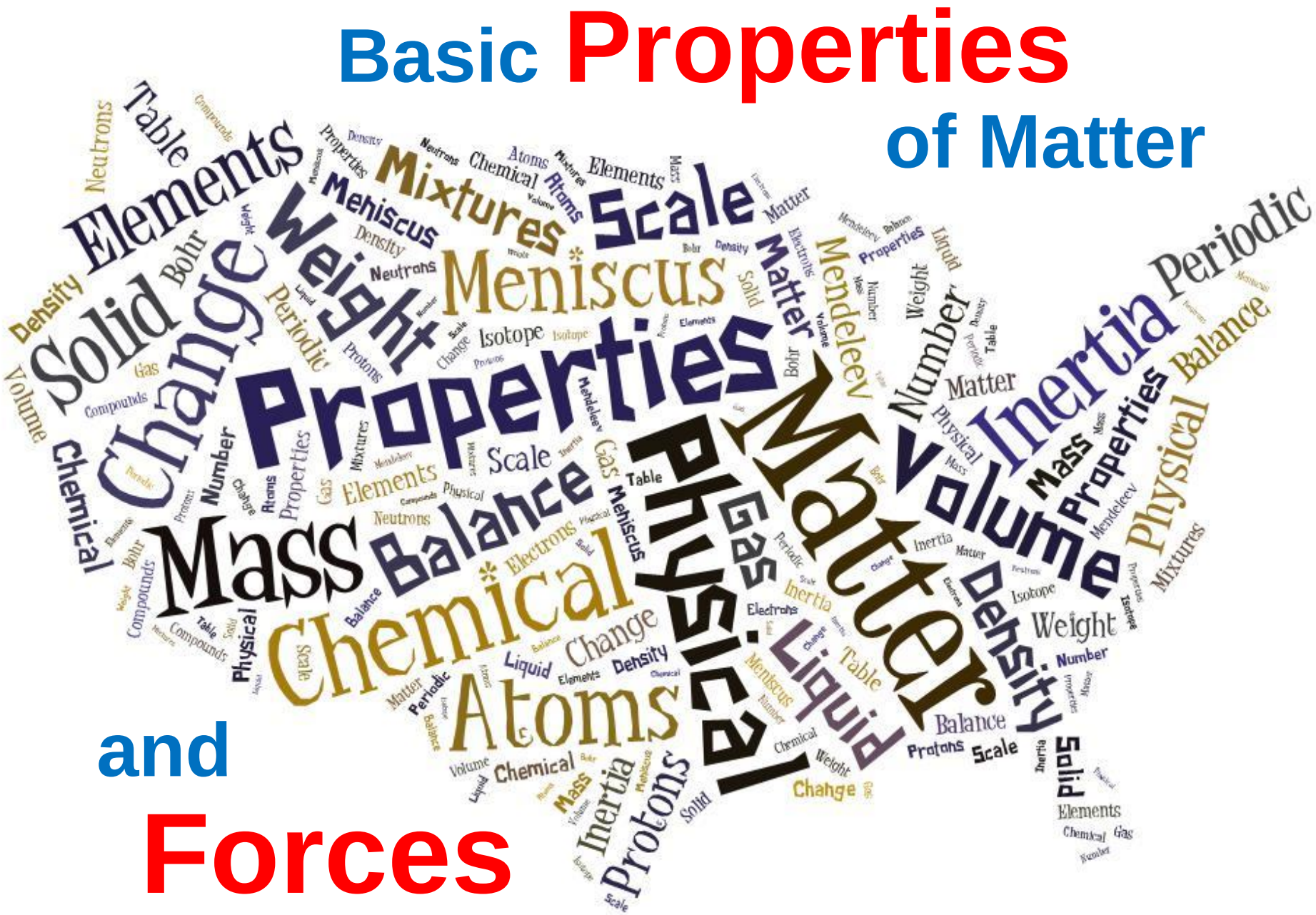
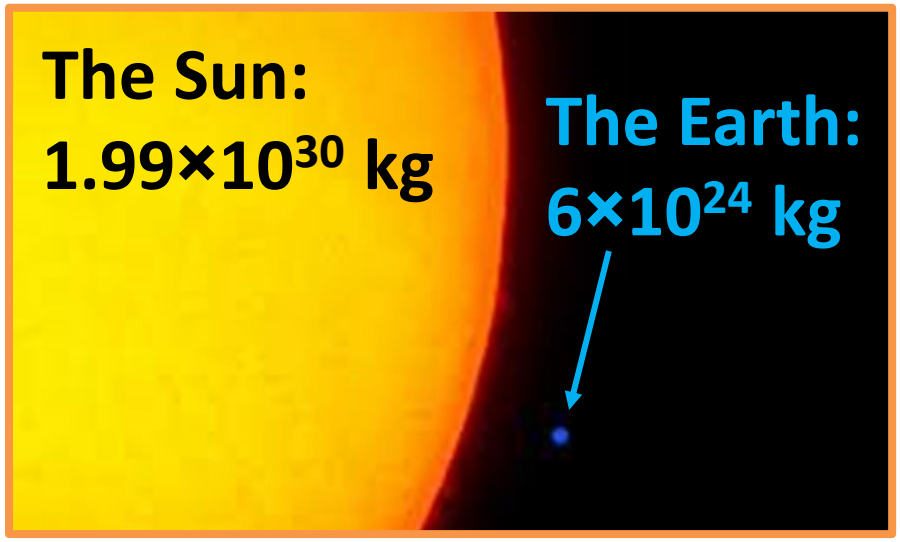
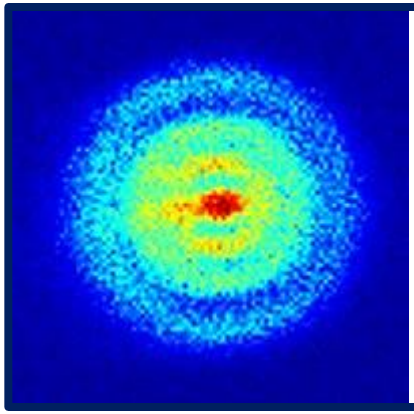
Basic Properties of Matter and Forces



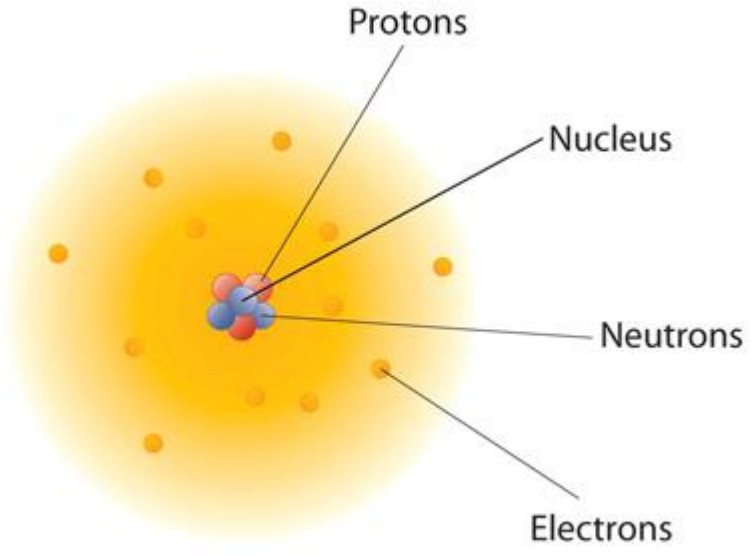
Mass is the **amount of material** in an object

- **SI unit of mass is kg**





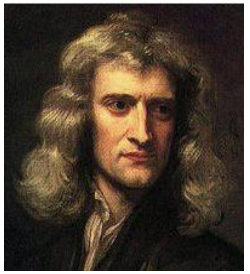
The mass of a smallest atom, Hydrogen, is 1.67×10^{-27} kg



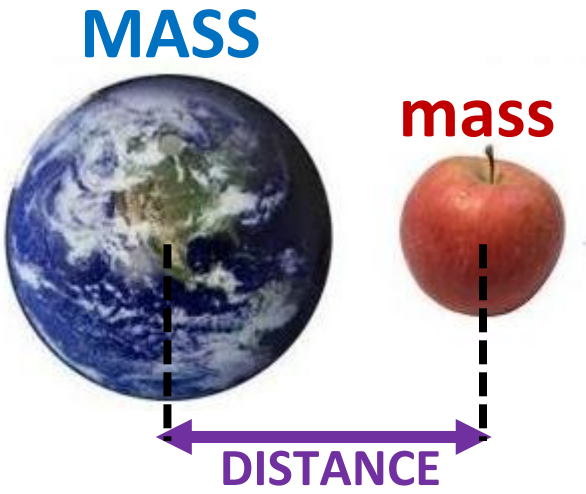
- Since **all atoms making up any object are composed of protons, neutrons and electrons**, mass is essentially defined by the

total amount of all those particles in an object.

Gravity aka **gravitation**



is the universal **force of attraction** that acts **between any two or more objects that have mass**



$$\text{GRAVITY} = G \cdot \frac{\text{MASS} \cdot \text{mass}}{(\text{DISTANCE})^2}$$

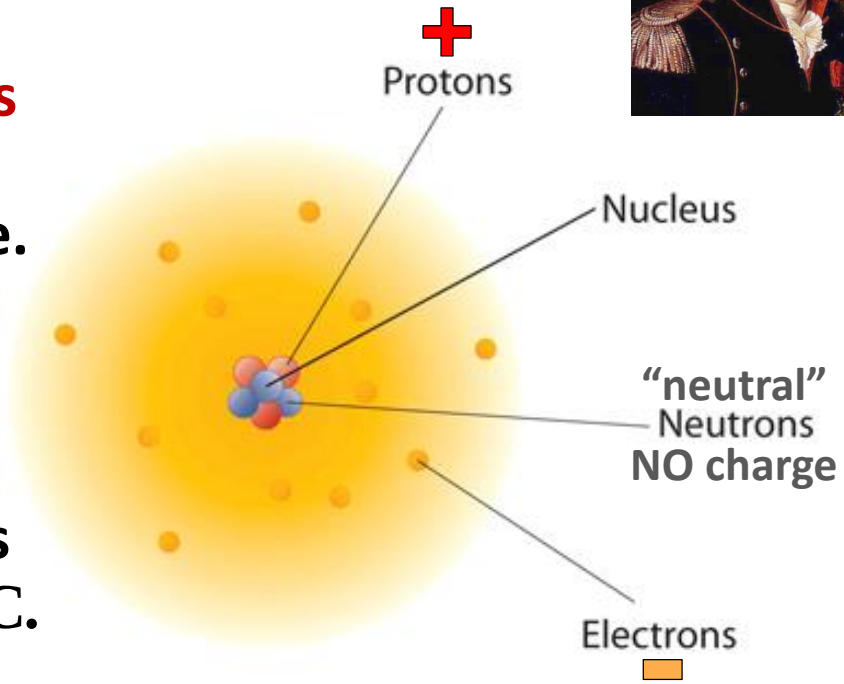
$$6.67 \times 10^{-11}\ \text{Nm}^2/\text{Kg}^2$$

"gravitation constant"

- **Gravity is generally a "weak" force…but massive objects create strong gravitational pull!**
- **Gravity has infinite range…but very distant objects experience very little attraction!**

Charge, + or −, is the basic property of matter that gives rise to all electrical and magnetic forces and interactions.

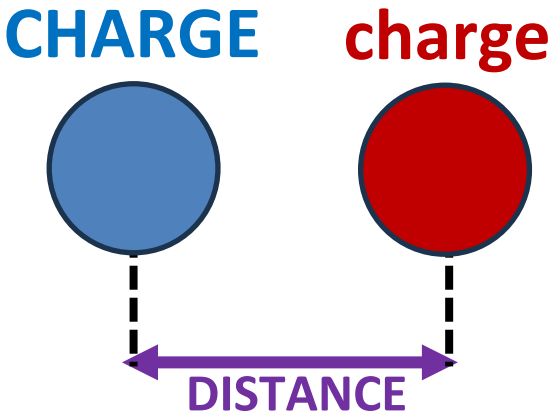
- In atoms, electrons carry the negative (-) charge, and protons carry the positive (+) charge; neutrons have NO (zero) charge.
- SI unit of charge is Coulomb.
- The charge of a single electron, known as *elementary charge*, is equal to *negative* 1.602×10^{-19} C.



- The charge of a single proton is the same but *positive*.
- Matter is usually *charge-neutral*, meaning the positive and negative charges balance out on large scale.

Electromagnetism

is an interaction that occurs between particles that have electric charge



$$\text{ELECTRIC FORCE} = k \cdot \frac{\text{CHARGE} \cdot \text{charge}}{(\text{DISTANCE})^2}$$

$8.99 \cdot 10^9\ N \cdot m^2/C^2$

"electrostatic force constant"

A "strong" force at the atomic level… responsible for binding atoms into molecules and molecules into liquids and solids!