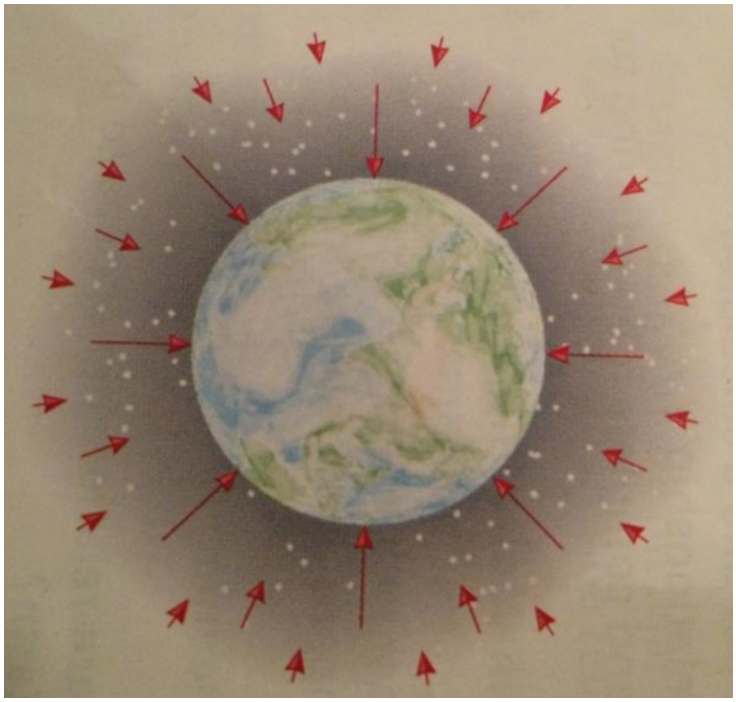
Gravitational Force on Earths Surface

A **force field** is a space surrounding an object in which the object exerts a force on other objects. This means that EVERY mass feels a force pulling it toward the Earth.

The **gravitational field strength** is the amc force per unit mass acting on objects in the gravitational field. It us a vector quantity that has the direction downward or toward the center of the Earth. Its SI units are N/kg



A simple way to measure the force of gravity is to hang a mass from a force scale or sensor.

http://www.convertunits.com/from/kg/to/N

Mass (kg)	Force of Gravity(N[↓])
0	0

What is the slope? What units does it have?

Since the gravitational field strength and the acceleration due to gravity are numerically equal, the same symbol for gravity is used.

Example 1

The maximum train load pulled through the Chunnel, the train tunnel under the English Channel that links England and France, is at 2434 tonnes (1 tonne = 1000 kg). Determine the force of gravity on this huge mass.

Mass and Weight

Weight is a commonly used term that is often confused with mass.

Mass is the quantity of matter in an object. As long as the amount of matter inside an object remains the same the mass will remain the same.

Weight is the force of gravity on an object. Being a force, weight is measured in newtons. The same symbol for the force of gravity ($\vec{F}_g$) also applies to weight.

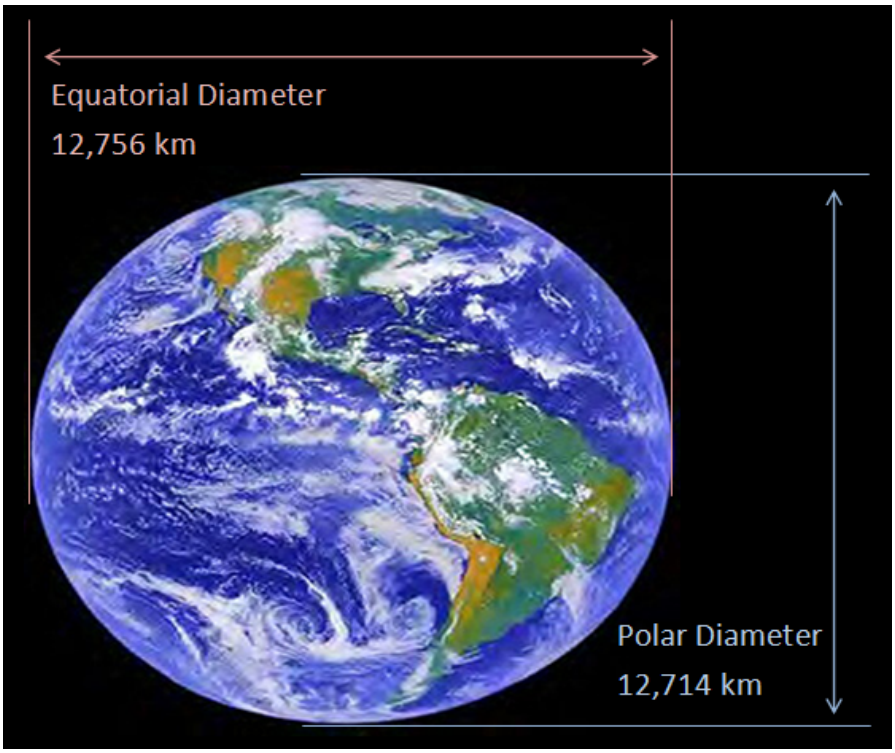
Example 2

Calculate the weight of a fully outfitted astronaut who has a mass of 150 kg on the Moon. (The force of gravity on the moon is only $1/6^{th}$ of that on Earth)

Variation in Earth's gravitational field strength

Gravity is not consistent throughout our planet. There are two main considerations.

1st - The Earth is not completely spherical and actually bulges at the equator.



As a result, the gravitational field strength at the north pole is slightly greater than that at the equator.

The table below summarizes this information

Table 2 Variation in $\vec{g}$ with Latitude (at sea level)

Latitude (°)	$\vec{g}$ (N/kg [↓])	Distance from Earth's centre (km)
0 (equator)	9.7805	6378
15	9.7839	6377
30	9.7934	6373
45	9.8063	6367
60	9.8192	6362
75	9.8287	6358
90 (North Pole)	9.8322	6357

2nd - The altitude, or height above sea level also changes the gravitational field strength.

Table 3 Variation in $\vec{g}$ with Altitude (at similar latitudes)

Location	Latitude (°)	$\vec{g}$ at sea level (N/kg [↓])	Altitude (m)	$\vec{g}$ (N/kg [↓])
Toronto	44	9.8054	162	9.8049
Mount Everest	28	9.7919	8848	9.7647
Dead Sea	32	9.7950	−397	9.7962

Gravitational Forces on the Earth Worksheet