

## Section 7.2 Notes: *Field strength*



1. **17<sup>th</sup> century...Newton**: force of gravity between any two bodies is proportional to the product of the masses and inversely proportional to the square of the distance between their centers of mass.

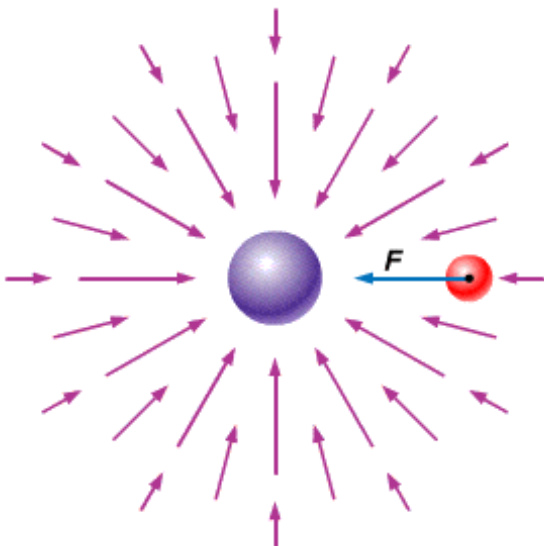
$$F \approx \frac{m_1 m_2}{r^2}$$

2. **18<sup>th</sup> century...Cavendish**: determined “**G**”, the **constant of proportionality** or the **universal gravitational constant**.

$$G = 6.67 \times 10^{-11} \text{ N m}^2/\text{kg}^2$$

$$F = G \frac{m_1 m_2}{r^2}$$

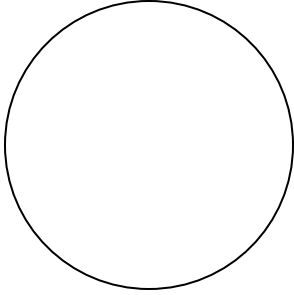
3. Typically, forces act through contact. Many thinkers had trouble accepting the idea of a force “*acting at a distance*”...Newton was uneasy, but said “gravity acts without contact”
4. **19<sup>th</sup> century...**the concept of a force field was “invented”:
  - A force field is what fills the space around a **mass**, electric or magnetic charge.
  - Anything that has mass is surrounded by a gravitational field.
  - It is the field that acts on a second body, resulting in a force of attraction
5. To find gravitational field strength, place a body of mass “m” in the field and measure the force or “**weight**”.



$$F = mg = G \frac{m M_E}{r^2}$$

$$g = \frac{F}{m}$$

6. Find gravitational **field strength** at Earth's surface.



7. Find gravitational **field strength** at altitude of space shuttle (300 km)

8. Find gravitational **field strength** at 40,000 km above Earth's surface

9. Orbital Velocity:

$$F = G \frac{m_1 m_2}{r^2}$$

$$F_c = ma_c = \frac{mv^2}{r}$$

set  $F = F_c$  and solve for  $v$

10. Orbital Period:

$$v = \frac{2\pi r}{T}$$

$$v = \sqrt{\frac{GM}{r}} \quad (\text{orbital velocity})$$

set  $v = v$  and solve for  $T$