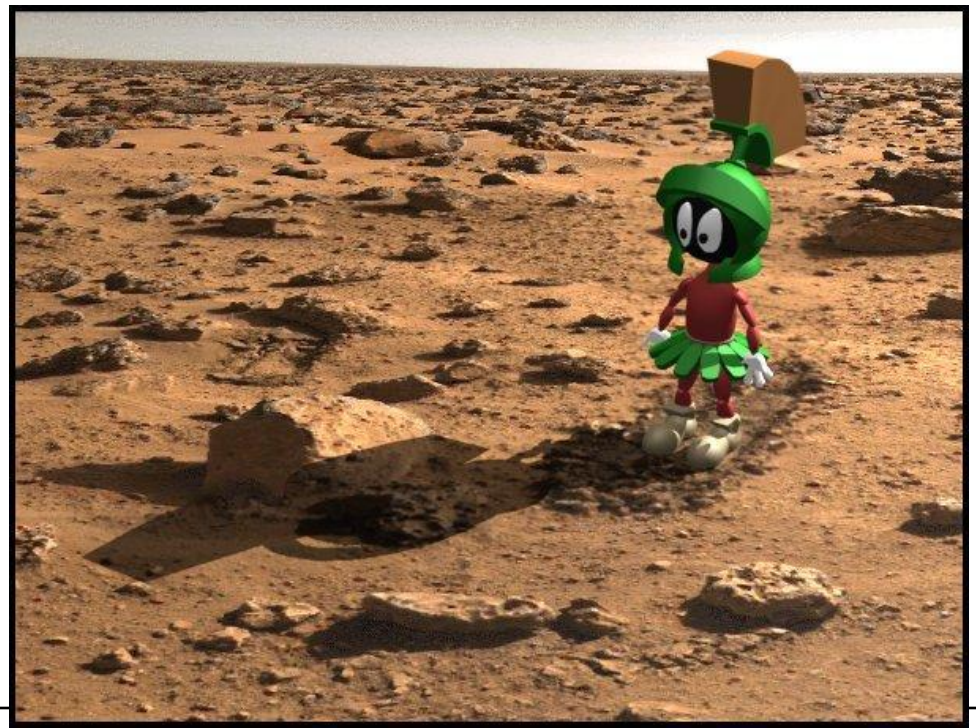
Weight and Mass

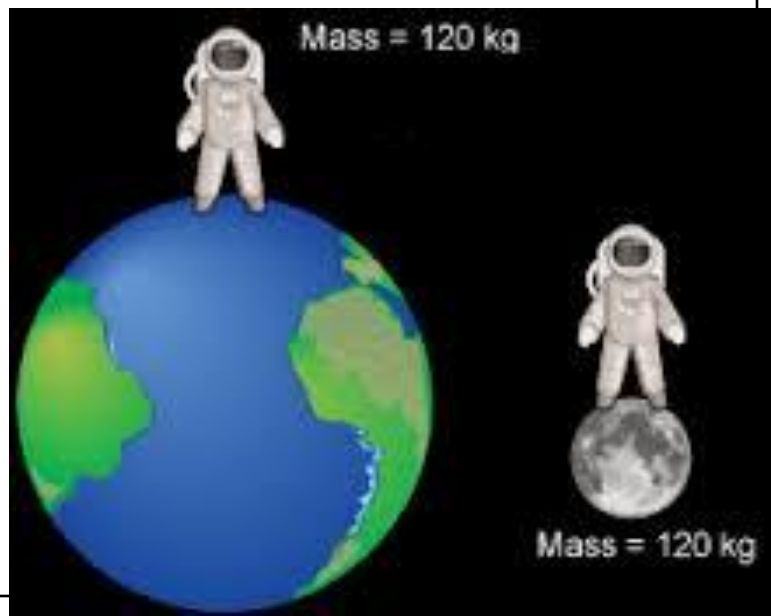
Life on Mars

- So imagine that you are on planet Mars. Is the amount of matter that makes you up different?
- Is the force pulling you downward different?



Weight

- **Weight** – The force pulling down on an object created by earth's gravity ($9.8 m/s^2$)
  - Weight is a FORCE
  - Therefore, units = **NEWTONS (N)**
- Your **Weight** will be different on Earth and Mars
  - Earth's gravity = $9.8 m/s^2$
  - Moon's gravity = $1.6 m/s^2$
  - Weight changes with gravity



Calculating Weight

Formula: Force Weight = Mass * Gravity

Symbols	Fw	=	m	* g
Units	(N)	=	(kg)	(m/s^2)

- Remember to use Newtons NOT Pounds since we are Scientific. (1 N = 2.2 lbs)

Look Familiar?

Formula: Force Weight = Mass * Accel due to Gravity

Symbols Fw = m * g

Formula: Force = Mass * Accel

Symbols F = m * A

Calculating Weight

Example:

If you have a mass of 22kg on Earth ($9.8 m/s^2$), what is your weight?

- $Fw = 22kg * 9.8m/s^2$
- $Fw = 215.6\ kg*m/s^2$
- $Fw = 215.6\ N$

If you have a mass of 22kg on Mars (with 1/3 the gravity of Earth), what is your weight?

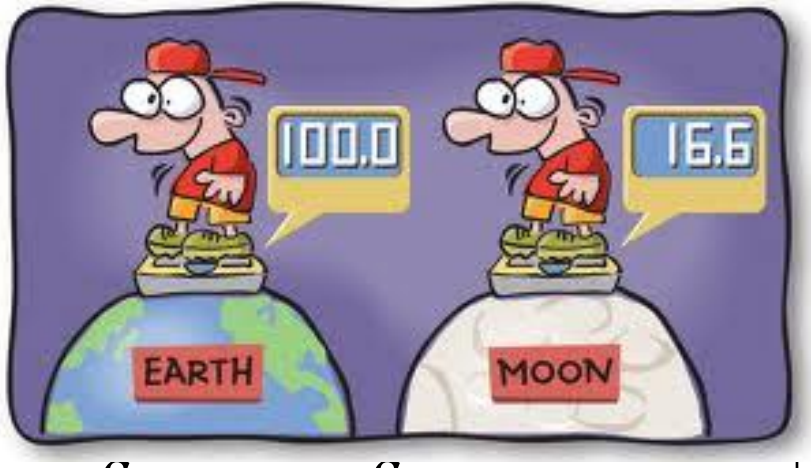
- $Fw = 22kg * ((9.8m/s^2) * (1/3))$
- $Fw = 22kg * 3.27m/s^2$
- $Fw = 71.94\ kg*m/s^2$
- $Fw = 71.94\ N$

Mass

- **Mass** – amount of matter that makes up an object.
  - Units = kg

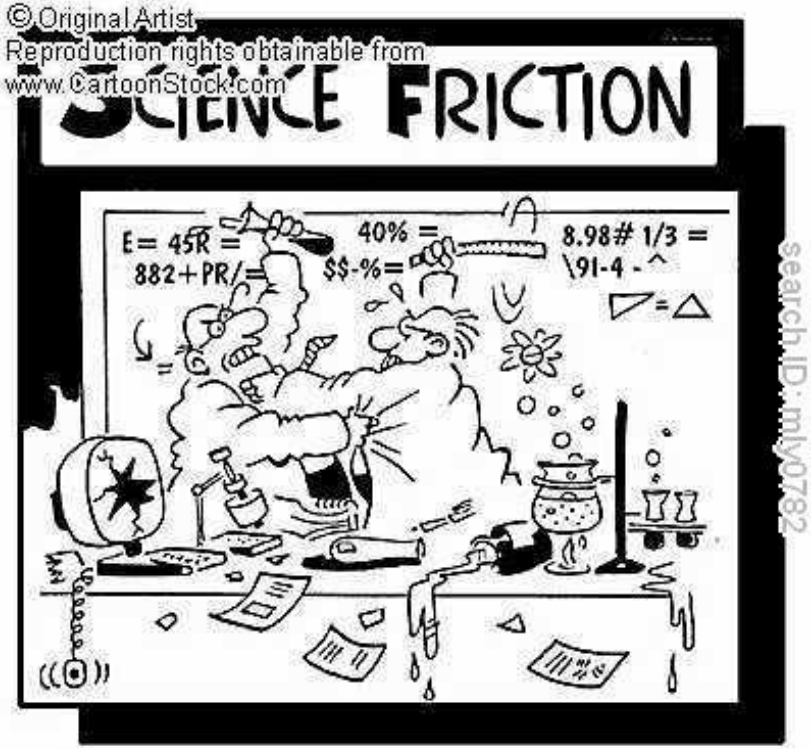
- Your **Mass** will be the same on Earth or Mars.
  - You have the same amount of matter everywhere.

Weight vs. Mass



- **<u>Weight</u>** is measure of the force of gravity acting on your mass
  - Weight will be different everywhere
  - Units = N (because it is a FORCE)
- **<u>Mass</u>** is the same everywhere, regardless of gravity
  - Mass will always remain the same
  - Units = kg

Friction



- If gravity is always pulling us down (or if we are moving) we are always going to be in contact with something.
- **Friction** is a force that results from the relative motion between objects
  - AKA: The force that works against and slows motion because *the surface of any object is rough*

Friction

- **Some friction is useful**
  - Walking (friction between ground and foot)
  - Driving (friction between ground and tire)
  - Brakes (friction between brake pad and the disc (attached to wheel)
  - Writing (friction between paper and pen/pencil)
  - Throwing (friction between hand and ball)

- **Some friction is unwanted**
  - Overheating in a machine/engine is caused by friction
  - Any moving that slows down when it is not wanted
  - Friction makes moving heavy objects much harder

Without Friction, we may struggle…

Man

And his best friend

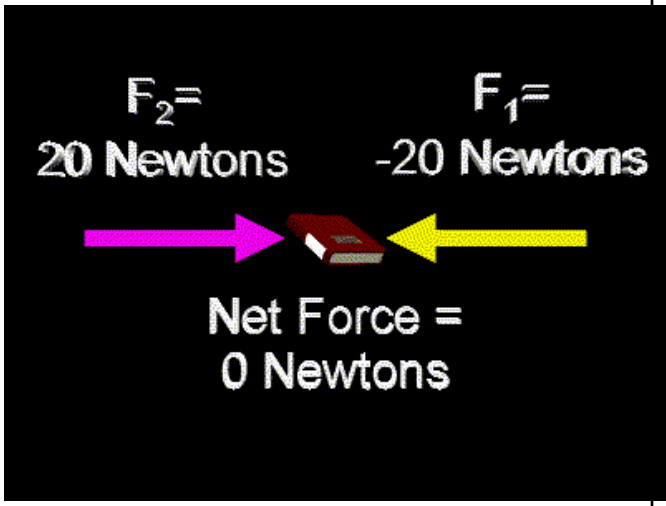
Recap - Weight, Gravity and Friction

- Gravity pulls everything toward center of earth.
  - $9.8 m/s^2$ (Accelearation)
- Weight is a measure of the force of gravity pulling on an object's mass.
- Friction is a force caused by the relative motion between 2 objects.

Multiple Forces Acting At Once

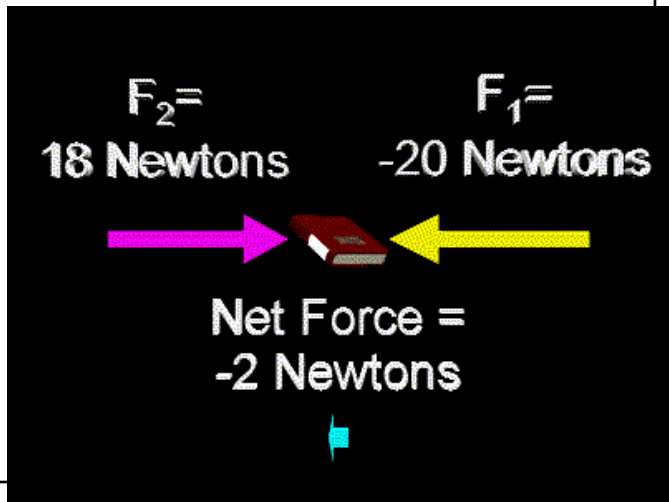
There will always be MORE than 1 force acting on an object at a time.

- **Net force** = total of all forces

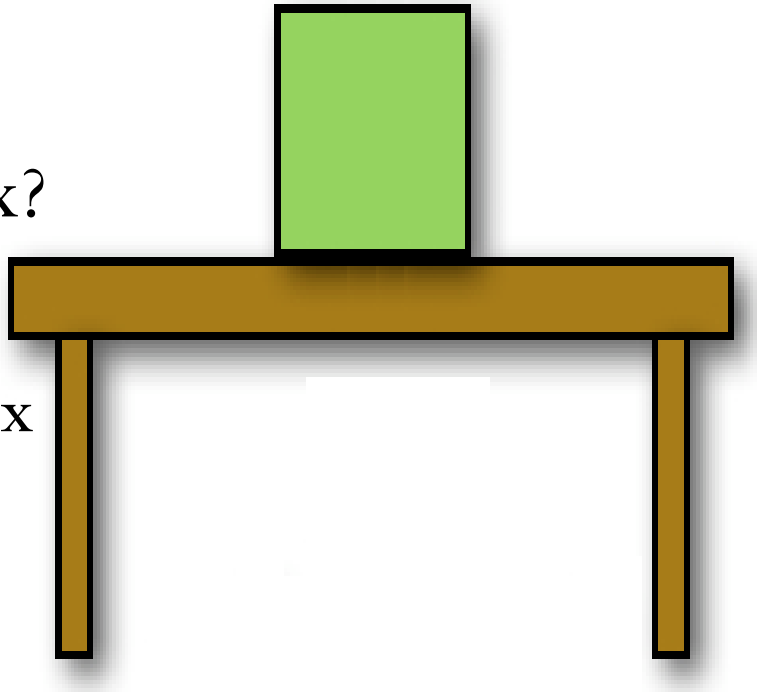


There are 2 options:

- **Balanced forces**
  - **Equilibrium** = all forces on an object are balanced and no change in movement occurs
- **Unbalanced forces**
  - Net forces do not equal zero
  - Motion will occur in the direction of the Net Force



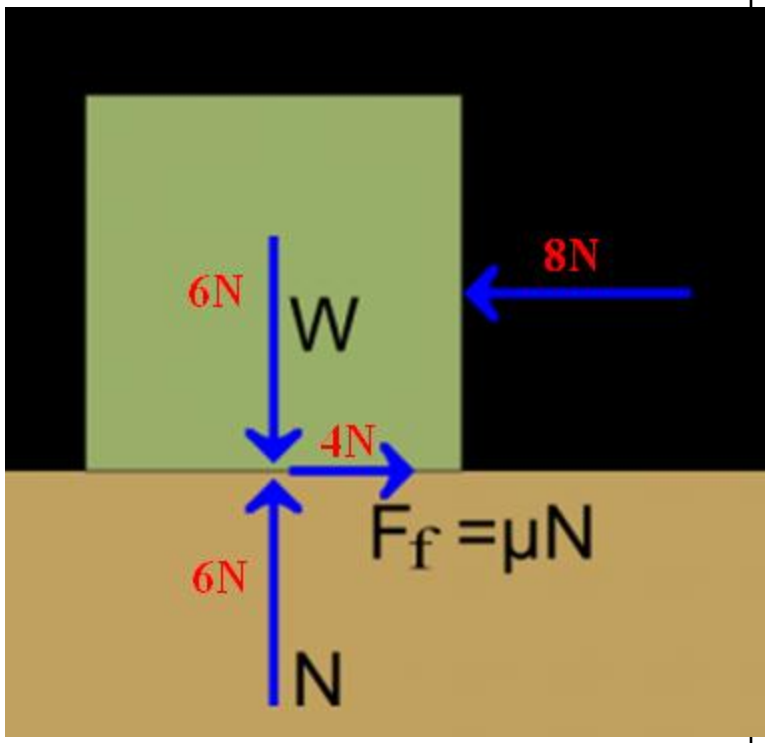
Free Body Diagrams - HONORS



- There is a box on the table.
- What forces are acting on this box?
  - Weight
    - Gravity pulling down on the box
  - Normal Force
    - Table pushing up
- What other forces can act on the box?
  - Push to the right (or pull from the right)
  - Friction force
    - In the opposite direction of the push

Free Body Diagrams - HONORS

- Identify the value for:
  - Force of Weight:
  - Normal Force:
  - Friction Coefficient:
  - "Push":



- Is this box moving?
  - If so, which direction and with what unbalanced force?

Free Body Diagrams - HONORS

- This can be shown 2 different ways:
  - Arrows pointing towards the center of the object
  - Arrows originating from the center of the object.