

Density: why things float or sink

Grade 6 science (Year 7 · Class 6) · Lesson

Quick answer: Density is the mass of a material per unit of volume, found with the formula $\text{density} = \text{mass} \div \text{volume}$. It is measured in g/cm^3 or kg/m^3 . An object floats in a liquid when its density is lower than the liquid's density, and it sinks when its density is higher.

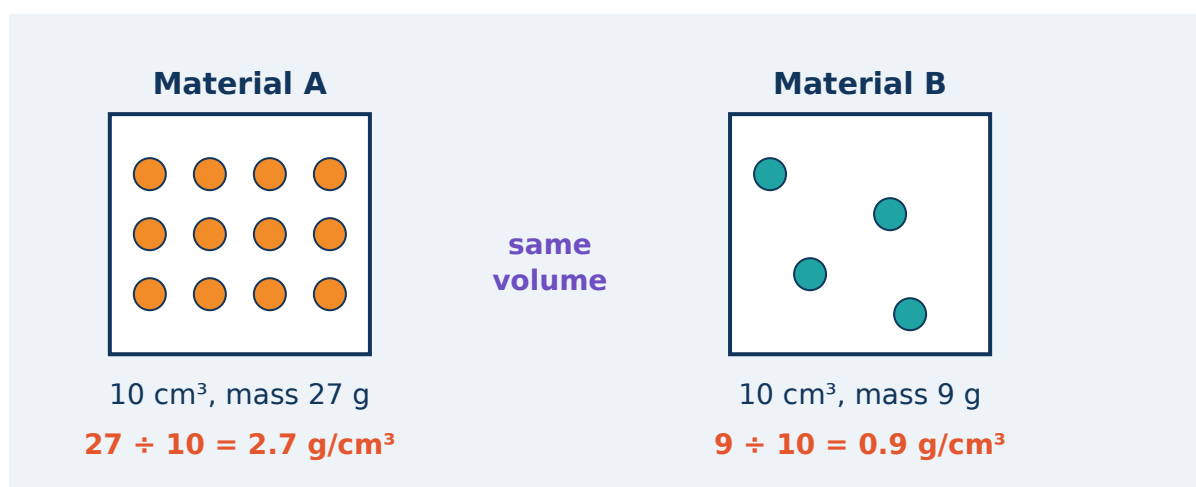
Level: Grade 6 science (Year 7 · Class 6) · **Curriculum:** MS-PS1-2

What is density?

Imagine lifting a bucket full of feathers and a bucket of the same size full of sand. The sand bucket feels far heavier, even though both fill the same space. The difference is **density**, which tells you how much matter is packed into a given volume.

Definition

Density is the mass of a material per unit of volume. A dense material has a lot of mass squeezed into a small volume; a low-density material has little mass in the same space.



Equal volumes, different masses: the box with more matter packed in has the higher density.

How do you calculate density?

To find a density, measure the mass with a balance and the volume with a cylinder or a ruler, then divide.

Formula

$\rho = m \div V$, where ρ (the Greek letter rho) is density in g/cm^3 or kg/m^3 , m is mass in g or kg, and V is volume in cm^3 or m^3 . Rearranged: $m = \rho \times V$ and $V = m \div \rho$. Note that $1 \text{ g/cm}^3 = 1000 \text{ kg/m}^3$.

Worked example 1

A shiny block has a mass of 54 g and a volume of 20 cm³. Find its density.

$\rho = m \div V = 54 \div 20 = \mathbf{2.7 \text{ g/cm}^3}$. This matches aluminium.

Worked example 2

Priya in Mumbai cuts a pine plank of volume 300 cm³. Pine has a density of 0.5 g/cm³. Find the mass.

$m = \rho \times V = 0.5 \times 300 = \mathbf{150 \text{ g}}$.

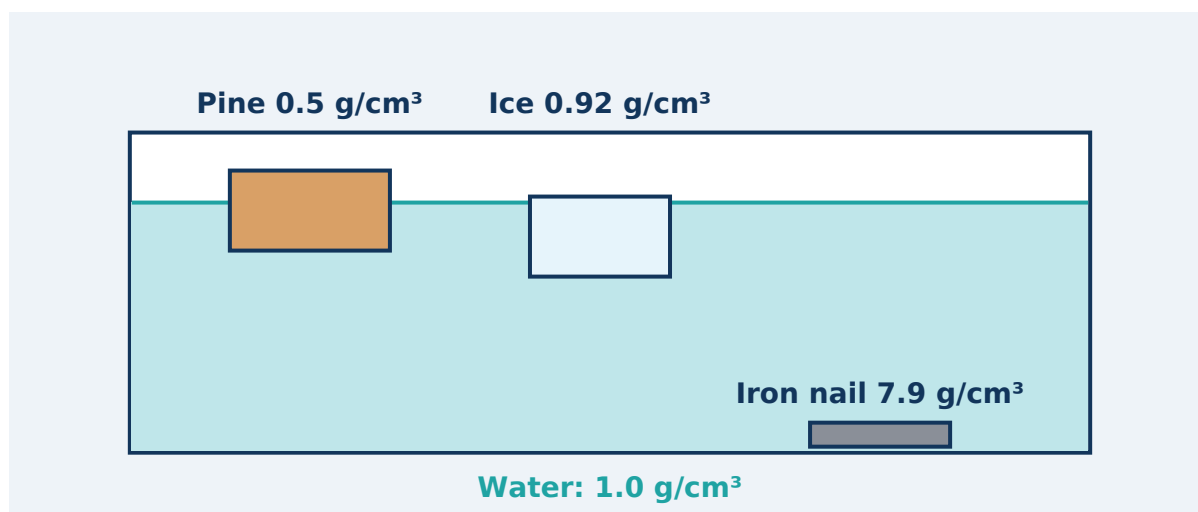
Material	Density (g/cm ³)	Floats on water?
Pine wood	0.5	Yes
Ice	0.92	Yes
Sunflower oil	0.92	Yes
Water	1.00	-
Aluminium	2.7	No
Iron	7.9	No
Lead	11.3	No
Gold	19.3	No

Why do some objects float and others sink?

Compare the density of the object with the density of the liquid around it. The comparison, not the size or weight of the object, decides what happens.

Key rule

If an object is **less dense** than the liquid, it floats. If it is **more dense**, it sinks. If the two densities are equal, it hangs in the liquid.



Objects less dense than water float; the lower the density, the higher the object sits. Objects denser than

water sink.

Worked example 3

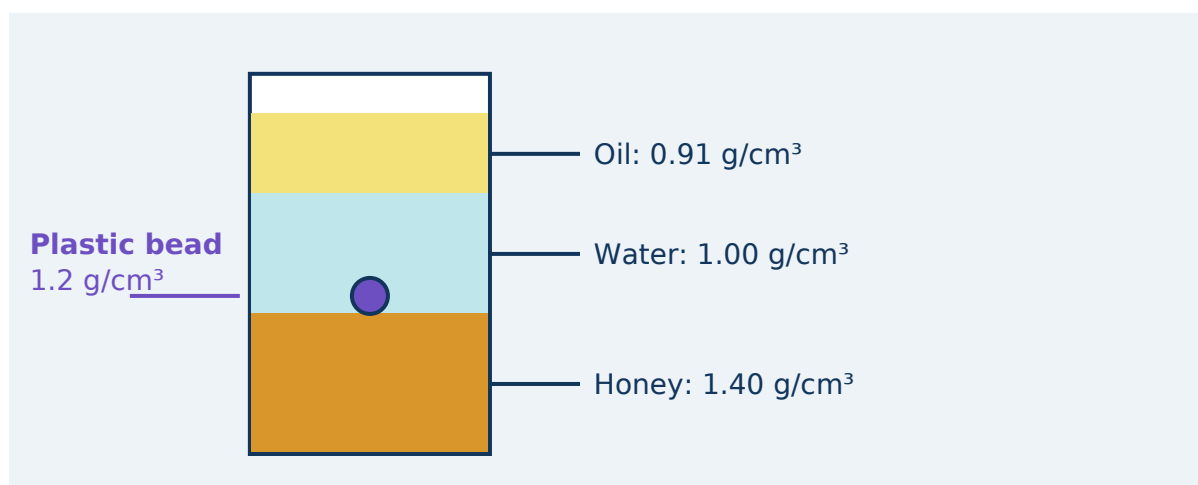
A sealed plastic bottle has a mass of 180 g and a volume of 200 cm³.

$\rho = 180 \div 200 = 0.90 \text{ g/cm}^3$, which is less than 1.00 g/cm³, so it **floats**.

Tariq adds sand until the total mass is 260 g. Now $\rho = 260 \div 200 = 1.30 \text{ g/cm}^3$, which is more than 1.00 g/cm³, so it **sinks**.

Can a liquid float on another liquid?

Yes. Liquids that do not mix arrange themselves by density. Oil pours onto water and stays on top because it is less dense. The same idea explains why a layer of fat floats on soup.



Liquids that do not mix settle in layers: the densest at the bottom. The bead sinks through the oil and water but floats on the honey.

Common mistake

Do not say that heavy things sink and light things float. A huge log floats while a tiny pebble sinks. Always compare *densities*, not masses.

Lina's tip

Write the three quantities as m , ρ and V and decide which one you are missing. If both numbers you know are on the same row of the formula, divide; if you know ρ and V , multiply to get m .

Why does a steel ship float?

Steel is almost eight times denser than water, yet a cargo ship floats. The hull is a hollow shape filled mostly with air, so the whole ship, steel and air together, has an average density below that of water. If water floods in, the average density rises above 1.0 g/cm³ and the ship sinks.

Key points to remember

- Density $\rho = m \div V$, in g/cm^3 or kg/m^3 .
- Water has a density of 1.00 g/cm^3 (1000 kg/m^3).
- An object floats if its density is lower than the liquid's, and sinks if it is higher.
- Mass = density $\times$ volume; volume = mass $\div$ density.
- Liquids that do not mix form layers with the densest at the bottom.

Density: why things float or sink: frequently asked questions

How do you find the density of an object?

Measure its mass with a balance and its volume with a ruler or by displacement. Then divide the mass by the volume. The answer is in g/cm^3 when mass is in grams and volume is in cm^3 .

Why does ice float on water?

Ice has a density of about 0.92 g/cm^3 , which is lower than the 1.00 g/cm^3 of liquid water. Because ice is less dense, most of it sits below the surface and a small part stays above.

What is the density of water?

Pure water has a density of 1.00 g/cm^3 , or 1000 kg/m^3 . This is the reference value used to decide whether a solid will float or sink in water.

Can a heavy object float?

Yes. A heavy object floats if its density is lower than the liquid's. A ship is very heavy, but its hollow shape gives it an average density below that of water.

How do you convert g/cm^3 to kg/m^3 ?

Multiply by 1000. For example, 2.7 g/cm^3 equals 2700 kg/m^3 . To go the other way, divide kg/m^3 by 1000.