

4A What is a Newton?

What is force and how is it measured?

You can think of force as a push or pull. Objects interact with each other (and you) through forces. It takes force to start an object's motion, and also force to stop an object in motion. This investigation will explore the precise definition of force and measure the strength of forces.

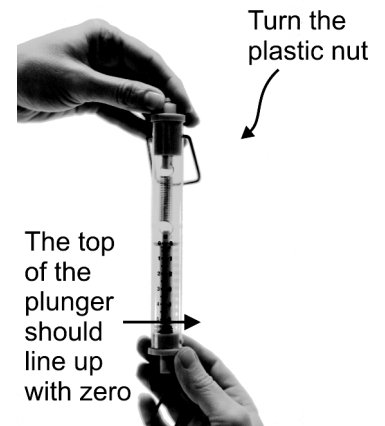
Materials

- Spring scale (0 - 5 N)
- 15 round metal washers (1/2 inch inner diam.)
- loop of string
- electronic scale (or triple beam balance)

1 Measuring forces

Forces have two important properties: strength and direction. In the English system of units, the strength of a force is measured in pounds. When you measure your own weight in pounds, you are measuring the force of gravity acting on your body. In the metric system, the strength of a force is measured in newtons (N). A quarter-pound hamburger has a weight of about 1 newton (1 lb = 4.448 N).

1. In the laboratory, you can measure force with a spring scale. Before using the spring scale however, you must be sure it correctly starts at zero. Calibrate the spring scale by turning the nut on the top until the plunger lines up with the zero mark.
2. Pull on the hook so the spring extends. When you pull, you are applying a force. Can you make a force of two newtons (2 N)?



2 Weight: the force of gravity

Weight is one of the most common forces. Objects that have mass can also have weight. Weight comes from the action of gravity on an object's mass.

1. Attach 3 steel washers to a loop of string.
2. Use a calibrated spring scale to measure the weight of the washers in newtons (N).
3. Use an electronic scale or triple beam balance to measure the mass in grams (g). Convert each mass in grams to kilograms (divide by 1000 or move decimal point three places to the left).
4. Repeat the experiment for 6, 9, 12, and 15 washers.



Find the weight in Newtons



Find the mass in grams, then convert to kilograms

**Table 1: Weight and Mass Data**

Number of washers	Weight (N)	Mass (kg)
3		
6		
9		
12		
15		

3 Stop and think

What do the results of your experiment tell you about the relationship between weight in newtons and mass in kilograms? Create a graph as described below to answer this question.

- Make a graph of your data from Table 1. Place weight on the y-axis and mass on the x-axis.
- Describe the graph. What does it tell you about the relationship between mass and weight?
- At Earth's surface, the strength of gravity is about 9.8 newtons per kilogram. What does this number mean?
- If an object has a mass of 10 kilograms, how much does it weigh in newtons?

4 Applying what you have learned

- Explain how you could estimate the weight and mass of seven of your steel washers.
- Find the weight and mass for seven of your steel washers. How close is the actual value to your estimated value? Give reasons for differences.