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Viscosity: a liquid's internal resistance or friction that keeps it from flowing.

Fluids with a higher viscosity do not flow as easily.

If I raise the temperature of my fluid, will that increase or decrease it's velocity?

Different fluids also have different **densities**.

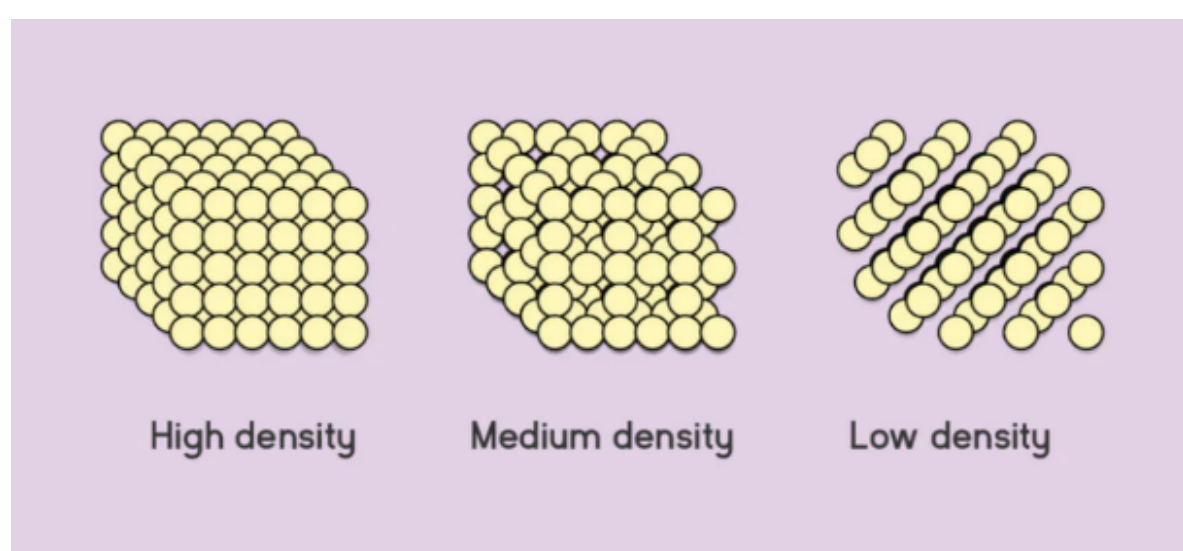
What is density?

dense adjective

ˈden(t)s ◀▶

denser; densest

[Synonyms of dense](#) >



1 a : marked by compactness or crowding together of parts

| *dense* vegetation

| *dense* traffic

b **chemistry** : having a high mass (see [MASS entry 2 sense 1c](#)) per unit volume (see [VOLUME entry 1 sense 2](#))

| Carbon dioxide is a *dense* gas.

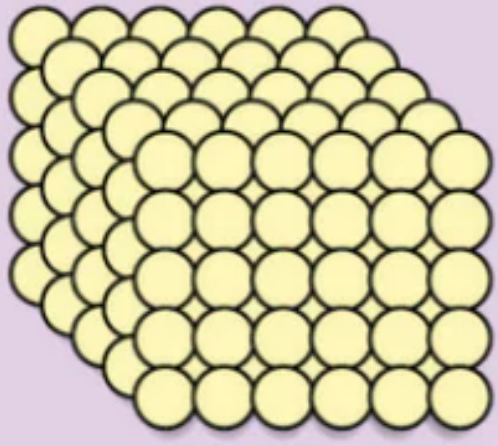
| The cake was overly sweet and *dense*.

2 a : slow to understand : **STUPID, THICKHEADED**

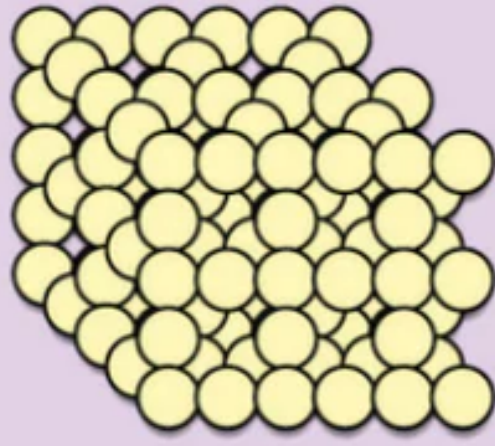
| was too *dense* to get the joke

b : **EXTREME**

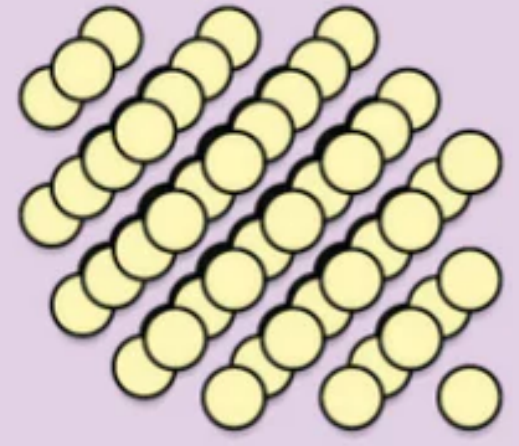
| *dense* ignorance



High density



Medium density



Low density

Density is the amount of matter (or number of particles) in a given volume

What unit is the "amount of matter" measured in? What unit is "volume" measured in?

Mass: the amount of matter in an object.

Is this the same as weight?

What changes on the moon? Mass or weight?

Volume: how much space it takes up.

So if **density** is the amount of matter in a given volume, how would we calculate it?

Calculating Density

We've discovered that we'll do **mass/volume** to calculate density.

So what units will we use for density?

(Think of the units of mass and the units of volume)

So how do we calculate density as a number? For example, if 242mL of a substance has a mass of 424g, what is the density?

$$1.75 \text{ g/mL}$$

What if the substance has the same mass, 424g but had a greater volume of 400mL?

$$1.06 \text{ g/mL}$$

Kahoot

If we're not given the mass of a substance, how could we find it?

If we're not given the volume of a substance, how could we find it?

Exploring Mass, Density, and Volume Experiment

We will be doing this as a group, but **each person** must hand in a completed paper.

1. Using two identical beakers, measure out the same volume of rice and cereal (using the lines on the beaker representing ml)

2. Using the balance scale, find the mass of each substance in the beaker. (This may require finding the mass of an empty beaker and using subtraction)

3. |

Volume	Mass of Rice	Mass of Cereal
Density		

4. Using the balance scale, measure out 25g of cereal and 25g of rice. Place them in two separate beakers.

5. Find the volume of each by using the lines representing ml on the beakers.

6. |

Mass	Volume of Rice	Volume of Cereal
25g		
Density		

7. Answer the following questions **INDEPENDENTLY** (this part is for marks):

a) When you have two substances with the same volume: (Use the words "greater" or "lower")

larger mass= _____ density

smaller mass= _____ density

b) When you have two substances with the same mass: (Use the words "greater" or "lower")

larger volume= _____ density

smaller volume= _____ density

We calculated density by first finding the mass of the rice/rice krispies (using a balance scale) and finding the volume of the rice/rice krispies (by pouring it into a beaker or graduated cylinder.)

What if the object doesn't fill a container?

How would you find the volume of this object?

Eureka!

Archimedes-Greek mathematician

-famous for his bath

<https://www.youtube.com/watch?v=ijj58xD5fDI>



The crown and the gold have equal weight.



The crown displaced more water than the gold.



In Archimedes' experiment, he calculated the density of a **solid** by placing it in a **liquid** to find the volume.

When we measure the volume of solids in math, we use cm^3 as the units. Yet in science, we are using mL. This is because $1\text{cm}^3 = 1\text{mL}^3$. Both are acceptable units for volume.

The volume of the object is equal to how much water gets displaced. But this only works if the object is completely submerged in water.

What happens if the object floats? How would we calculate its volume?

What happens if the object floats? How would we calculate its volume?

We would have to use a sinker (another object that we know the volume of) to make it sink and then we can look at the water displaced, subtract the volume we know, and the resulting amount is the volume of the floating object.

Why does an object float?

Why does an object float?

If an object's density is less than the density of water, it will float! In order to know if it is less than water, we need to learn a little bit more about water!

Density of Water and Other Fluids

Water is special for many reasons.

First Nations and Metis peoples have observed the similarities between our bodies and Mother Earth. Imagine viewing your body as a system of rivers. Water is very good at dissolving substances. If you pour toxic things into a river, is the water quality better or worse?

The same happens in your body's water environment. Your health can become affected if you put anything toxic into it.

From a scientific point of view, water is special in its properties. The density of water is exceptional. Other substances have densities greater or less than water.



This is why oil floats on water. Oil is less dense than water.

Honey is more dense than water.

So if I put honey and water in a glass (without stirring and letting the honey sit), what would this look like?

Let's think back to the Particle Theory of Matter

Solid:Liquid:Gas:

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What is the effect of temperature on the particles?

(Think about what happens to particles when the substance is heated)

Using your previous logic, what happens to the volume of a substance when the temperature increases?

So then what happens to the density?

Using your previous logic, what happens to the volume of a substance when the temperature increases?

The volume gets bigger!

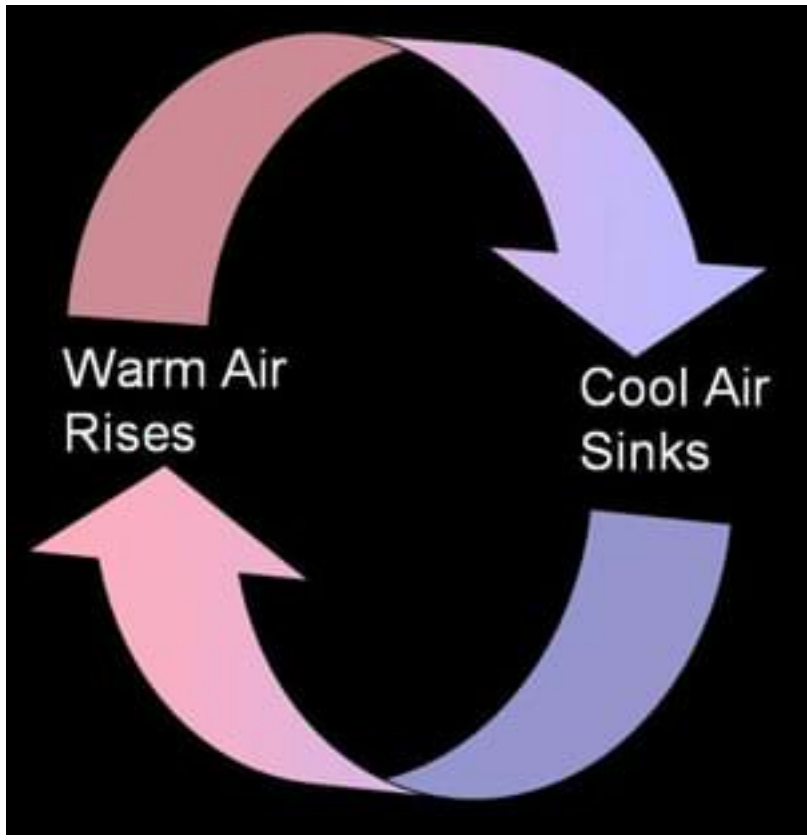
So then what happens to the density?

It gets smaller. (Volume is the denominator of the fraction. When the denominator gets bigger, the fraction gets smaller. $1/2$ is bigger than $1/4$, but the 4 is a bigger volume than the 2.)

If a fluid is warmer, it has more volume and less density!

This is why hot air rises and cold air sinks!

This is also why warmer water rises to the top and colder water sinks to the bottom.



Viscosity and Density Quiz

We just learned that for something to float, its density must be less than the density of water.

Will a paperclip float? What does this say about its density?

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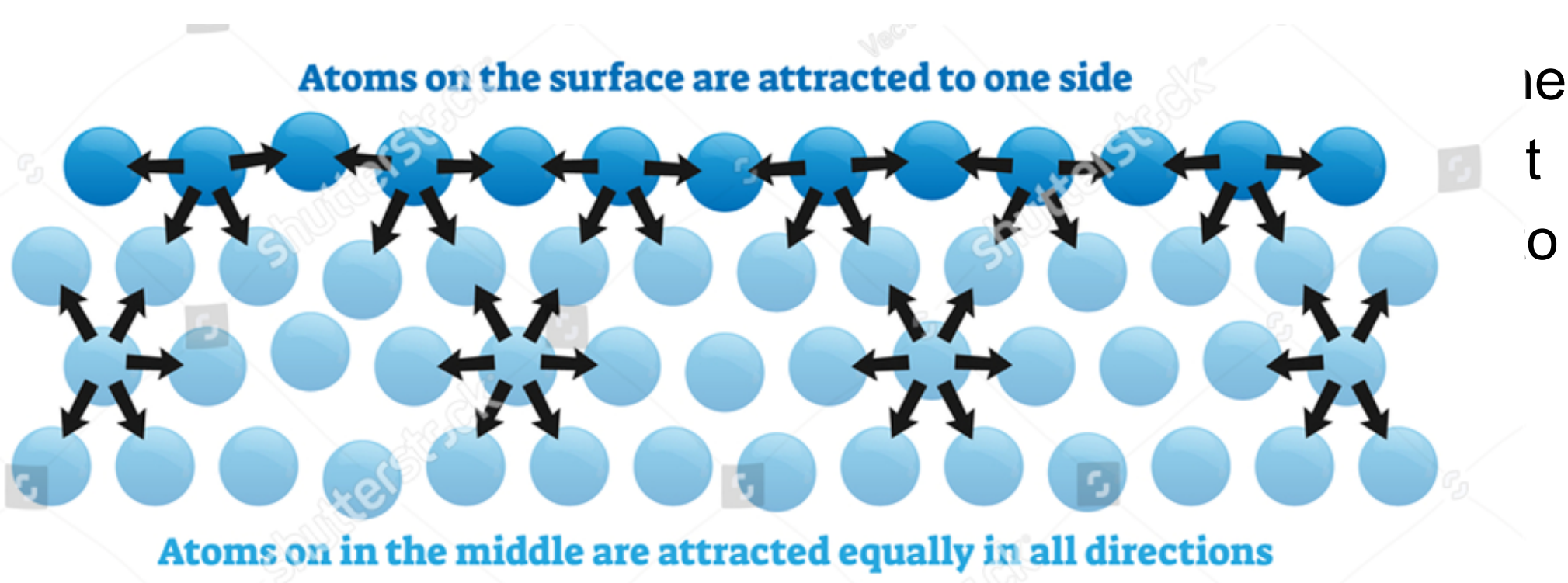
According to this logic, if the paperclip sinks, the only way to make it float would be to make it less dense. I could do this by either lowering its mass (cutting it) or raising its volume (stretching it out to take less space). Without changing the density, the paperclip will always be more dense than water so it will always sink. Let's try it again with the same paperclip with the same density.

This shows us that density is not the only factor determining if something will float or sink.

If density was the only factor, that paperclip would continue to sink if I didn't change the density.

The other factor working in this case is called **surface tension**, which is another property of fluids.

Surface tension is the **tension** a fluid has at the **surface**.



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Do you think anything can reduce this surface tension fluids have and spread out those particles?

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Do you remember what a surfactant is? Surfactants can reduce surface tension!

Let's see how this works with food coloring!