Newton's Law of Universal Gravitation Notes

- Newton pondered why things tended to fall toward the Earth, as opposed to other directions and what kept the moon orbiting around the Earth and the Earth around the sun.
- He theorized that the force of something he called "gravity" is inversely proportional to the square of the distance between the centers of the masses.
- Because of his Third Law of Motion, Newton also realized that forces exist in pairs, meaning if the Earth pulls on objects, those objects pull on Earth as well.
- He then theorized that the force of gravity is directly proportional to the product of the masses of the objects.
- Therefore: $F_g = \frac{G m_1 m_2}{R^2}$
- **Where $G = 6.67 \times 10^{-11}\ N\ m^2/kg^2$**
- **Law of Universal Gravitation:** All particles in the universe gravitationally attract all other particles in the universe and that gravitational attraction is inversely proportional to the square of the distance between the objects and directly proportional to the product of the masses.

- The Law of Universal Gravitation applies to <u>all</u> objects.
- When considering the force of attraction between any two objects:
  - The force is greater when the mass of either of the two objects is greater.
    - Earth, with its huge mass has a relatively large attractive force with all of the objects near its surface.
    - The moon has less mass than Earth, so the moon has less attraction for objects on its surface than Earth does. (Objects on the surface of the moon weigh less than on Earth because the gravitational force of the moon is less than the gravitational force of Earth.)
  - The reason we do not notice the attraction between ordinary sized objects when we are on earth is that the force that the earth exerts on objects is so great; the force of attraction between other objects is very small.
    - The closer the two objects are, the greater the force
    - When an object such as a space vehicle moves away from Earth, the gravitational attraction between Earth and the vehicle becomes less and less.