Gravity and Weight on Other Planets

Objectives

- Students will apply Newton's Second Law.
- Students will differentiate between mass and gravity.

1. Find your weight here on Earth by using the bathroom scale. If you would prefer to use your ideal weight instead, that is fine. Record your weigh (or ideal weight) _____ pounds.
2. Determine your mass by converting your weight in pounds to mass in kilograms:

$$\frac{\_\_\_\_lbs.}{1} \times \frac{454g}{1\ lb} \times \frac{1\ kg}{1000g} = \_\_\_\_\_kg$$

   This removes the effect of gravity on your mass.

3. Next, in the table below, calculate your weight on each planetary body using the formula:

$$F_g = G\frac{m_1 m_2}{d^2}$$ where $\mathbf{F_g}$ is the force due to gravity (F_g = Weight) $\mathbf{m_1}$ is your mass in kg, $\mathbf{m_2}$ is the mass of the planet that you are standing on, **d** is the radius of the planet and **G** is the gravitational constant which is 6.67×10^{-11} Nm^2/kg^2.

   If you take the law of universal gravitation and divide both sides by mass you get $\mathbf{a_g}$ is the acceleration due to **gravity** on the planet.

$$a_g = G\frac{m_2}{d^2}$$

   Record your answers in your data table.

Data Table:

Planet	r of orbiting body in m	m of orbiting body in kg	a_g in m/s^2	Your m in kg	Your F_g in N
Earth	6,371,000		9.81		
Earth's moon		7.3477×10^{22}	1.63		
Sun	695,508,000	1.989×10^{30}			
Mercury	2,439,500		3.70		
Venus		4.8673×10^{24}	8.86		
Mars	3,389,500	6.4169×10^{23}			
Jupiter	69,911,000		25.9		
Saturn		5.6832×10^{26}	11.1		
Uranus	25,362,000	8.6810×10^{25}			
Neptune	24,622,000		11.3		
Pluto		1.3090×10^{22}	0.659		

Analysis Questions:

1. Where do you weigh the most?

2. Where do you have the least mass?

3. Where would you jump higher?

4. Where would it be easiest to lift a car?

5. Notice that Saturn and Neptune have similar a_g's. Do they have the same mass? Find the ratio of the mass of Saturn to mass of Neptune.