Density Lab

Which has more mass:

A kilogram of feathers...

...or a kilogram of lead?

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Answer:
They both have a mass of 1 kilogram.

What is Mass?

Mass is NOT weight.

MASS	WEIGHT
The amount of stuff...	...The amount that gravity pulls on stuff.
vs.	
Same everywhere in the universe...	...Different depending on local gravity.
Measured in grams (or kilograms)...	...Measured in pounds.
The total number of protons and neutrons...	...The total force acting on protons and neutrons.

Big, Scary Equation Time!

Weight is related to Mass according to:

$$\text{Weight} = \frac{G \times \text{Mass}_{\text{object}} \times \text{Mass}_{\text{planet}}}{\text{Distance}^2}$$

Remember: "Distance^2" just means (distance x distance)

What is Volume?

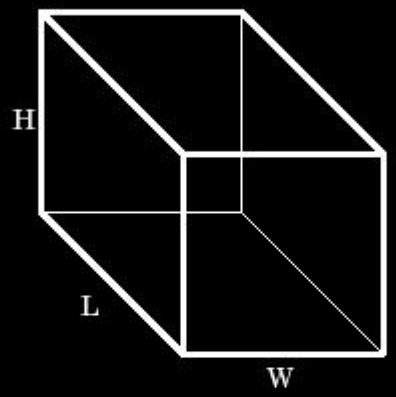
Volume is just how much space something occupies.

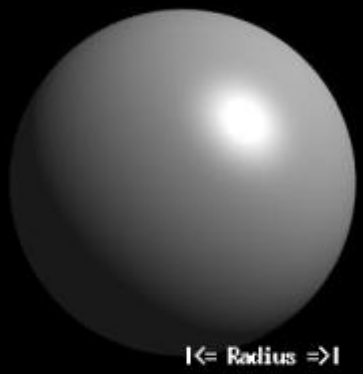
In other words - how big is it?

Aggie Stadium.
Takes up a lot of space.

A Miniature Chihuahua.
Not really taking up much space.

Equations of Volume





Volume of Rectangular Solid:
V = Length x Width x Height

Volume of Sphere:
V = (4/3) x Pi x (Radius^2)

Units of volume are in (cm x cm x cm) = cm^3.
One cm^3 is also the same as one milliliter (ml).

Examples of Equations of Volume

Gold Brick Measurements:
Length = 12.25cm, Width = 4.25cm, Height = 1cm

Volume of Gold Brick =
Length x Width x Height = 12.25cm x 4.25cm x 1cm = 52 cm^3

What is Density?

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}} = \frac{\text{Stuff}}{\text{Space}} = \frac{\text{Protons \& Neutrons}}{\text{Size of Object}} = \frac{\text{\# of grams}}{\text{\# of cm}^3\text{ (ml)}}$$

Water always has a density of 1 g/cm^3, because
1 gram of water occupies 1 cm^3 (1 ml) of space,
2 grams of water occupy 2 cm^3 (2 ml) of space,
etc...

Examples of Equations of Density

Mass of Gold Brick = 1 kilogram = 1000 grams

Volume of Gold Brick = 52 cm^3 (52 ml)

$$\text{Density of Gold} = \frac{\text{Mass of Brick}}{\text{Volume of Brick}} = \frac{1000\ g}{52\ cm^3} = 19.3\ g/cm^3$$

Examples of Densities for Various Substances

Gold ...	19.3 g/cm^3
Lead ...	11.4 g/cm^3
Iron ...	7.9 g/cm^3
Rock ...	2.5 g/cm^3
Water ...	1.0 g/cm^3
Ice ...	0.92 g/cm^3
Wood ...	0.6 - 0.9 g/cm^3
Feathers ...	0.0025 g/cm^3
Air ...	0.0013 g/cm^3
Helium ...	0.00018 g/cm^3

Which is *denser*:

A kilogram of feathers...

...or a kilogram of lead?

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A kilogram of feathers...

...or a kilogram of lead?

Answer: Lead

Why? Because lead has the same amount of stuff in less space.
In other words, same mass, less volume means greater density.

Volume Problem!



How do we find the volume of things that aren't boxes or spheres - like kittens, or potatoes, or Johnny Depp?

Volume of Funky-Shaped Objects:
V = ?

The Story of Archimedes and the Crown

Volumes of objects can be found by putting them in water, then watching how much the water is "displaced".

Volume of any object =
(Volume of water after object is added) - (Volume of water before object is added)

Masses can be found using the small balance scale.
Just record the total mass of the weights needed to balance the object.

HOWEVER, to find the mass of the bigger objects you'll need to use the bathroom scale.

In that case, find your weight with the object, then subtract your weight without the object. This will give you the **weight of the object in pounds. To convert to the **mass** in grams, multiply the value by 454. In other words:**

Mass of object = [(Your weight w/object) - (Your weight w/o object)] x 454 grams

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$$\text{And Remember...Density} = \frac{\text{Mass}}{\text{Volume}}$$