Unit 2 - Forces

Terminology

Force - A push or a pull

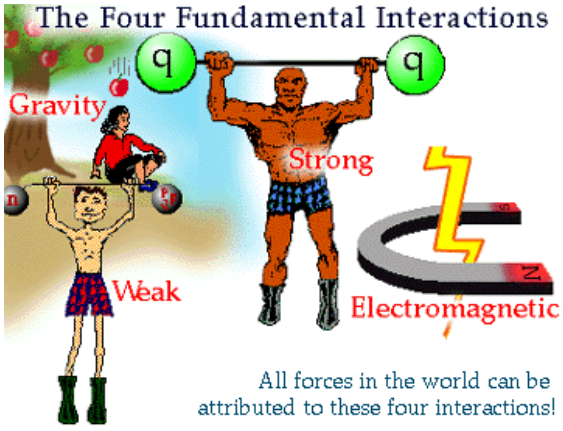
Fundamental Force - Forces are classified into 4 categories - gravitational, electromagnetic, strong nuclear, and weak nuclear

Gravitational Force - Force of attraction between all objects

Electromagnetic Force - Force caused by electric charges

Strong nuclear force - Force that holds protons and neutrons together in the nucleus of an atom

Weak nuclear force - force responsible for interactions involving elementary particles such as protons and neutrons



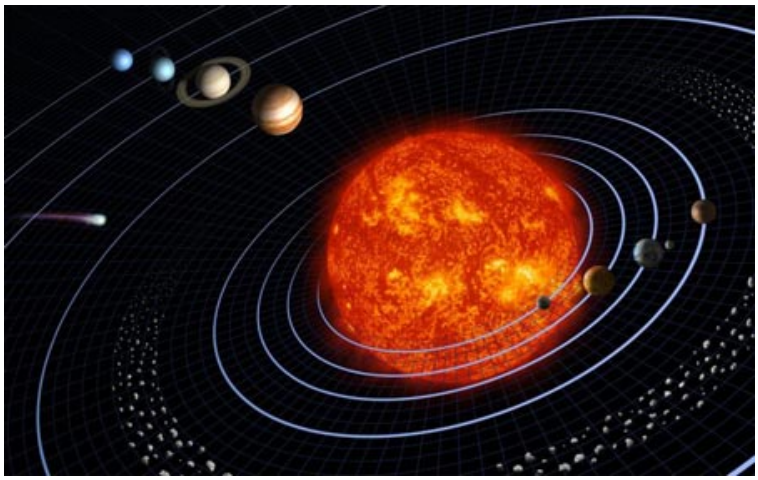
A force is a vector quantity which means that it has a direction (up, down, east, northeast, forward, etc.) as well as a magnitude.

All forces that have been found so far can be classified into the 4 fundamental forces.

- Gravitational Force
- Electromagnetic Force
- Strong Nuclear Force
- Weak Nuclear Force

GRAVITATIONAL FORCES

These forces don't just apply to the things here on Earth but also on the stars, planets and moons. It holds them together and controls their motion.



Gravitational forces act on two objects even if they are not touching. Even light obeys gravitational forces!

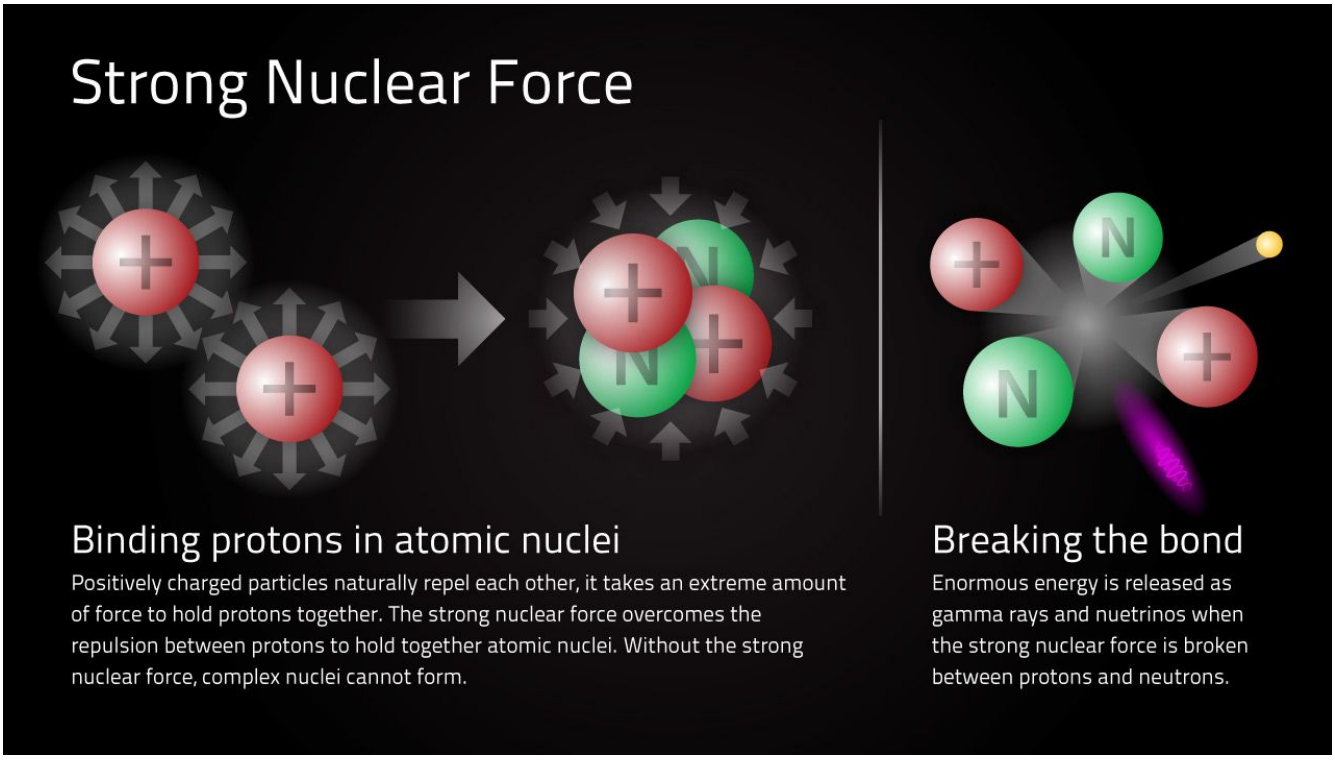
Electromagnetic Forces

- Includes both electrostatic forces (like static electricity) and magnetic forces (such as a force that affects a magnetic compass).
- Can exert an attraction or repulsion
- Responsible for holding atoms together, making diamonds hard and cotton weak.
- Most common forces are electromagnetic in origin.

https://www.youtube.com/watch?v=yE8rkG9Dw4s

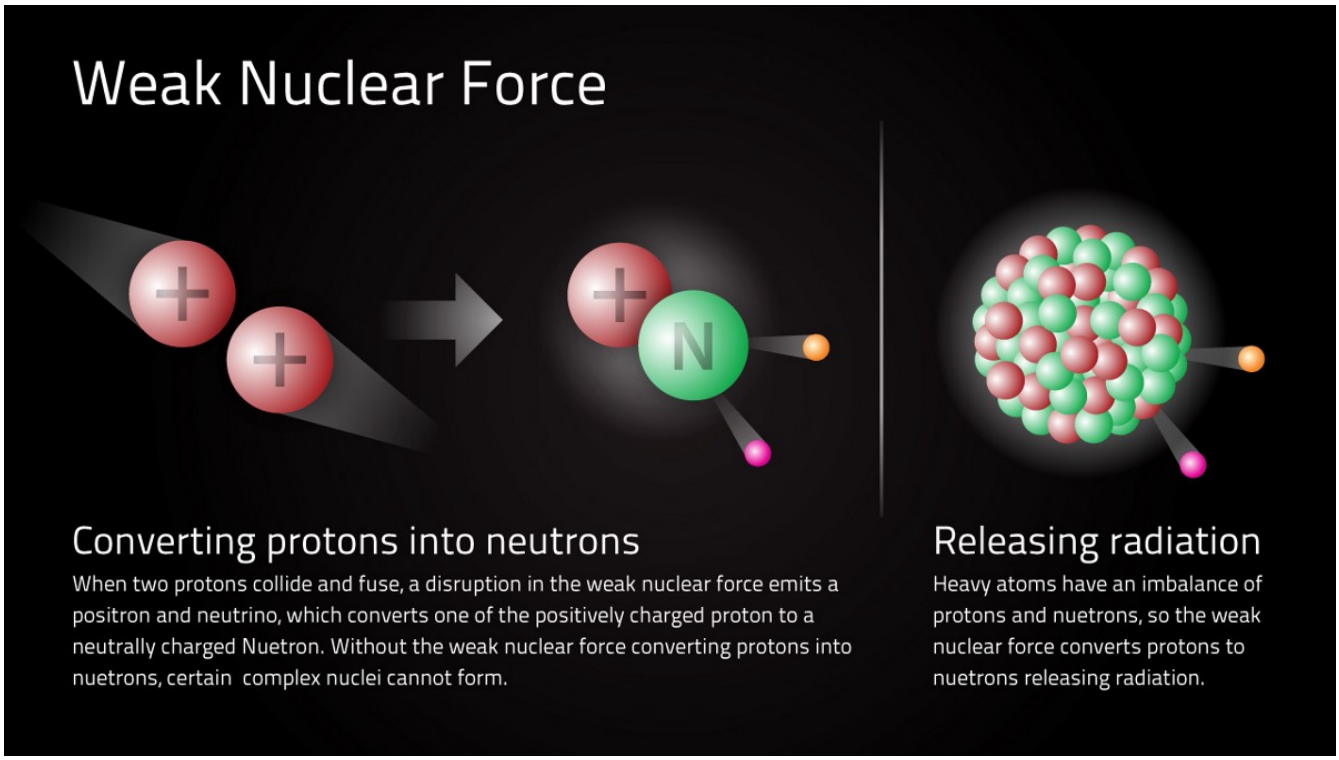
Strong Nuclear Force

- Holds protons and neutrons together in the nucleus
  - protons naturally would want to repel from inside the atom, which is the reason why there is so much energy given off when an atom is split
- Only works when objects are close together
- Stronger then electromagnetic forces

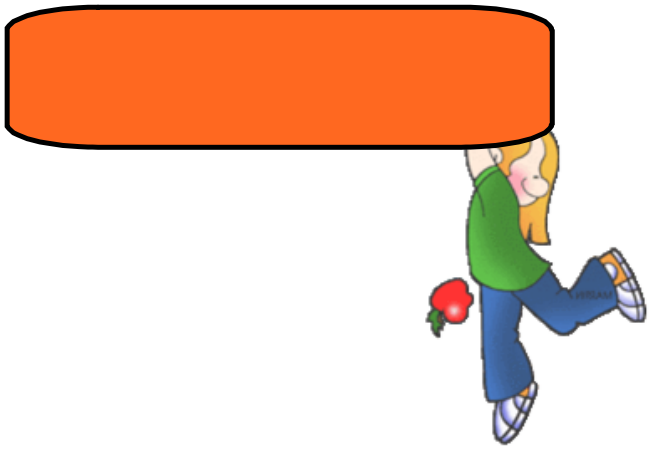


Weak Nuclear Force

- Noticed only at extremely small distances
- Without the weak force we wouldn't be able to tell how old things are through carbon-14 dating or uranium-lead dating



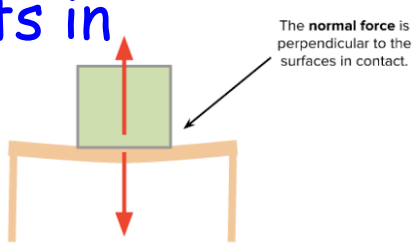
What is one force we are all experiencing right now?



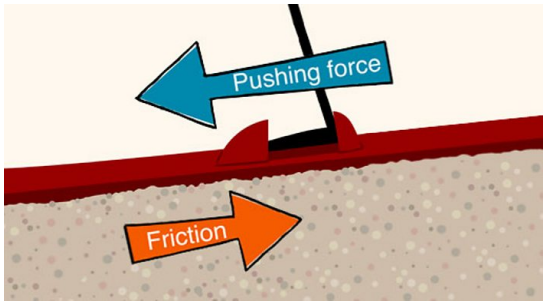
What about the books resting on your desk? or the pencils? Are they experiencing gravity?

Terminology

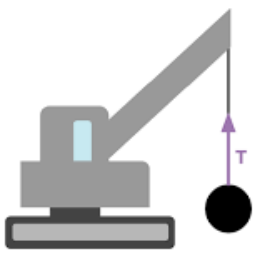
Normal Force - the force perpendicular to the surfaces of the objects in contact



Friction - the force between objects in contact and parallel to the contact surface



Tension - the force exerted by strings, ropes, fibers, and cables



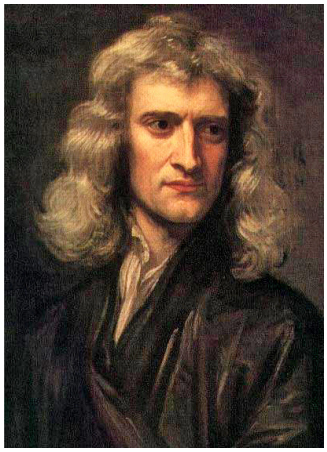
The force exerted by a **rope, cable, chain, etc.** is called the force of tension F_T or T.

The normal force, force of friction and tension are all contact forces. In other words, they exist when objects are in direct contact with each other.

They are caused by the interaction of particles on the contact surfaces and are therefore a result of *electromagnetic* force.

Measuring Force

The unit of force is called a **newton (N)** after Sir Isaac Newton (1643-1727)



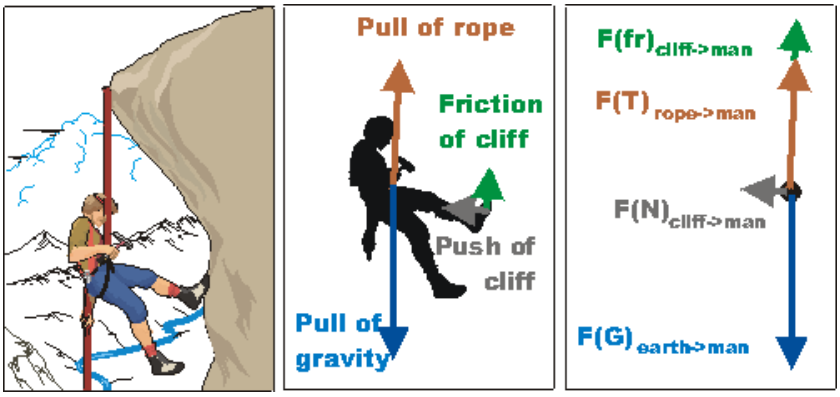
The newton is a derived SI unit and can be expressed using kilograms, meters, and seconds.

$$1\ \text{N} = 1\ \frac{\text{kgm}}{\text{s}^2}$$

Drawing Force Diagrams

There are two types of force diagrams we will be using in this course.

1. System Diagrams - A sketch of all the objects involved in a situation



2. Free Body Diagram (FBD) - Only the object being analyzed is drawn. Uses arrows to show all the forces acting on the object.