



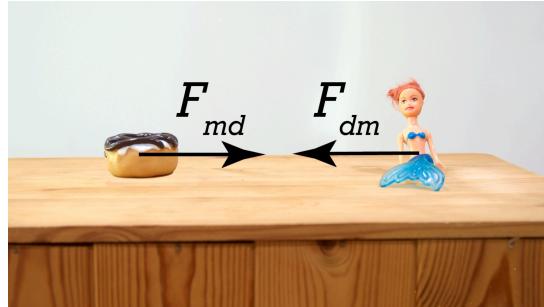
Flipping Physics Lecture Notes:

How Much is a Mermaid Attracted to a Doughnut? (Newton's Universal Law of Gravitation)

Example: A 17 g doughnut is sitting 21 cm from a 14 g mermaid. Determine the force of gravitational attraction between the two.

$$\text{Knowns: } m_d = 17g \left(\frac{1kg}{1000g} \right) = 0.017kg; m_m = 14g \left(\frac{1kg}{1000g} \right) = 0.014kg;$$

$$r = 21cm \left(\frac{1m}{100cm} \right) = 0.21m; F_g = ?$$



$$F_g = \frac{Gm_1m_2}{r^2} = \frac{Gm_d m_m}{r^2} = \frac{(6.67 \times 10^{-11})(0.017)(0.014)}{0.21^2} = 3.59968 \times 10^{-13} \approx \boxed{3.6 \times 10^{-13} N}$$

In an otherwise empty universe, the doughnut and mermaid meet at their two-object center of mass:

$$x_{cm} = \frac{m_d x_d + m_m x_m}{m_d + m_m} = \frac{(17)(0) + (14)(21)}{17 + 14} \Rightarrow x_{cm} = 9.4839 \approx 9.5cm$$