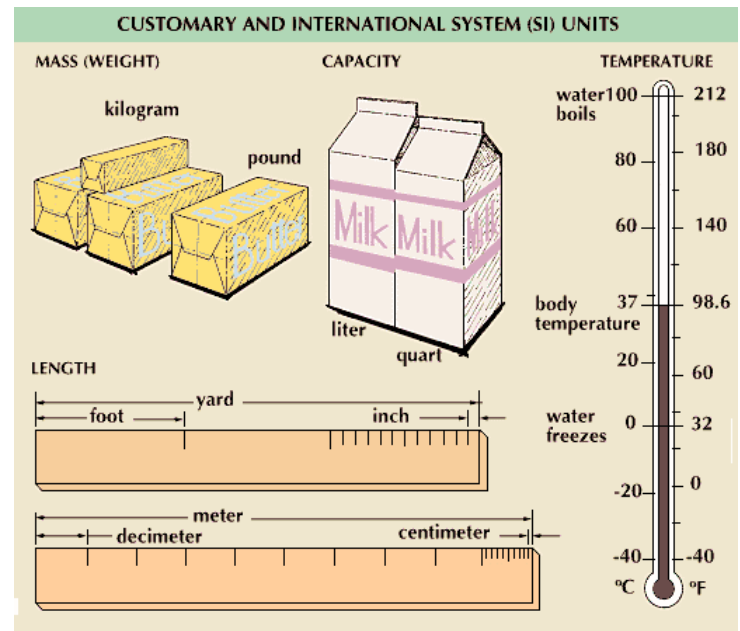


Scientific Measurements: Length, Mass, Volume, and Density

SI Units of Measurement

- Many of the units you're familiar with (inches, feet, and degrees Fahrenheit) are *not* used in science.
- Scientists use a set of measuring units called SI, or the International System of Units (also known as the **metric system**)

- Why do you think we use the metric system?



Measurements & Units

- For a measurement to make sense, it needs a **number** and a **unit**



Base Units

- There are 7 metric units, known as base units

SI Base Units		
Quantity	Unit	Symbol
Length	meter	m
Mass	kilogram	kg
Temperature	kelvin	K
Time	second	s
Amount of substance	mole	mol
Electric current	ampere	A
Luminous intensity	candela	cd

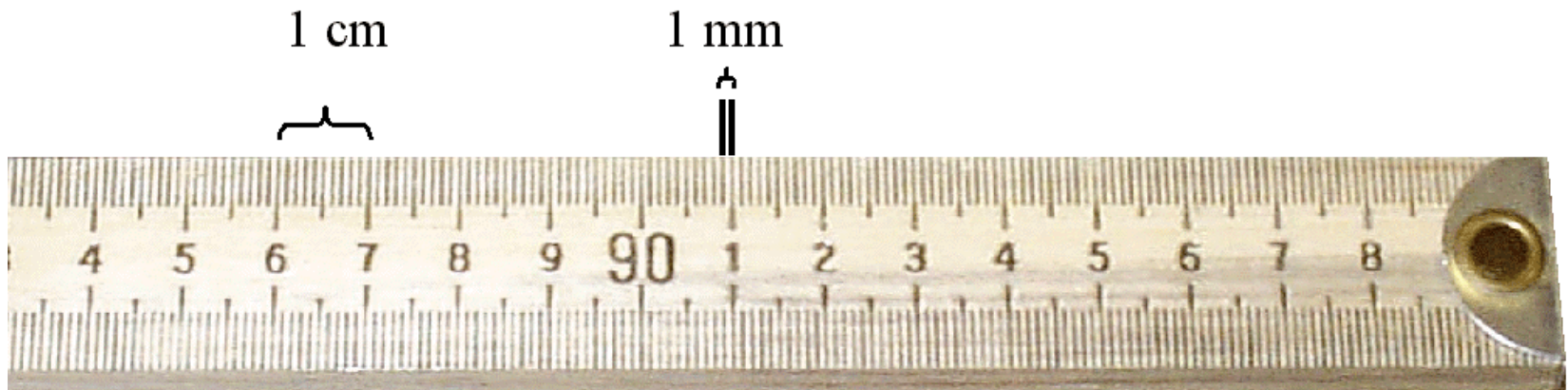
Length

- The **meter** is the basic unit of length in the metric system
- 1 meter = 39.4 inches
- To measure longer distances, you use the ***kilometer***
 - There are 1000 meters in a kilometer



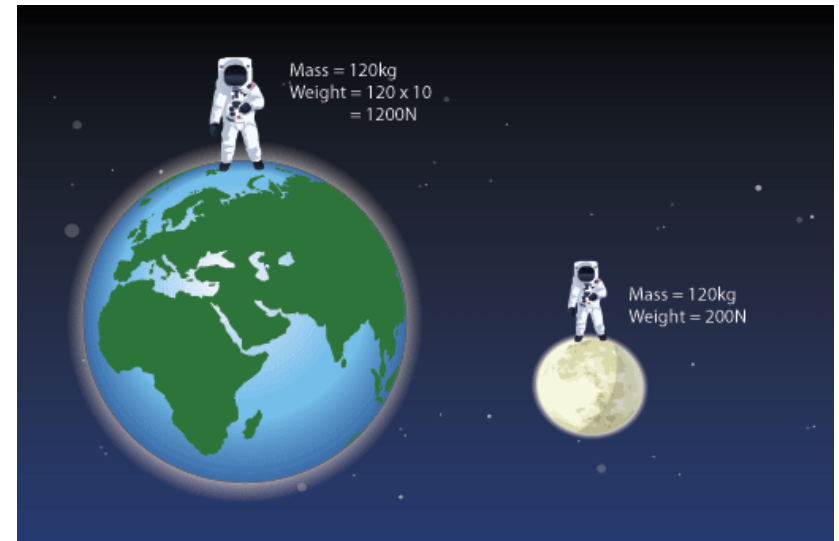
Length (continued)

- Meters are divided into ***centimeters***
 - there are 100 centimeters in a meter
 - to measure something smaller than a meter, you would use centimeters
- ***Centimeters*** are divided into ***millimeters***



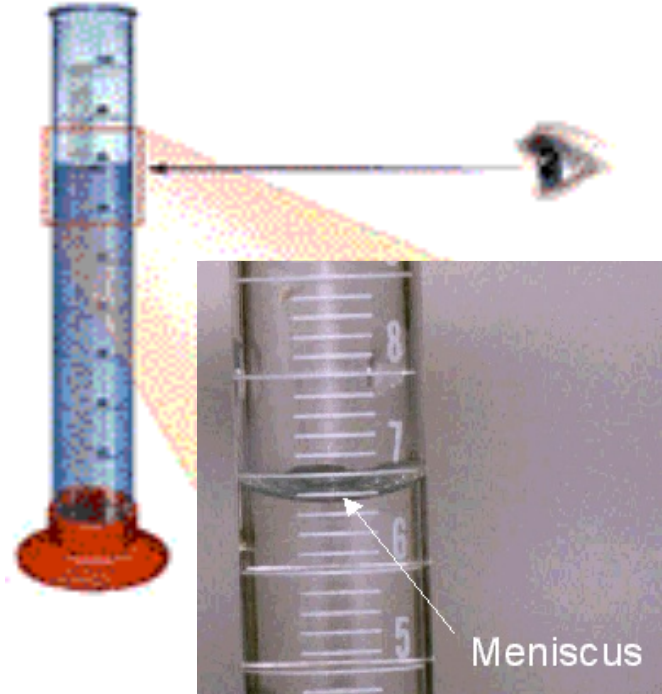
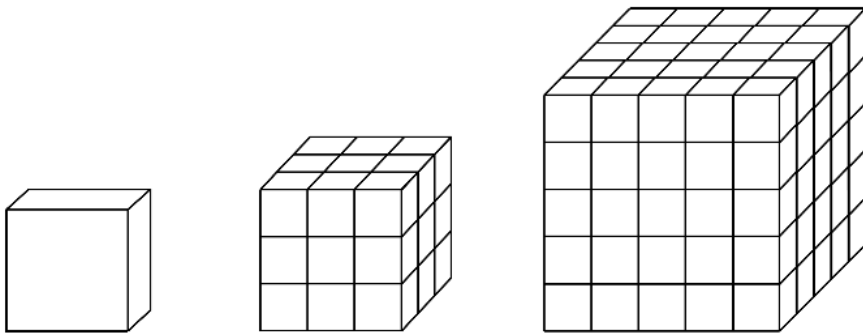
Mass & Weight

- **Mass**: the amount of matter in an object
 - Ex: a truck has more mass than a toy car
- **Mass is not the same as weight**
- **Weight** is your mass multiplied by **gravity**
 - Your weight is a measure of how much gravity is pulling you down



Volume

- **Volume**: amount of space an object takes up
- The liter is the basic unit of volume
- The milliliter is the unit for small volumes of liquid
- The cubic centimeter (cm^3) is the unit for small volumes of solid, or liquid.



Density

- **Density**: the mass per volume of an object

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



Metric Prefixes

	Many	Kids	Have	Died	By	Doing	Conversion	Math
Prefix	mega-	kilo-	hecto-	deka-	Base Unit: gram meter second mole kelvin ampere	deci-	centi-	milli-
Math Equality	$\frac{1}{1,000,000}$	$\frac{1}{1,000}$	$\frac{1}{100}$	$\frac{1}{10}$	1	10	100	1,000
Decimal Places	6	3	2	1	-	1	2	3

Big to Small - Decimal to Right

BIG → → → → → → → → → → → → → → → **small**

Small to Big - Decimal to Left

BIG ← ← ← ← ← ← ← ← ← ← ← ← ← ← ← **small**

Derived Units

- Additional SI units, called derived units, are made from combinations of base units
- For example:
 - Volume: the amount of space an object takes up
 - Density: ratio of object's mass to its volume

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

Derived Units

- Specific combinations of SI base units make derived units.

Derived Units		
Quantity	Unit	Symbol
Area	square meter	m^2
Volume	cubic meter	m^3
Density	kilograms per cubic meter	kg/m^3
Pressure	pascal ($\text{kg}/\text{m}\cdot\text{s}^2$)	Pa
Energy	joule ($\text{kg}\cdot\text{m}^2/\text{s}^2$)	J
Frequency	hertz (1/s)	Hz
Electric charge	coulomb ($\text{A}\cdot\text{s}$)	C

Density

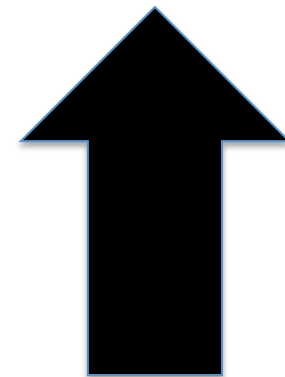
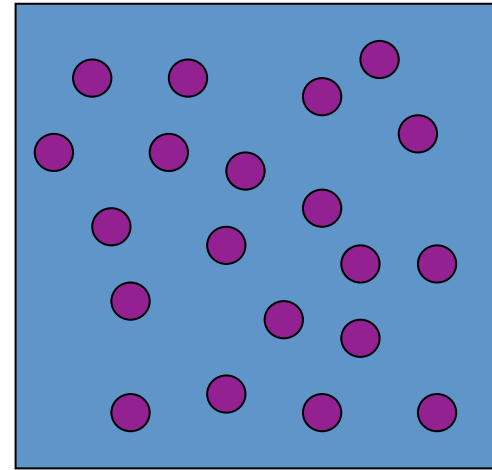
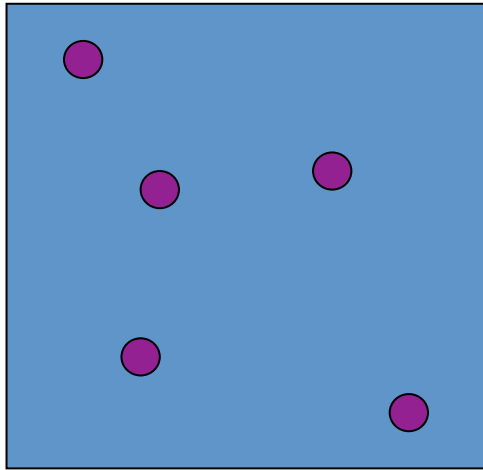
- **Density**: the mass per volume of an object
- Density is a comparison of how much matter there is in a certain amount of space.

SUBSTANCE	DENSITY (G/CM ³)
AIR	0.0013
WOOD (OAK)	0.85
WATER	1.00
ICE	0.93
ALUMINUM	2.7
LEAD	11.3
GOLD	19.3

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

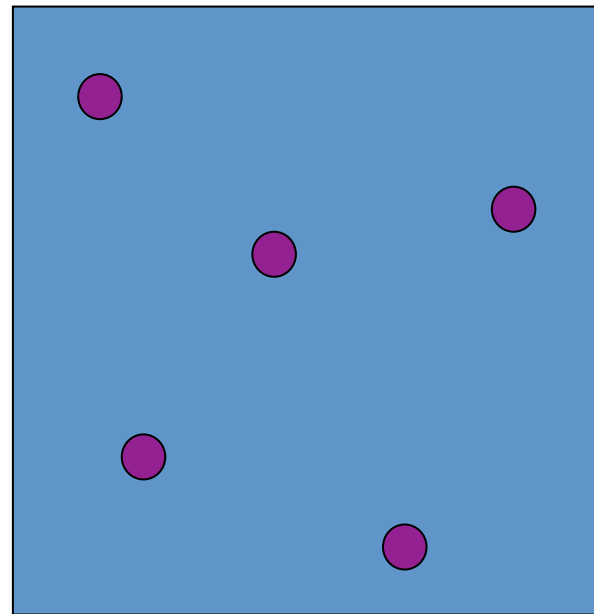
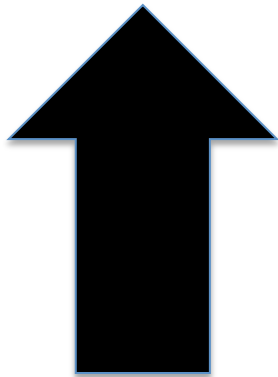
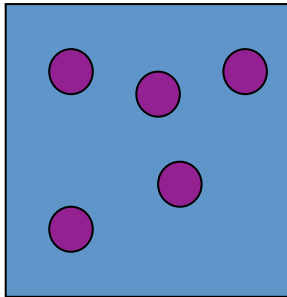


Which one is more dense?



Which one is more dense?

- Now which one is more dense?



Liquid Layers

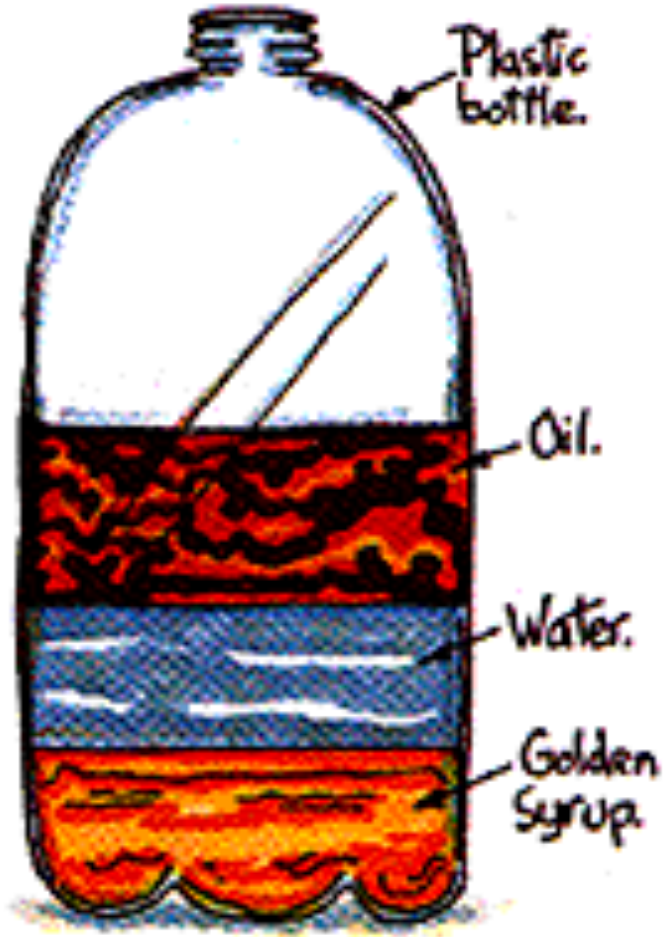
- If you pour together liquids that don't mix and have different densities, they will form liquid layers.
- The liquid with the **highest density** will be on the bottom.
- The liquid with the **lowest density** will be on the top.

Liquid Layers

- Check out this picture from your book. Which layer has the highest density?
- Which layer has the lowest density?
- Imagine that the liquids have the following densities:
 - 10g/mL. 3g/mL.
 - 6g/mL. 5g/mL.
- Which number would go with which layer?



Liquid Layers – Try with your neighbor



- Which liquid has the highest density?
- Which liquid has the lowest density?
- Which liquid has the middle density?