Flipping Physics Lecture Notes:

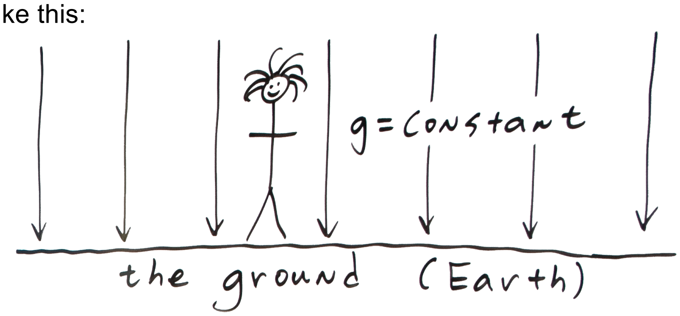
Gravitational Field Introduction

We have two equations for the force of gravity:

- $F_g = m_o g$ which is true when acceleration due to gravity is constant.
- Newton's Universal Law of Gravitation: $F_g = \frac{Gm_1m_2}{r^2}$ which is always true.

The constant gravitational field equation is derived from the equation for the force of gravity when g is constant:

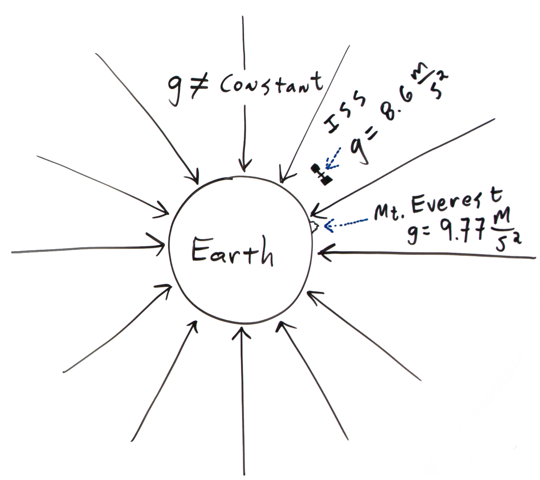
- $F_g = mg \Rightarrow g = \frac{F_g}{m}$ Constant gravitational field equation
- It has units of $\frac{N}{kg}$ which is the same as $\frac{m}{s^2}$. Because $g = \frac{F_g}{m} \Rightarrow \frac{N}{kg} = \frac{\frac{kg \cdot m}{s^2}}{kg} = \frac{m}{s^2}$
- We illustrate it like this:



- Lines are called Field Lines.
  - The strength of a field is illustrated by how close the field lines are to one another.
  - Closer field lines illustrates a stronger field.
  - The gravitational field lines in the above illustration are parallel to one another because the gravitational field is constant.

Gravitational field around any object is derived from Newton's Universal Law of Gravitation:

- $F_g = m_o g = \frac{Gm_o m_E}{r^2} \Rightarrow g = \frac{Gm_E}{r^2}$ This is around the Earth.
- $g = \frac{Gm}{r^2}$ But all objects with mass are surrounded by a gravitational field.
- Notice in the illustration the field lines are farther apart the farther from the object. This is because the strength of the gravitational field decreases as we move farther from the planet.



Gravitational fields caused by single objects are always directed towards the center of mass of the object. On the surface of the Earth, that means *down*.