Particle model and density of materials

The **density** of a material tells us how much **mass** of that material is in one unit of **volume** (1 m^3).

Materials denser than water will sink. Materials less dense than water will float.

We can calculate the density of a material using the equation:

$$density = \frac{mass}{volume}$$

$$\rho = \frac{m}{V}$$

- ρ = density (unit: **kilogram** per metre cubed, kg/m^3)
- m = mass (unit: kilogram, kg)
- V = volume (unit: **metre** cubed, m^3)

NAILIT!

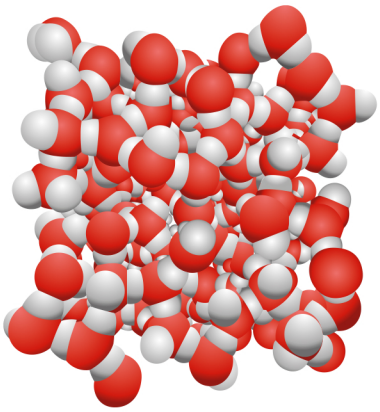
You need to recall and apply this equation. If you struggle to remember which way around the mass and volume go in the equation, think of the units of density, kg/m^3, which is a mass divided by a volume.

You might be asked to calculate the volume of regular shapes. For example, the volume of a cube is $V = l \times l \times l = l^3$, or in other words the length of its side multiplied by itself three times.

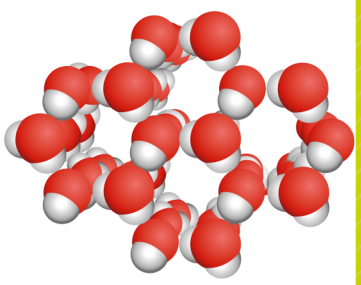
The particle model

Everything is made of particles (atoms and molecules). Materials that have more massive particles that are closer together are more dense than other materials.

The same material can change density as it **changes state**. For example, ice is made of water molecules that are in a **solid state**. The solid state of water is less dense than its **liquid state** (ice molecules are spread out over a bigger volume than water molecules). This is why ice floats in water.

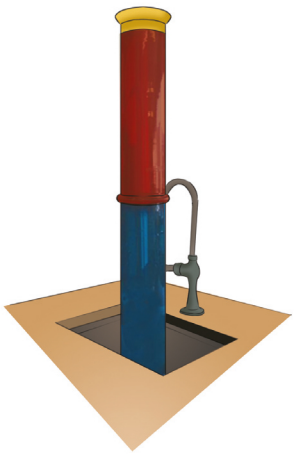


Molecules of water (liquid state)



Molecules of water as ice (solid state)

Most materials expand when the temperature increases, so become less dense. The red water in the image to the right is at much higher temperature than the cold (blue) water at the bottom, so the red dyed water floats on top of the blue dyed water.



DOIT!

Think about what you would see as the red liquid cools down.