DENSITY!

(A 7-letter word for fun)

MASS

MASS

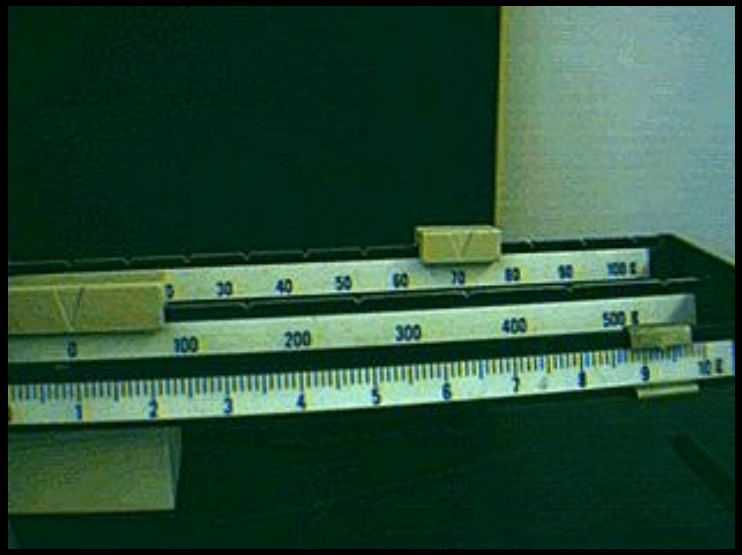
Mass is how much stuff an objects has.

(stuff = protons and neutrons)

We measure mass in grams.

Lots of mass

A little bit of mass



Mass Balance

“Weight” a minute. . .

What is weight?

And how is it different from mass?

Weight. . .

- is how much gravity pulls on stuff.

  (the force that gravity exerts on protons and neutrons)

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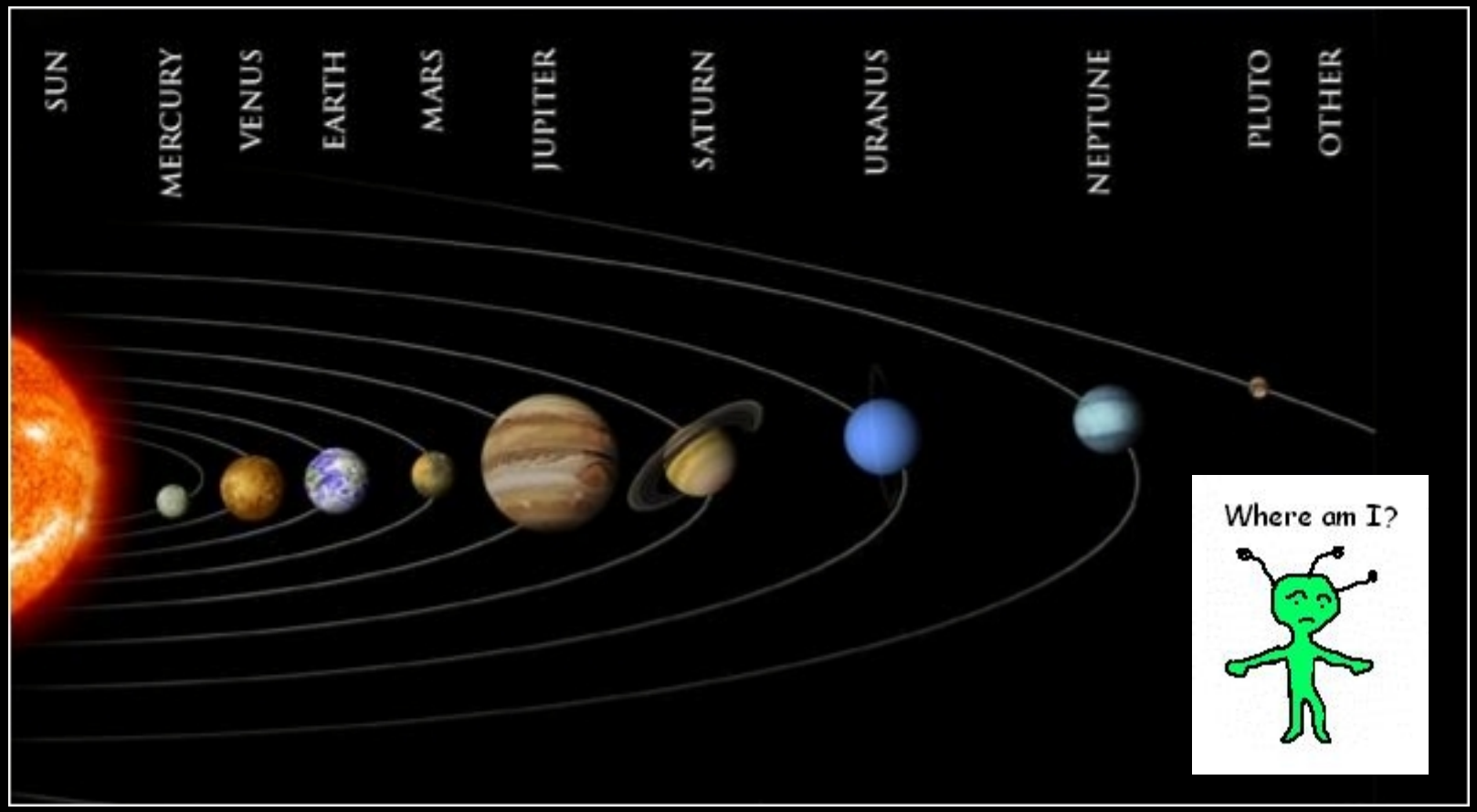
  (the force that gravity exerts on protons and neutrons)

- depends on where you are in the universe.
  (because it depends on gravity)

- is measured in pounds.
  On Earth, 1 pound = 454 grams = .454 kg.

And while weight can change depending on where you are. . .



And while weight can change depending on where you are. . .

MASS IS ALWAYS CONSTANT!

Wherever an object is, it always has the same number of protons and neutrons.

VOLUME

how much space an object takes up

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how much space an object takes up

big football player

lots of volume

VOLUME

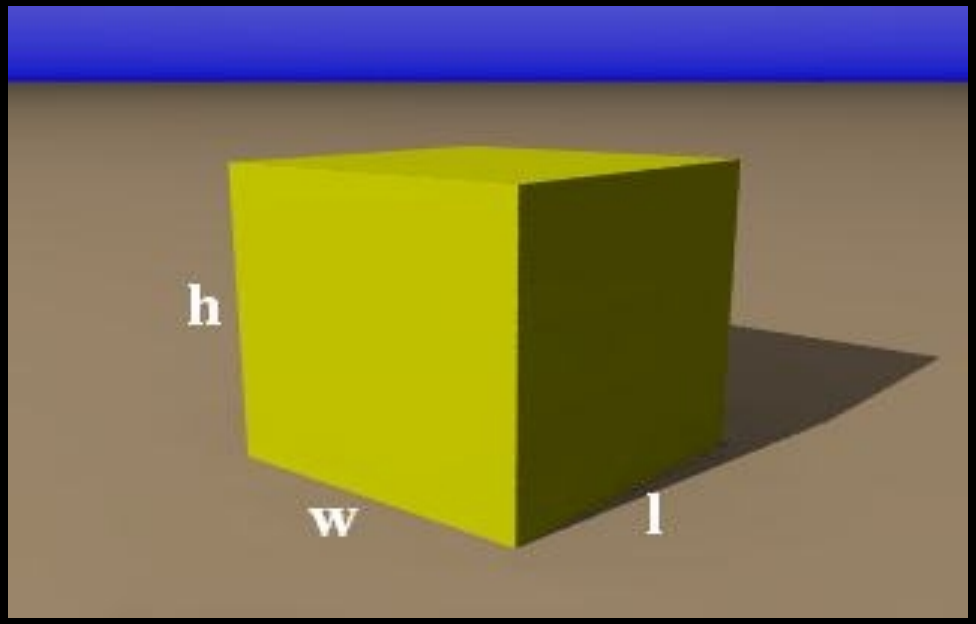
how much space an object takes up

big football player

lots of volume

baby penguin

little volume



Volume = length x width x height

EUREKA!

Another way to measure volume is to use

WATER DISPLACEMENT

Archimedes 287 – 212 BC

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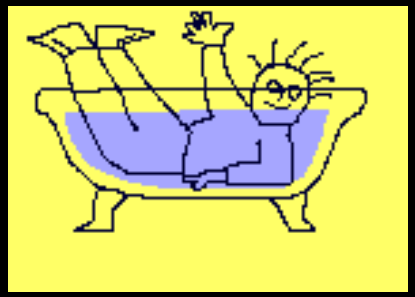
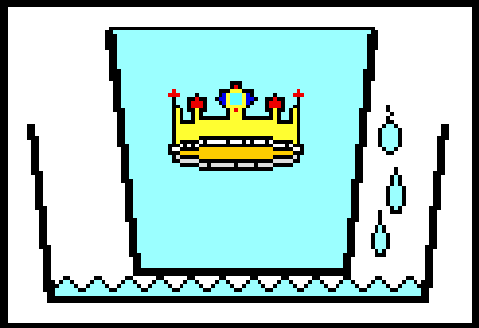
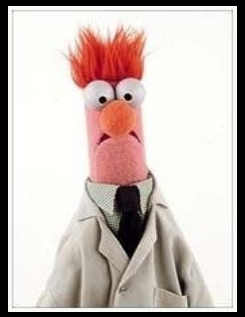
WATER DISPLACEMENT

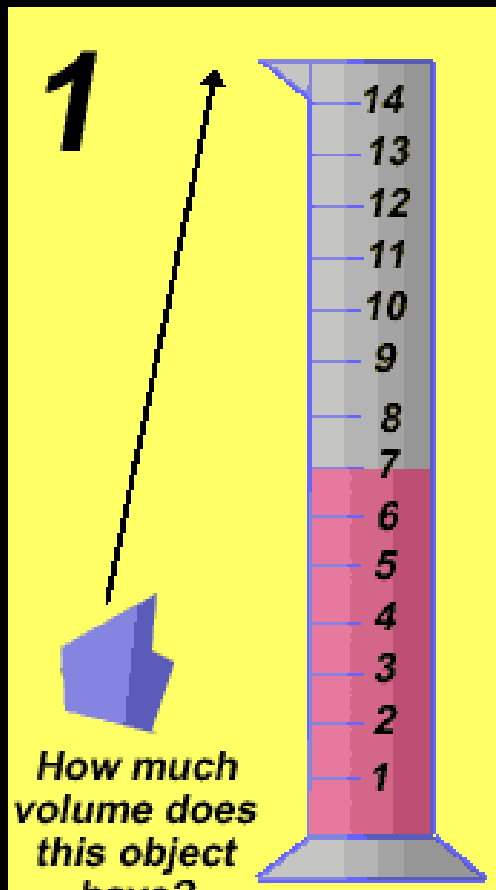




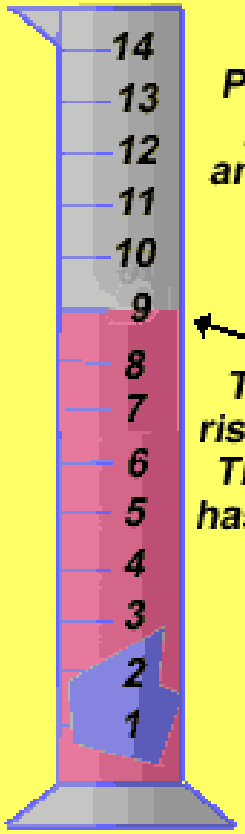
Archimedes 287 – 212 BC



1



How much volume does this object have?



Put it in the graduate and find out.

The water rises 2 units. The object has a volume of 2.

2

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

It’s how much stuff is in a given space.

Mass is measured in grams.

Volume is measured in cm^3.

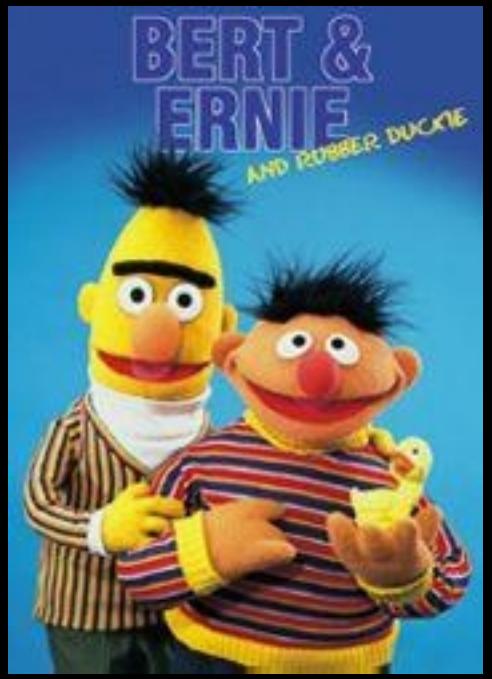
So density is measured in $grams/cm^3$.

The density of water is 1, because 1 gram of water takes up one cubic centimeter of space.

WILL IT FLOAT?

The density of Rubber Duckie is less than 1.

So Rubber Duckie floats in water.



A brass monkey has a density greater than 1.

A brass monkey will therefore sink in water.

Air has a density of .00124 g/cc.

Air has a density of .00124 g/cc.

Helium is less dense than air, so helium floats.

Yoda is more dense than air, so he does not float.

(Usually.)

Density!

- Mass: use mass balance

- Volume: use water displacement
  use your ruler

- Density: mass divided by volume

- Use density to identify the mystery object

- Use density to help figure out how the Moon formed and what's in the Earth's core

GRAVITY

- g = 9.807 meters/second^2 on Earth

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- g = 9.807 meters/second^2 on Earth
- speed = g x time
- distance fallen = ½ x g x time^2
- more massive objects have a higher "g"

When an object is falling, it has kinetic energy.

$$\text{Kinetic Energy} = \tfrac{1}{2} \times \text{mass} \times \text{speed}^2$$

Meteorites are moving at very high speeds when they hit the Earth.

They can also be very massive.

Meteorites are moving at very high speeds when they hit the Earth.

They can also be very massive.

This means meteorites can have a lot of kinetic energy and do a lot of damage.

The moon has been hit by lots of meteorites.