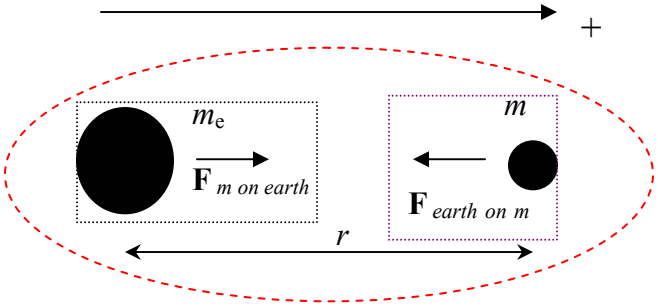
# Gravity of the Earth

What is the magnitude of the acceleration due to the gravity of the earth on an object of mass $m$ near its surface?

$m_e = 5.96 \times 10^{24}\ kg$ $\qquad$ $G = 6.67 \times 10^{-11}\ N\ m^2 / kg^2$

$r_e = 6.37 \times 10^{6}\ m$ $\qquad$ $m$ = mass of the object




From Newton's Law of Gravitation and Newton's 2nd Law,

$$F_{earth\ on\ m} = -\frac{Gm_e m}{r_e^{\,2}} = -ma$$

➔ $$a = \frac{Gm_e}{r_e^{\,2}}$$ *acceleration of m due to $m_e$ a distance $r_e$ away*

Notice this expression doesn't contain the *mass* of the object at all!

* Is the magnitude of this observed acceleration different for different masses?

*No, it is the same for any m is since there is no m term in the expression for a*

$$a = \frac{(6.67 \times 10^{-11}\ N\ m^2 / kg^2)(5.96 \times 10^{24}\ kg)}{(6.37 \times 10^{6}\ m)^2}$$

$$a \approx 9.8 \frac{m}{s^2} \equiv g$$

**g** is what we call the acceleration due to '*the*' gravity *of the earth*.

[*In general, g can represent the acceleration due to gravity of any massive object.*]

Therefore, the earth exerts an attractive force on any object of mass $m$ near its surface causing it to accelerate at a rate of 9.8 $m/s^2$.