Flipping Physics Lecture Notes:

Newton's Universal Law of Gravitation Introduction

Remember: Force of Gravity and Weight mean the same thing. The equation we already have for this is:

- $F_g = mg$

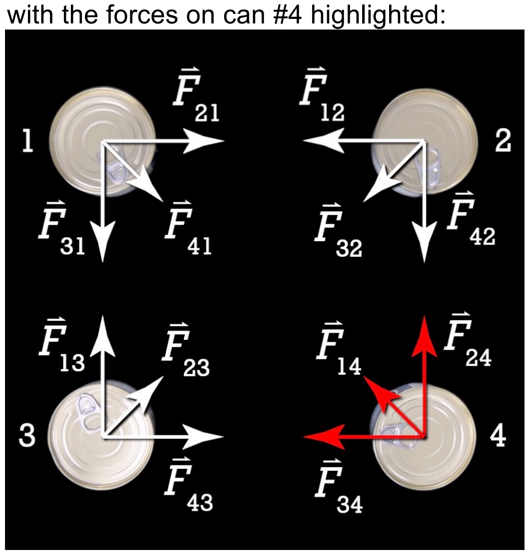
However, this is missing a subscript that has been assumed up until this point:

- $F_g = m_o g$: m_o means the *mass of the object*. This equation is for the Force of Gravity that exists between and object and a planet. Usually for us the planet is the Earth. $g_{Earth} = 9.81\frac{m}{s^2}$

Truth is that a force of gravitational attraction exists between any two objects. The equation to determine this force of gravitational attraction is Newton's Universal Law of Gravitation:

- $\boxed{F_g = \frac{Gm_1m_2}{r^2}}$
    - G is the Universal Gravitational Constant. $\boxed{G = 6.67\times10^{-11}\frac{N\cdot m^2}{kg^2}}$
    - I call this The Big G Equation!
    - m_1 and m_2 are the masses of the two objects.
    - r is not defined as the radius.
        - r is the distance between the centers of mass of the two objects.
        - r sometimes is the radius.
    - Equation was established by Sir Isaac Newton in 1687.
    - Not until 1796 was the Universal Gravitational Constant first measured by British Scientist Henry Cavendish. He used a large torsion balance to measure G.

The cans of dog food example with the forces on can #4 highlighted:



An interesting point: According to The University of Oxford Department of Physics,♠ "Cavendish used the balance in 1798 and measured the mean density of the earth at 5.48g/cm3. This implied that G was 6.754x10-11m3s-2kg-1 although Cavendish did not derive it." Therefore Cavendish actually never calculated G. I apologize for this oversight! Thank you to Dan Burns @kilroi22 for pointing out this error.

♠ http://www.physics.ox.ac.uk/history.asp?page=BigGHis