# An Intro to Forces

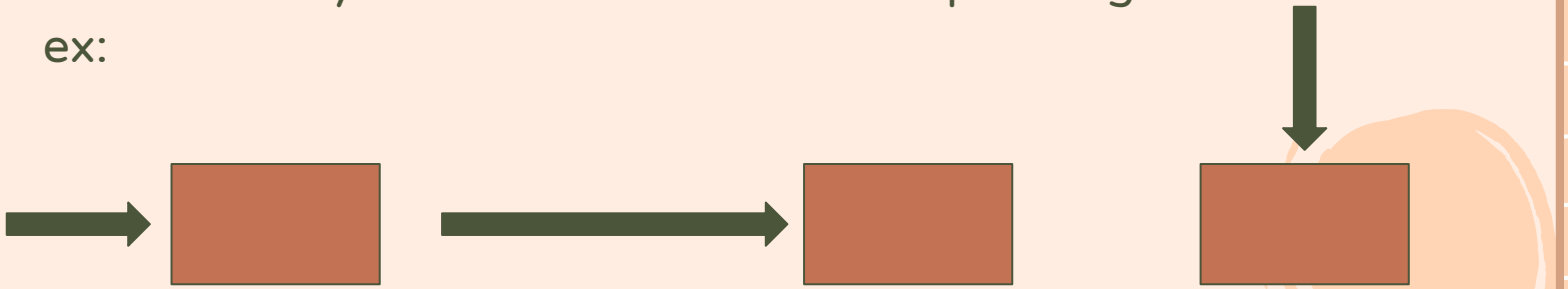
# What is a Force?

A Force is a push or pull on an object, resulting in a mutual interaction. Forces only exist as a result of an interaction.

# Contact Forces

**Definition**: forces that result when the two interacting objects are perceived to be physically contacting each other

- Forces are always **vectors**, and we depict them with arrows!
  - magnitude is shown by the length of the arrow; direction is shown by the direction the arrow is pointing
- ex:



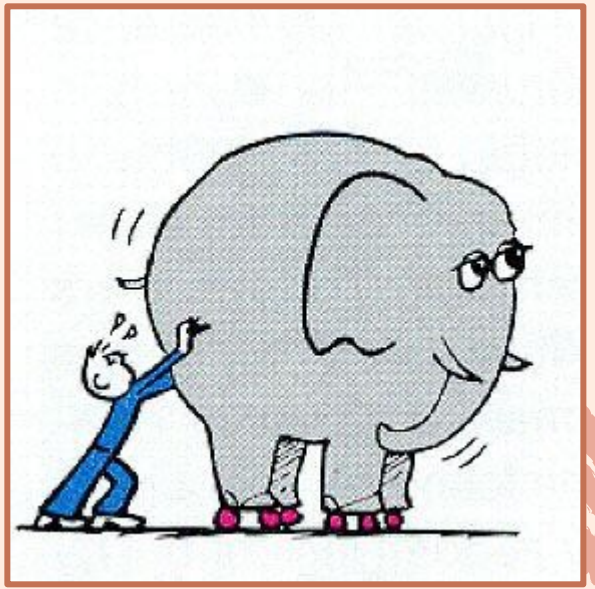
# Action-at-a-Distance Forces

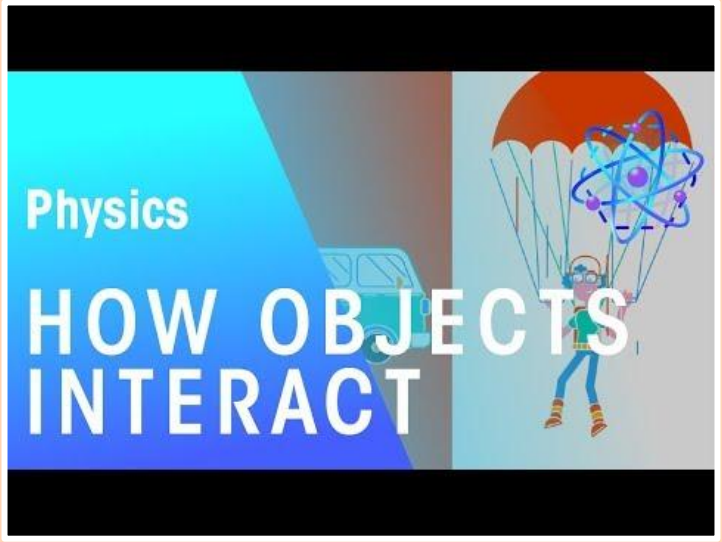
**Definition**: forces that result even when the two interacting objects are not in *physical contact* with each other, yet are still able to exert a push/pull on each other.

- These vector forces are still depicted as arrows in the same way as contact forces

# Units

Force is measured using the standard metric unit called the Newton. We normally abbreviate the Newton as "N."






Video

# Gravitational Force

**Definition**: the force with which the earth, moon, or other massively large object attracts another object towards itself.

- gravitational force is also defined as the *weight* of an object
  - the greater the gravitational force on an object, the greater weight it has

**Formula:**

$$F_g = m \cdot g$$

Where $m$ is the mass of the object, and $g$ is the acceleration due to gravity (on earth it is 9.8 $m/s^2$.)

# Mass vs. Weight

## Mass

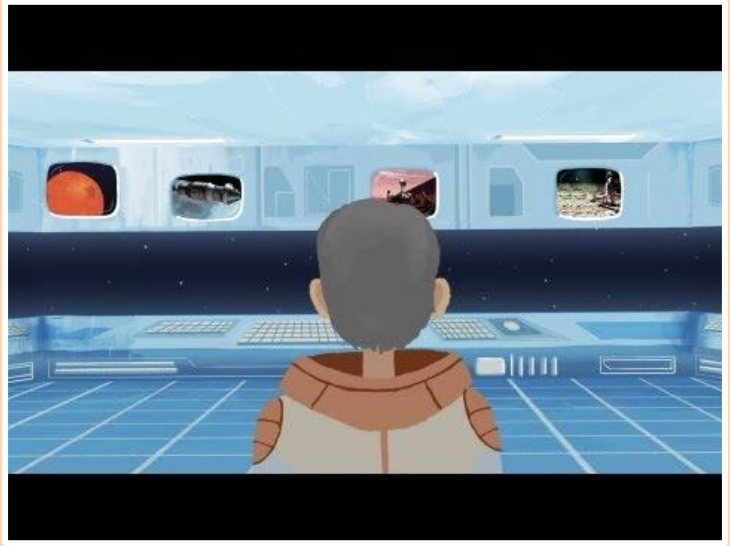
**Definition**: the amount of matter in an object.

- This is a constant: it will not change!

## Weight

Also known as the gravitational force on an object:

- It is not a constant!



# Thought Provoking Video

# Applied Force

**Definition**: a force that is applied to an object by a person or another object

- Ex. A person pushing a desk across the room

Abbreviation: $F_{app}$

Units: Newtons (N)

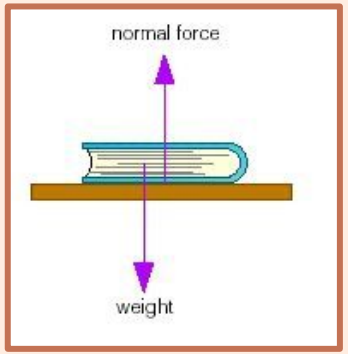
# Normal Force

**Definition**: the support force exerted upon an object that is in contact with another stable object, such as a table.

- ex. A book sitting on a table (normal force counteracts gravity)
- Normal force is <u>always</u> perpendicular to the surface

Abbreviation: $F_{norm}$

Units: Newtons (N)




# Intro to Friction

# Friction Force

**Definition**: the force exerted by a surface as an object moves across it or makes an effort to move across it

- Two types of friction: **static** and **kinetic**
- Friction always opposes the motion of an object
- Friction depends on the "**roughness**" of the surface, and the **weight** of the object sliding across it.

**Formula:**

$$F_{frict} = \mu \cdot F_{norm}$$

Where $\mu$ is the roughness constant of the surface, and $F_{norm}$ is the normal force exerted on the object.

# Air Resistance Force

**Definition**: a special type of frictional force that acts upon objects as they travel through the air

- Depends on the structure of the object traveling through the air, object's speed, size/shape of the object
  - Ex. a feather vs. a bowling ball

Abbreviation: $F_{air}$

Units: Newtons (N)

# Tension Force

**Definition**: The force that is transmitted through a string, rope, cable or wire when it is pulled tight by forces acting from opposite ends

- Directed along the length of the wire
- Tug of war!

Abbreviation: $F_{tens}$

Units: Newtons (N)

# Mini Lab Time!