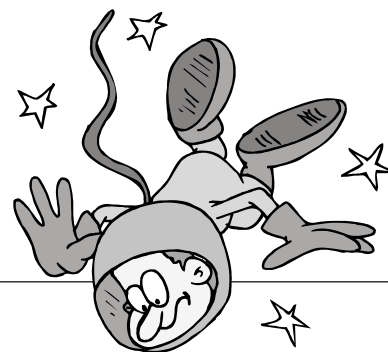


Laboratory Equipment, Safety, and Procedures

Section 2.2 Scientific Measurements



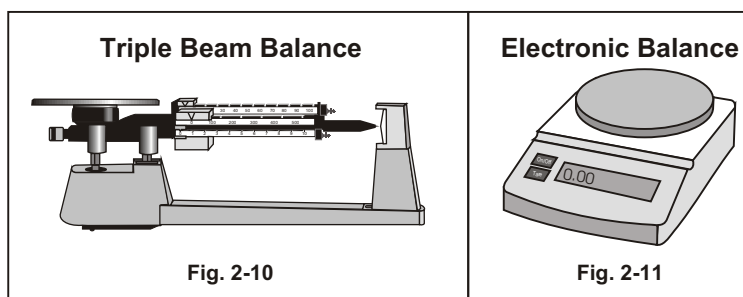
Pre-View 2.2

- **Mass** – the measure of how much matter is in an object
- **Gram** – SI unit for mass
- **Scale balance** – used to measure mass
- **Triple beam balance** – a type of scale balance commonly used in high school laboratories
- **Weight** – the measurement of *force* exerted by gravity on an object
- **Newton** – SI unit for force (and weight)
- **Spring scale** – equipment used to find force or weight
- **Ruler or meter stick** – equipment used in the laboratory to measure length in millimeters, centimeters, or meters
- **Meter** – SI unit for length

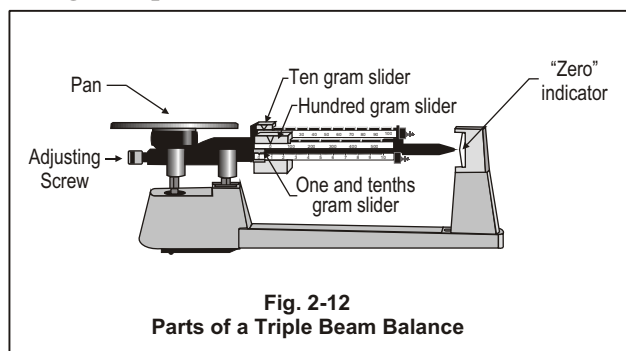
We mentioned in Section 1.3 that mass and weight are not the same, but what is the difference between the two? You've already seen that **mass** is the measurement of how much matter is in an object. It is measured in **grams** using a scale balance such as a triple beam balance. Weight is a measurement of the force of gravity on an object, and it is measured in newtons using a spring scale. If you went to the moon where the gravity is only about 20% of the earth's gravity, your mass would not change since your body would contain the same amount of matter, but your weight would be less on the moon than on earth due to gravity.

Equipment for Measuring Mass

To find the mass of an object, a **scale balance** is used. The most common types of scale balances are the **triple beam balance** (figure 2-10) and the **electronic balance** (figure 2-11). Both types of balances measure mass in grams. The triple beam balance is commonly found in high schools, so let's review how to use one to get a mass.



Using a Triple Beam Balance



Step 1

To use a triple beam balance like the one in Figure 2-12, you must first be sure that it is on a level surface. Before you put anything on the pan, move the three sliders as far left as they will go. The indicator on the right should be in line with the zero mark. If not, calibrate the balance by turning the screw under the pan until it is in line.

Section 2.2, continued Scientific Measurements

Step 2

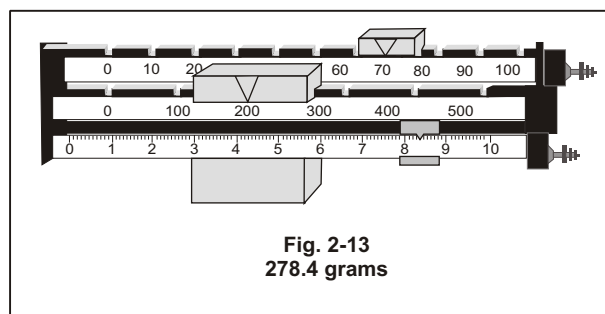
Place the object you are measuring on the pan and move the 100 gram slider on the beam until the indicator drops below the mark. Be sure it “clicks” into place. The number *to the left* of this point will show the number of hundreds of grams in the object. Move the slider back one notch to the left so that the indicator is once again above or equal to the zero mark. The slider should now point to the number of hundreds of grams in the object.

Step 3

Next, move the 10 gram slider along its beam until the indicator drops below zero. Be sure the slider clicks into place. Once again the number to the left of this point will tell you how many tens of grams are in the object. Move the slider back one notch to the left so that the indicator is above or equal to the zero mark. This slider will now point to the number of tens of grams in the object.

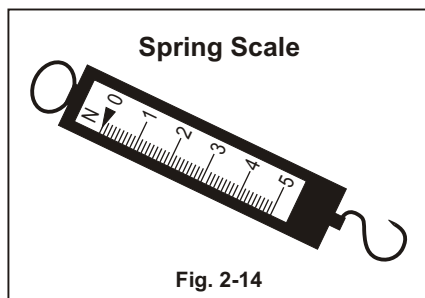
Step 4

The one gram slider is not notched, so you can move it anywhere on the beam. The numbers marked on this beam are grams, and the marks between are tenths of a gram. Move this last slider until the indicator exactly lines up with the zero mark. The object’s mass now “balances” the mass on the beams. By adding the numbers together, you can find the mass of the object. Notice that the mass shown in figure 2-13 is 278.4 grams.



Equipment for Measuring Weight or Force

Weight is a measurement of the force of gravity on an object, and it is measured in **newtons**. (The newton is the SI unit for force.) Weight and force are measured using a **spring scale**. Your bathroom scale is a spring scale although it does not look like the one in figure 2-14. Some scales have a dial readout, and others have a linear scale as shown in figure 2-14.



To find the weight of an object using this spring scale, you would hold the scale up and attach the object to be weighed to the hook at the bottom. The spring will stretch, and the pointer will move along the scale and point to the number that shows the object’s weight.

Measuring Length

As you saw in Section 1.2, the SI unit for length is the meter. In the laboratory, length is commonly measured with a **ruler** or **meter stick**. Review the ruler shown in figure 2-15, which is drawn to scale.

Do you remember what the small marks are called? How about the longer, numbered marks? The small marks represent millimeters, and the numbered marks represent centimeters.

