

Density

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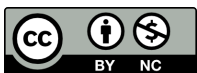
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CHAPTER 1

Density

- Define density.
- Demonstrate how to calculate density.



The man in this cartoon is filling balloons with helium gas. What will happen if he lets go of the filled balloons? They will rise up into the air until they reach the ceiling. Do you know why? It's because helium has less density than air.

Defining Density

Density is an important physical property of matter. It reflects how closely packed the particles of matter are. When particles are packed together more tightly, matter has greater density. Differences in density of matter explain many phenomena, not just why helium balloons rise. For example, differences in density of cool and warm ocean water explain why currents such as the Gulf Stream flow through the oceans. You can see a colorful demonstration of substances with different densities at this URL:

<http://www.youtube.com/watch?v=B3kodeQnQvU> (4:00)



MEDIA

Click image to the left or use the URL below.

URL: <http://www.ck12.org/flx/render/embeddedobject/54886>

To better understand density, think about a bowling ball and volleyball, pictured in the **Figure 1.1**. Imagine lifting each ball. The two balls are about the same size, but the bowling ball feels much heavier than the volleyball. That's because the bowling ball is made of solid plastic, which contains a lot of tightly packed particles of matter. The volleyball, in contrast, is full of air, which contains fewer, more widely spaced particles of matter. In other words, the matter inside the bowling ball is denser than the matter inside the volleyball.



FIGURE 1.1

A bowling ball is denser than a volleyball. Although both balls are similar in size, the bowling ball feels much heavier than the volleyball.

Q: If you ever went bowling, you may have noticed that some bowling balls feel heavier than others even though they are the same size. How can this be?

A: Bowling balls that feel lighter are made of matter that is less dense.

Calculating Density

The density of matter is actually the amount of matter in a given space. The amount of matter is measured by its mass, and the space matter takes up is measured by its volume. Therefore, the density of matter can be calculated with this formula:

$$\text{Density} = \frac{\text{mass}}{\text{volume}}$$

Assume, for example, that a book has a mass of 500 g and a volume of 1000 cm³. Then the density of the book is:

$$\text{Density} = \frac{500 \text{ g}}{1000 \text{ cm}^3} = 0.5 \text{ g/cm}^3$$

Q: What is the density of a liquid that has a volume of 30 mL and a mass of 300 g?

A: The density of the liquid is:

$$\text{Density} = \frac{300 \text{ g}}{30 \text{ mL}} = 10 \text{ g/mL}$$

Summary

- Density is an important physical property of matter. It reflects how closely packed the particles of matter are.
- The density of matter can be calculated by dividing its mass by its volume.

Explore More

Go to this URL and take the calculating-density quiz. Be sure to check your answers!

http://www.old-pz.gse.harvard.edu/ucp/curriculum/density/s2_resources_calculating_density.pdf

Review

1. What is density?
2. Find the density of an object that has a mass of 5 kg and a volume of 50 cm³.
3. Create a sketch that shows the particles of matter in two substances that differ in density. Label the sketch to show which substance has greater density.

References

1. Bowling ball: Matthew (Flickr: falcon1961); Volleyball: User:Amada44/Wikimedia Commons. [A bowling ball is denser than a volleyball](#) . Bowling ball: CC BY 2.0; Volleyball: Public Domain