1.1.6.2: SI Mass and Weight Units

Note from Dr. B.

Do not worry about the "Explore More" section. The link doesn't work.

Figure 1.1.6.2.1 (Credit: Courtesy of NASA; Source: http://commons.wikimedia.org/wiki/File:151746main_s121e05215-lg.jpeg(opens in new window); License: Public Domain)

How is he floating?

One of the many interesting things about travel in outer space is the idea of weightlessness. If something is not fastened down, it will float in mid-air. Early astronauts learned that weightlessness had negative effects on bone structure. If there was no pressure on the legs, those bones would begin to lose mass. Weight provided by gravity is needed to maintain healthy bones. Specially designed equipment is now a part of every space mission, so the astronauts can maintain good body fitness.

Mass and Weight

Mass is a measure of the amount of matter that an object contains. The base SI unit of mass is the kilogram or kg, which was originally defined as the mass of 1 L of liquid water at 4°C (the volume of a liquid changes slightly with temperature). The kilogram is the only SI base unit that contains a prefix. This is because when the first physical standard for mass was created in 1799, the methods to measure the mass of something as small as a gram did not exist. In the laboratory, mass is measured with a balance (figure below), which must be calibrated with a standard mass so that its measurements are accurate.

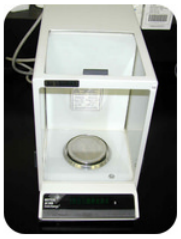

Figure 1.1.6.2.2: An analytical balance makes very sensitive mass measurements in a laboratory, usually in grams. (Credit: Courtesy of US Drug Enforcement Administration; Source: http://commons.wikimedia.org/wiki/File:Analytical_balance_mettler_ae-260.jpg(opens in new window); License: Public Domain)

Other common units of mass are the gram and the milligram. A gram is 1/1000th of a kilogram, meaning that there are 1000 g in 1 kg. A milligram is 1/1000th of a gram, so there are 1000 mg in 1 g.

Mass is often confused with the term weight. **Weight** is a measure of force that is equal to the gravitational pull on an object. The weight of an object is dependent on its location. On the moon, the force due to **gravity** is about one sixth that of the gravitational force on Earth. Therefore, a given object will weigh six times more on Earth than it does on the moon. Since mass is dependent only on the amount of matter present in an object, mass does not change with location. Weight measurements are often made with a spring scale by reading the distance that a certain object pulls down and stretches a spring.

Summary

- Mass is a measure of the amount of matter that an object contains.
- Weight is a measure of force that is equal to the gravitational pull on an object.
- Mass is independent of location, while weight depends on location.

Review

1. Define mass.
2. Define weight.
3. If I weigh 180 pounds on Earth, what will I weigh on the moon?
