendicular to surface ⊥ (rock climbers know this)
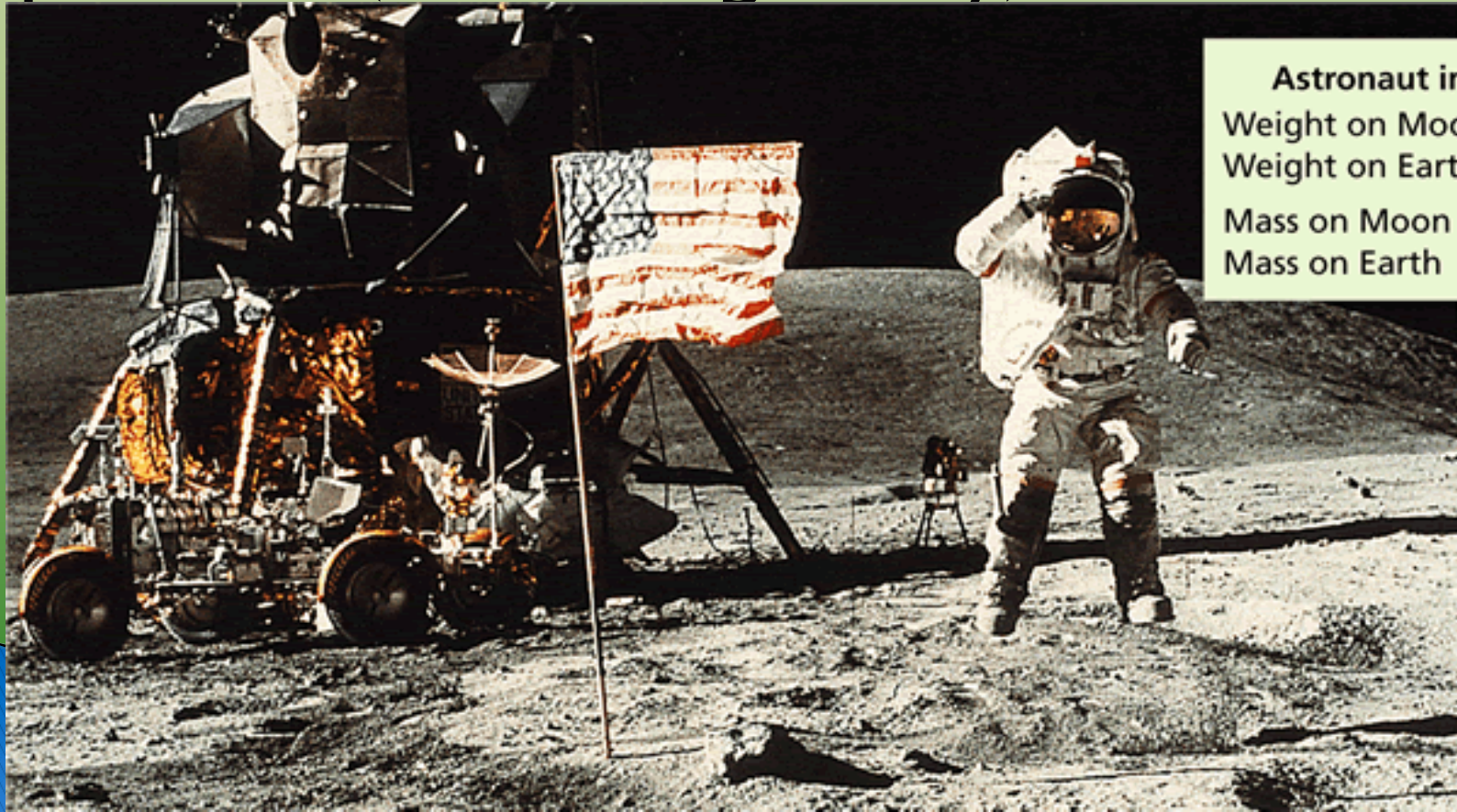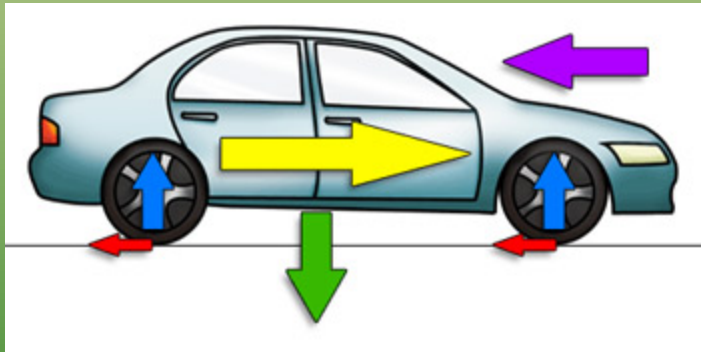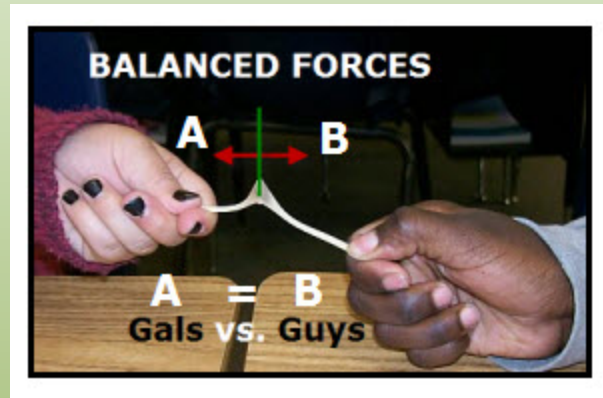
127 hours

10) Gravity

- A force that pulls objects towards each other
- The force that pulls falling objects towards earth

11) Weight

- Gravitational pull on an object
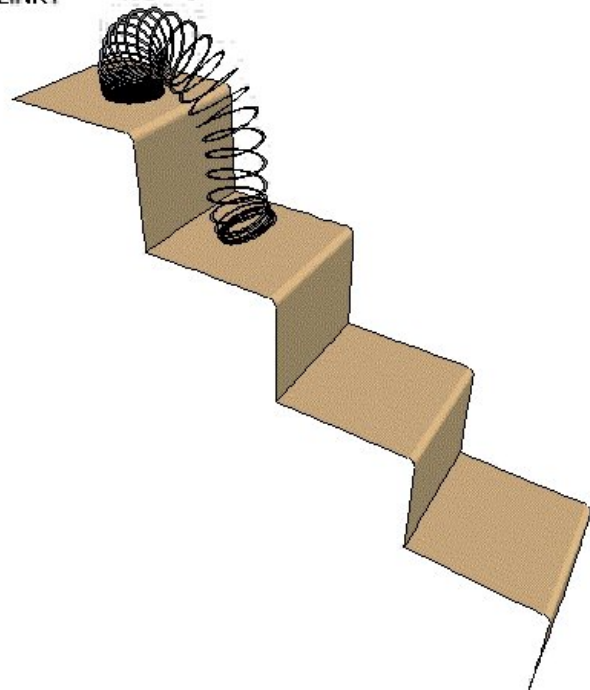- Changes when you go to different planets (mass x gravity)

Astronaut in Spacesuit

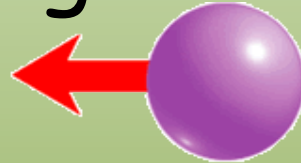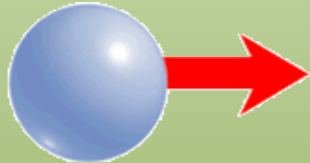|		
Weight on Moon	=	270
Weight on Earth	=	1,617
Mass on Moon	=	165
Mass on Earth	=	165

BALANCED FORCES
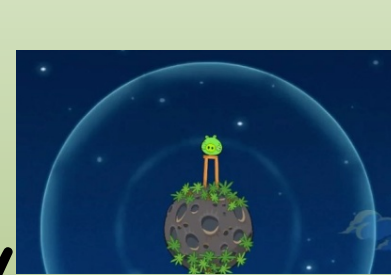
A ← → B

A = B
Gals vs. Guys
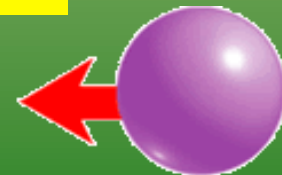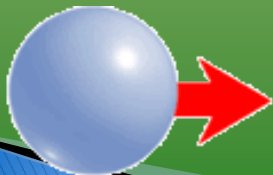
SLINKY

12) Universal Law of Gravity

All objects in the universe are attracted to each other by gravity

The force of gravity acts between all objects.

If mass increases, the force of gravity increases.

If distance increases, the force of gravity decreases.

13) Inertia

- The tendency of an object to <u>resist a change in motion</u>
- Inertia commonly described as Newton's 1st law
- Depends on the MASS of an object.
- The more mass an object has, the more inertia the object has.
  - <u>stack of rings</u>
  - <u>7 examples of imerta</u>

14) FIRST LAW OF MOTION: Law of Inertia

- An object at <u>rest</u> will <u>stay</u> at <u>rest</u> and an object in motion remains in motion at constant speed and in a straight line unless <u>acted</u> upon by an <u>unbalanced</u> force. (28s → 48s; 1:04s → 1:10s; 2:48 → 3:10)
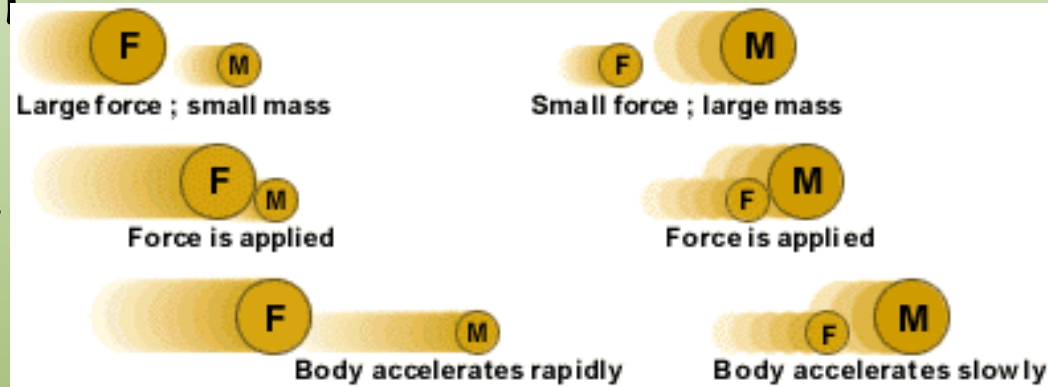
- http://www.youtube.com/watch?v=7Ix-eywqUOg&NR=1&feature=fvwp

15) Newton's 2nd law

- The <u>acceleration</u> of an object depends on the <u>mass</u> of the object and the <u>amount of force</u> applied.
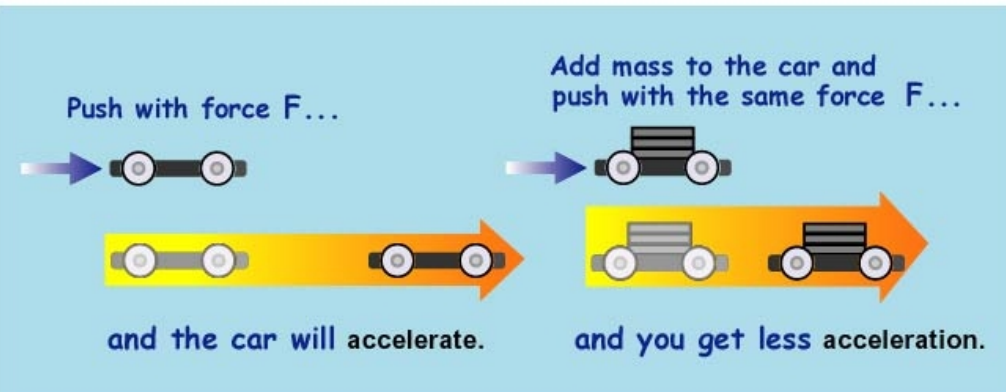- F = ma
- http://www.youtube.com/watch v=UhCG0qoY9Dc
- (0 → 18s; 27s →51s)

Large force ; small mass

Small force ; large mass

Force is applied

Force is applied

Body accelerates rapidly

Body accelerates slowly

Newton's Second Law of Motion

Push with force F...

Add mass to the car and push with the same force F...

and the car will accelerate.

and you get less acceleration.

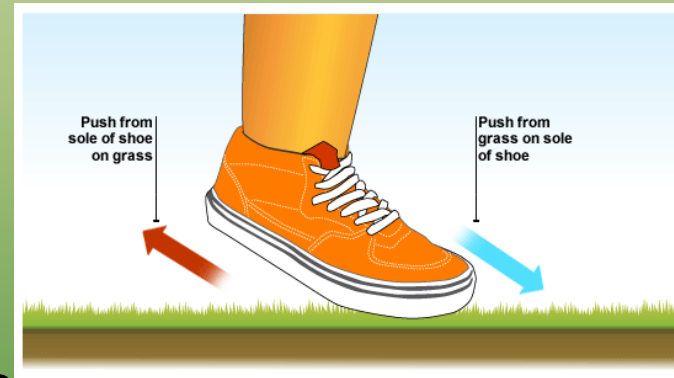Acceleration (m/sec^2) — $a = \dfrac{F}{m}$ — Force (newtons, N) — Mass (kg)
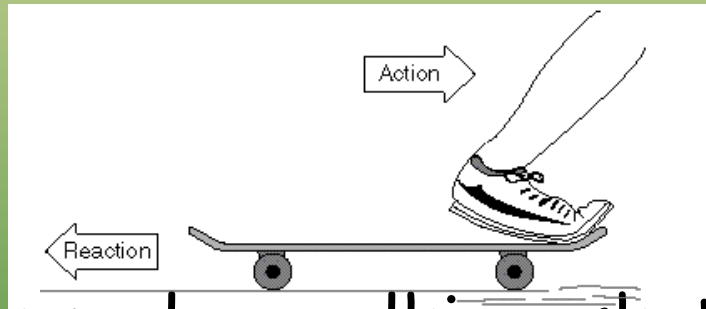
F= m x a

a= F / m
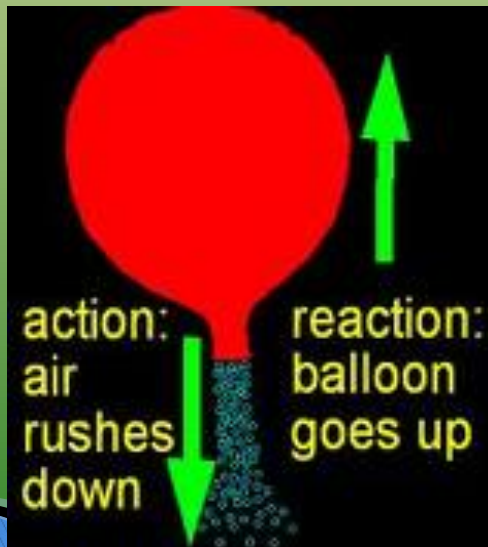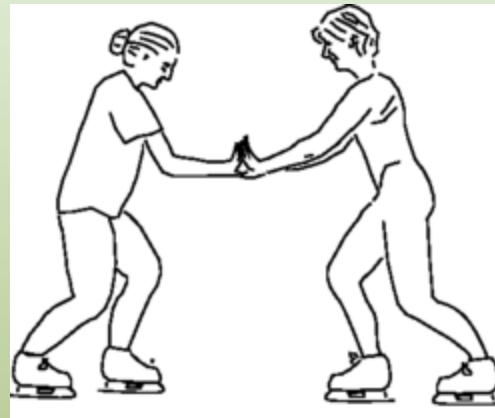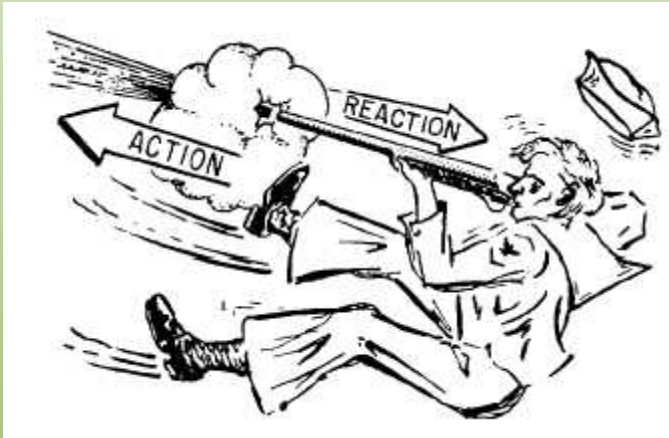
m= F / a

*UNITS
Force= N
Acceleration= m/s²
Mass= kg
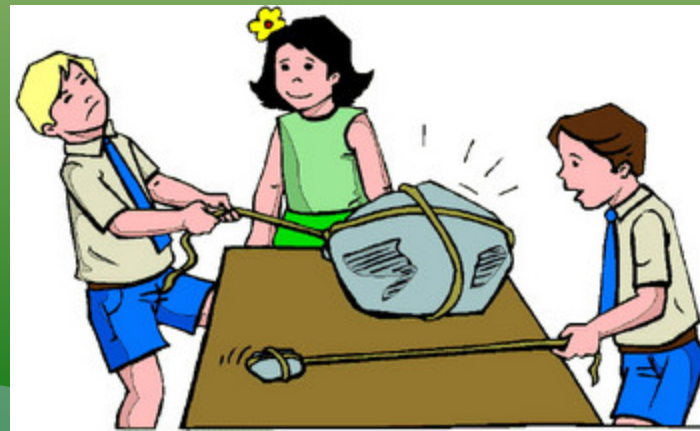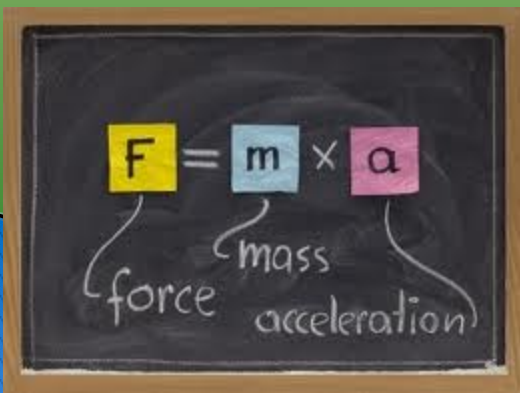
16) Newton's 3rd Law

- Whenever one object exerts a force on a second object, the second object exerts an equal and opposite force on the first.
- For every action, there is **an equal and opposite** reaction

- Example – walking, skateboarding
- http://www.youtube.com/watch?v=Xx9kiF00rts
- (3:41 → 4:00s)

ACTION
REACTION

I love Newton's third law!

action:
air rushes down
reaction:
balloon goes up

Action force
Reaction force

When the dog leaps, it pushes down on the ground. The reaction force of the ground pushes the dog into the air.

http://www.youtube.com/watch?v=cWOv7NyOnhY&list=PL3E788EDA794CCE7B&index=7&feature=plpp_video