

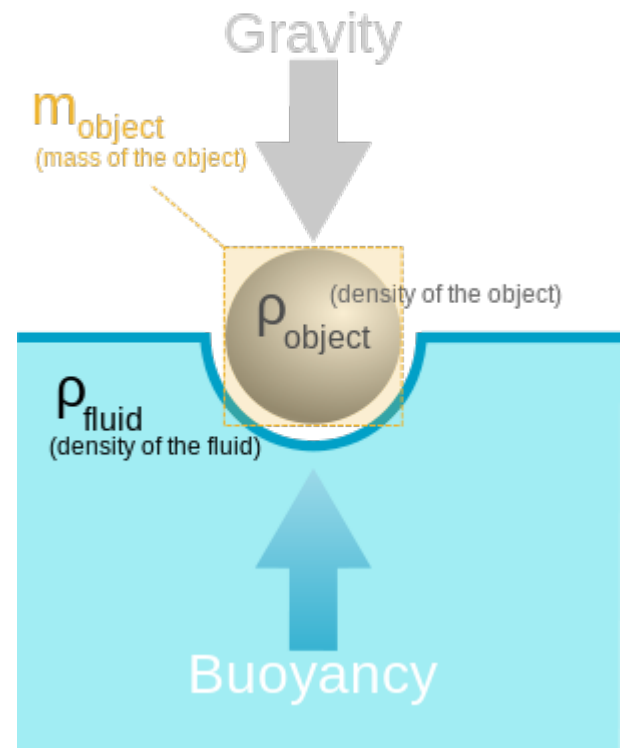
Buoyancy and Density Overview

Goals

- 1) Define buoyancy
- 2) Define density
- 3) Calculate density of various solid objects
- 4) Apply this to hot air balloons!

Buoyancy

- Upward force in a liquid that causes an object to float (buoyant force)
- Factors affecting buoyancy:
 - Density of object
 - Density of fluid
 - Shape of object



Density

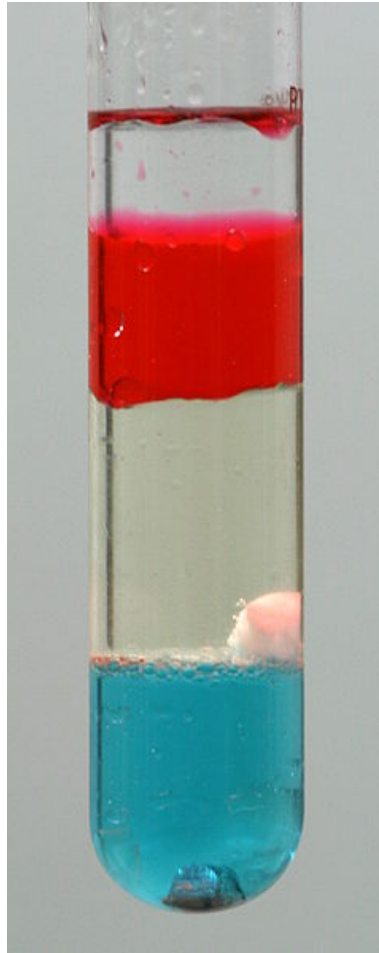
Ratio of mass of an object to volume of the object:

$$D = \frac{\textit{mass}}{\textit{volume}}$$

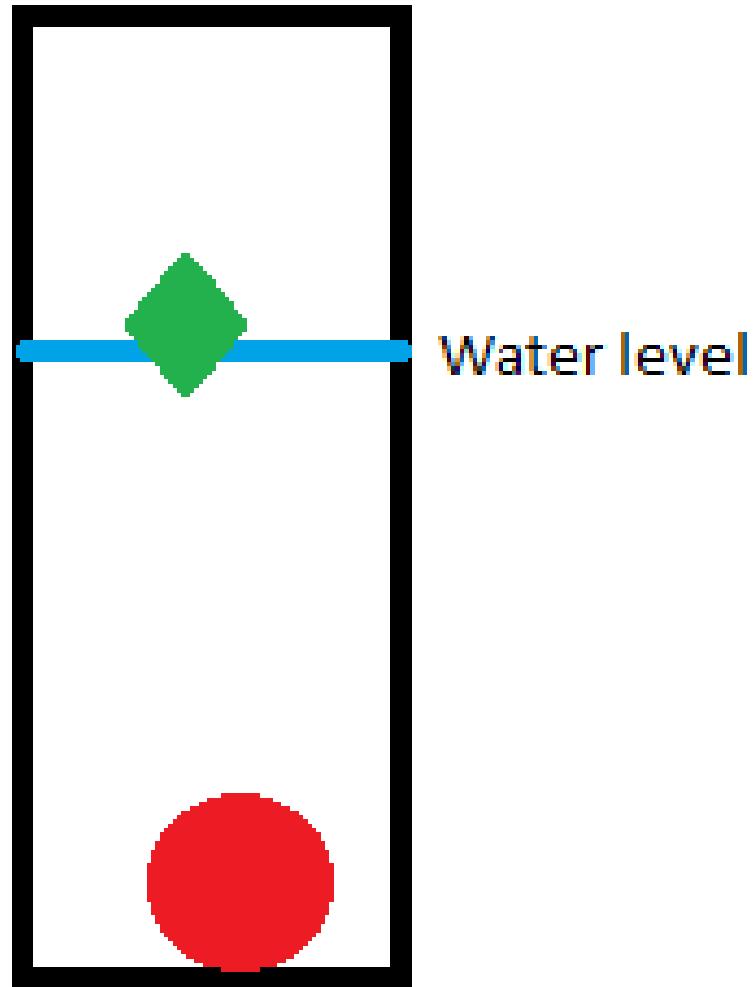
Units:

g/ml or g/cm³

Density: Liquids



Density: Solids in Liquids





Density: Gasses

Gas Density

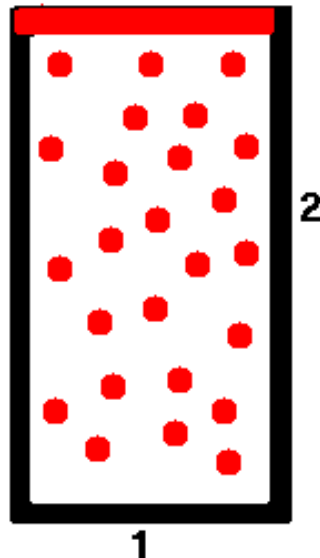
Glenn
Research
Center

Case # 1

Mass = .52 kg

Volume = $2 \times 1 \times 1$
= 2 m^3

Density = $.26 \frac{\text{kg}}{\text{m}^3}$

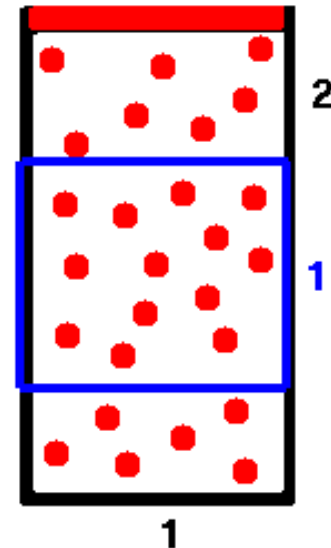


Case # 2

Mass = .52 kg

Volume = $2 \times 1 \times 1$
= 2 m^3

Density = $.26 \frac{\text{kg}}{\text{m}^3}$

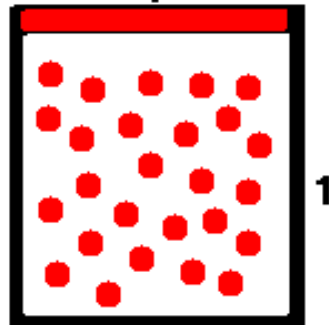


Case # 3

Mass = .52 kg

Volume = $1 \times 1 \times 1$
= 1 m^3

Density = $.52 \frac{\text{kg}}{\text{m}^3}$

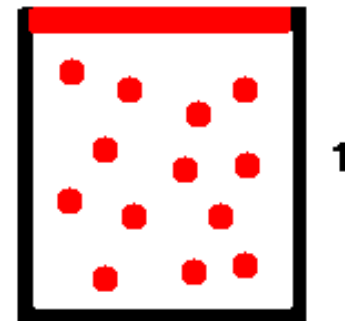


Case # 4

Mass = .26 kg

Volume = $1 \times 1 \times 1$
= 1 m^3

Density = $.26 \frac{\text{kg}}{\text{m}^3}$



$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

● = 20 gm = .02 kg

Density and Hot Air Balloons

So... how do hot air balloons work?

Hot air is less dense than cold air!



Density: Measuring in Lab

To measure density in lab:

Mass: use an electronic balance

Volume of irregular shaped objects: water displacement method

Volume of regular shaped objects: simple geometry!