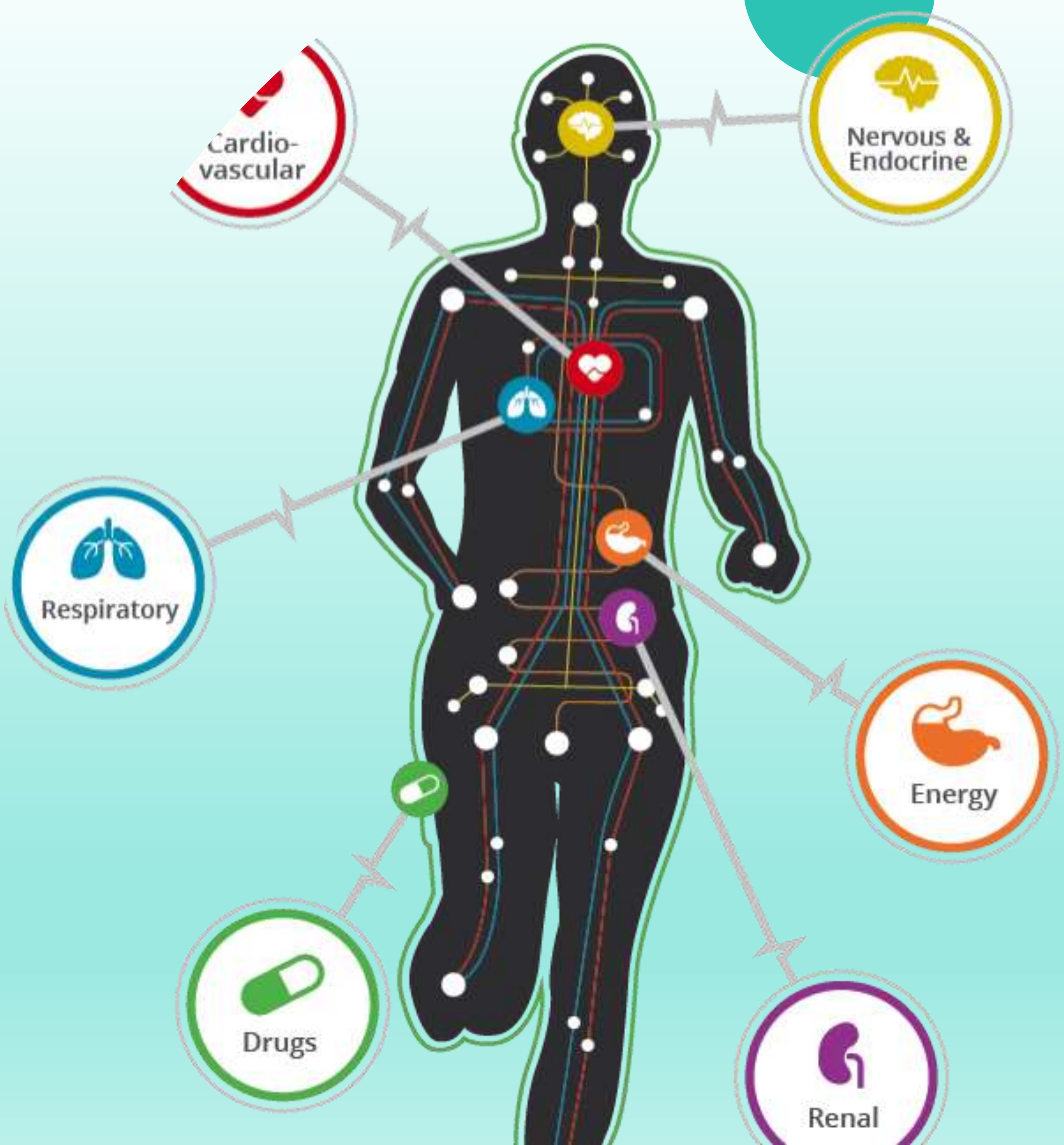
BODY FLUID AND OSMOLARITY AND OVERVIEW OF RESPIRATORY SYSTEM



Body fluid volume :

Dilution method :

1) A known amount of substance is given whose volume of distribution is the body fluid compartment of interest

The substance that is given according to the fluid compartment :

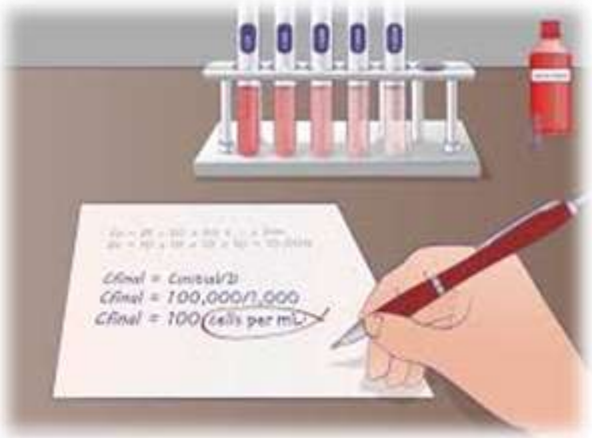
- TBE : isotopic water :means contain other type of H isotopes
- plasma :Evans blue
- ECF : mannitol

Dilution method :

2) Substance is allowed to equilibrate
3) The concentration of substance is measured in the plasma and the volume of distribution is calculated

$$\text{Volume} = \frac{\text{amount}}{\text{concentration}}$$

Volume : volume of distribution ‘
Amount : amount of the substance
Concentration : concentration of the substance in plasma



Determines volumes of specific body fluid compartments

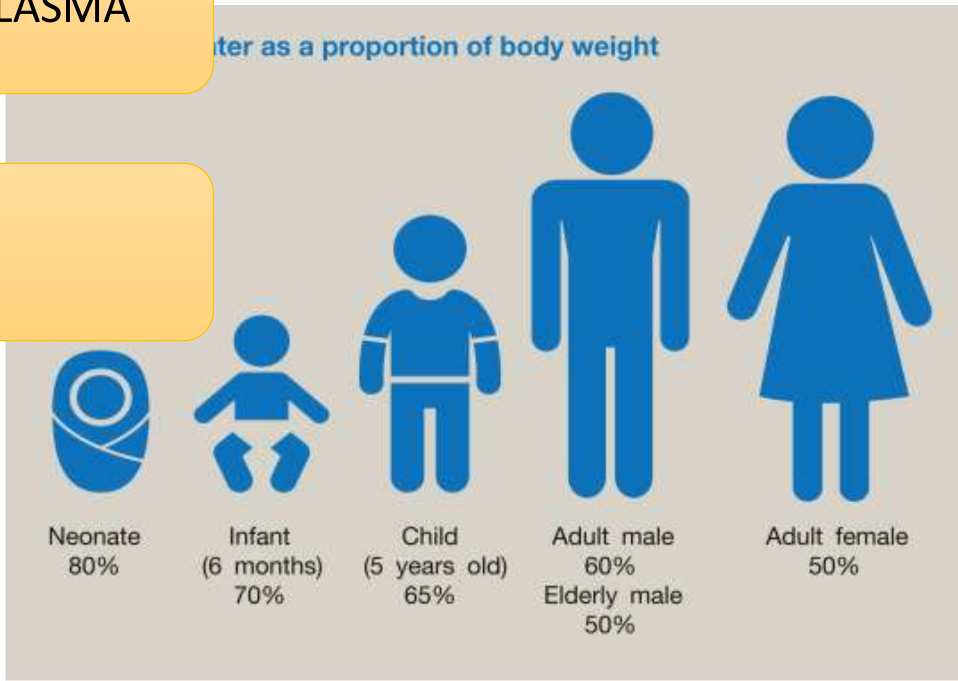
TBW : through dilution method usually isotopic water

PLASMA : through dilution method usually Evans blue dye

- ECF : through dilution method : usually mannitol

Interstitial fluid = ECF – PLASMA

ICF = TBW – ECF



Measurements

- **Measuring blood volume**

- Total blood volume$= \frac{\text{plasma volume}}{1-\text{hematocrit}}$

- Example:

Plasma volume=3 liters, hematocrit =0.40

$$\frac{3}{(1-0.4)} = 5 \text{ liters}$$

Total blood volume

Hematocrit (Hct) or Packed cell volume (PCV)

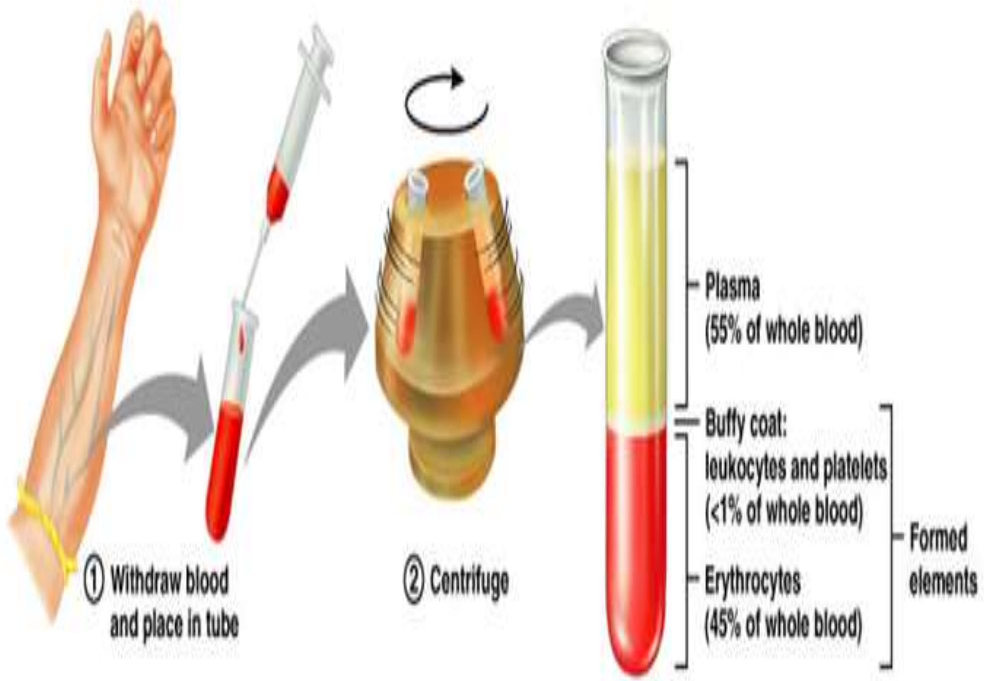
Hematocrit : is the percentage of RBCS

There is 2 ways to measure blood volume

- Blood volume = The blood cells 3% of body weight + blood plasma 5% of body weight =8% of our body weight expressed in kg
- 8% × 70kg = to 5.6L = 5.6 kg

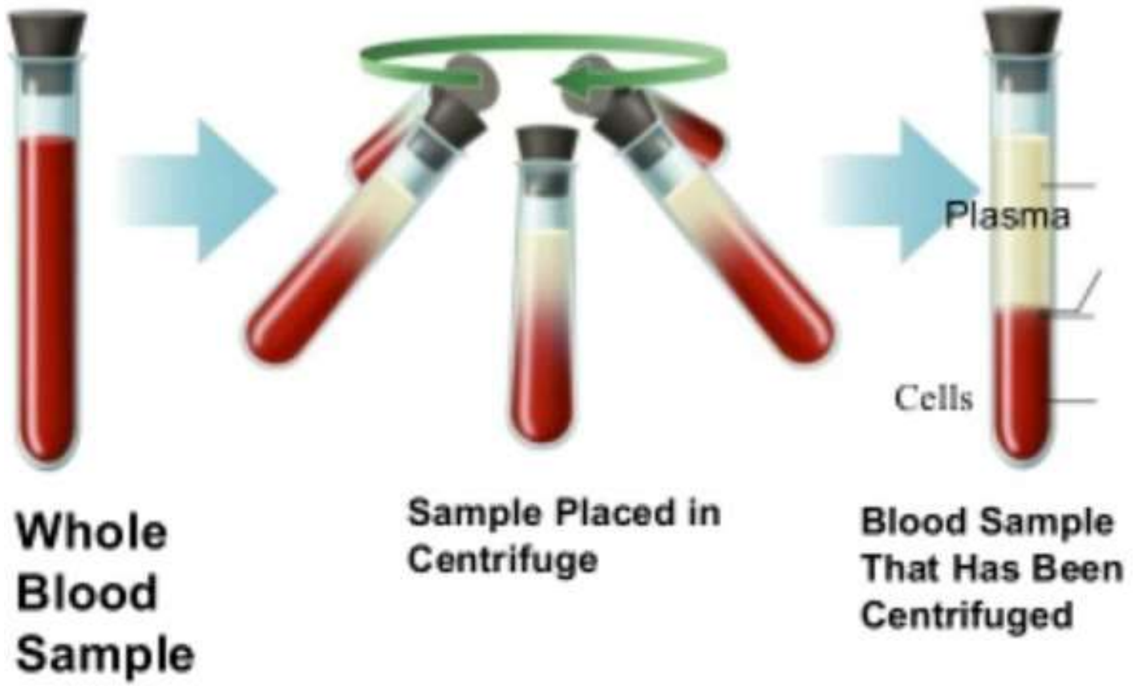
- Total Blood Volume (TBV) = Plasma Volume / 1- Hematocrit (PCV)
- Total Blood Volume (TBV)= 2.8 / 1- 45%= 5.6L

- Blood Plasma =55% × 5.6L
- Blood cell =45% × 5.6L



1) Move an amount of blood in a test tube contains anticoagulant often heparin

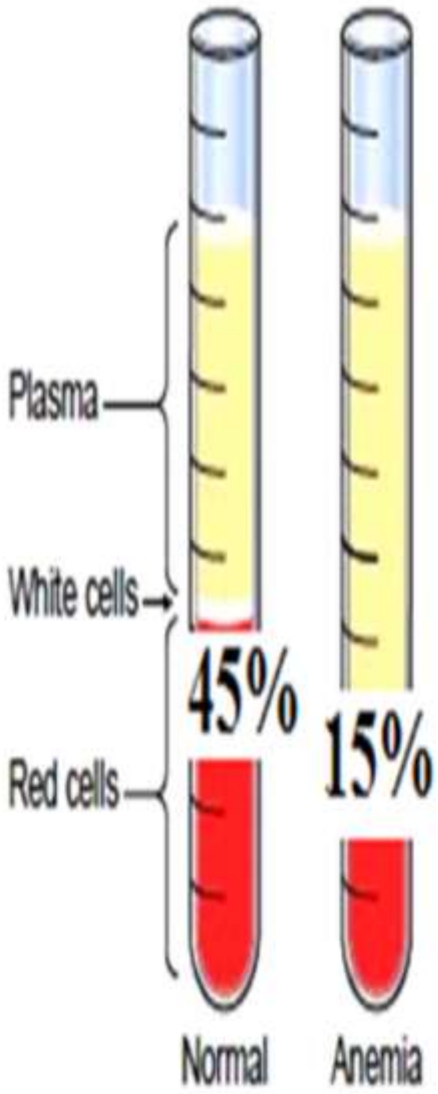
2) Take a sample of the test tube in small capillary



3) But the sample in the centrifugation (which runs around it self 1000/min)

4) The blood is separated into 2 parts Pass the hematocrit paper to measure the percentage

Blood Transfusion



Whole Blood transfusion increases a patient's hemoglobin and iron levels

A patient suffering from an iron deficiency or anemia. Iron deficiency cause lack of hemoglobin transport which carries the oxygen

Plasma is the liquid part of the body's blood.

Plasma transfusions are used for patients with liver failure, severe infections, and serious burns.

Platelets are a component of blood that stops the body from bleeding.

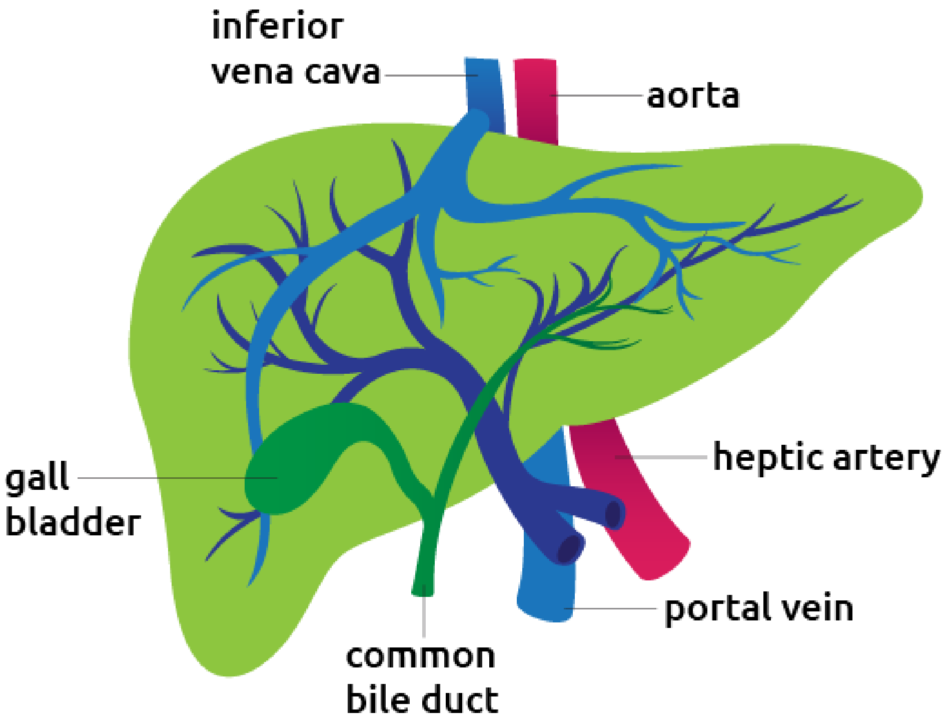
Patients who have illnesses like leukemia and chemotherapy treatment must get regular platelet transfusions to stay healthy.

Anemia : reduce the number account of whole RBCs in whole blood volume

Transfusion : transfer of blood from a person to another through IV drip to increase patient hemoglobin and then increase iron level

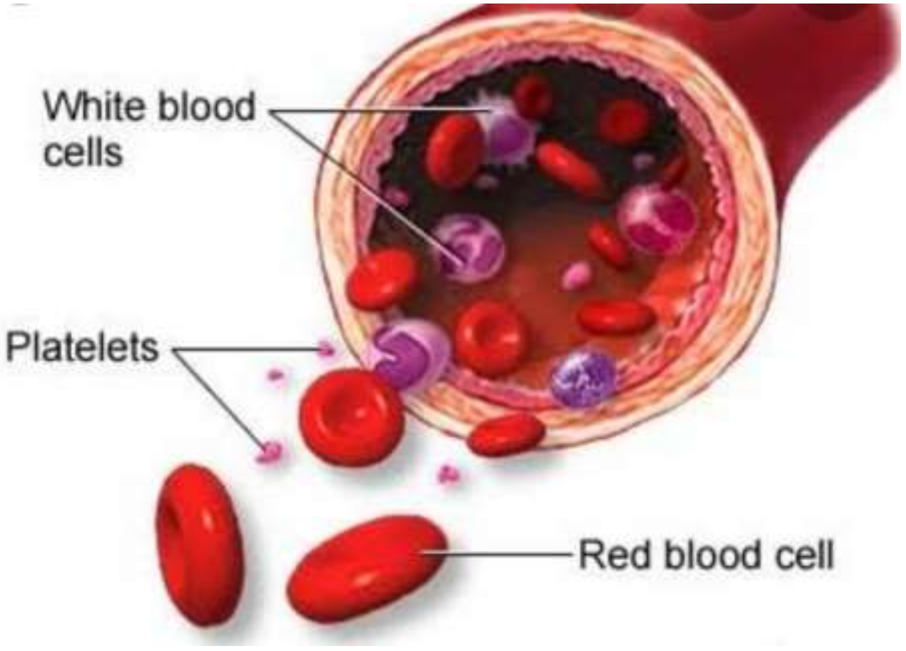
The normal RBCs percentage according of your blood is 45% more or less of this value refers to problems ……..suppose that the PCV =15% that refers to reduction of the amount of RBCs in whole blood volume and often called anemia

Sometimes no need for whole blood transfusion (not all blood components are needed) that’s depends on pathological cases



Some cases require only plasma transfusion :

1. Liver defects …. The liver function to produce many types of plasma proteins (albumin and globin)
2. sever infections due to deficiency of important proteins



Some cases require only platelets transfusion :
Platelets : has a very important function in positive feedback (coagulating)
1) Leukemia : cancer of bone marrow or lymphocyte

Blood Donation

One pint (blood unit)= 500ml or half a court (one quart = 2 pints)

UK AND US = PINTS

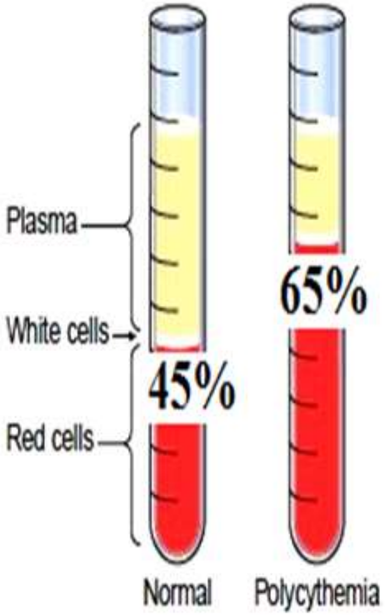
In this example you got 10pints in your blood .

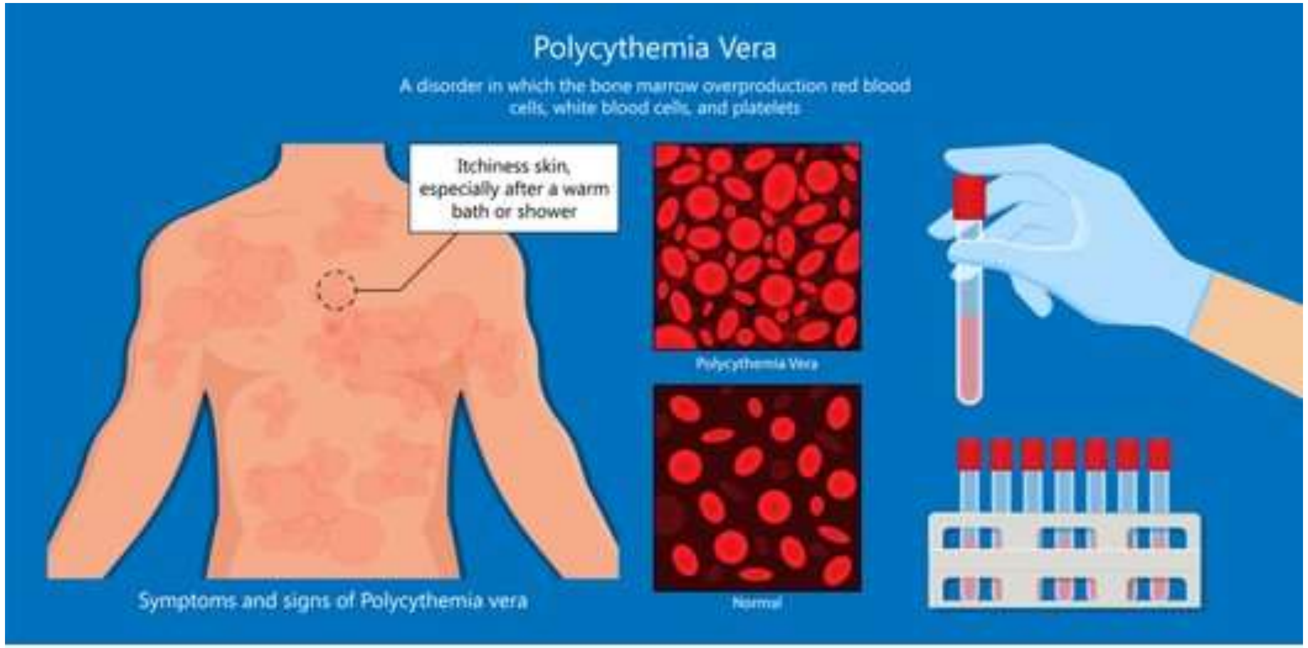
So, when you donate 1 pint you giving less than 1/10 of your blood body.

If you gave twice that you will lose a liter of blood, half a court of blood then you need a medical attention.

So, the person who less than 100 pounds doesn’t give blood. In other word when you donate blood you given 10% or less

Note : a person with 100 pound which almost 50 kg can't give !!
Because : 50 * 8% = 4 L
And 500ml/4000ml = 12%
And that means he donates more than 10% of his blood body





Polycythemia

Primary polycythemia very rare: slow growing blood cancer such as polycythemia vera

Secondary polycythemia

Exposure to low oxygen

1. living in high attitudes
2. Pulmonary disease

Tonicity

Periodic Table

	1 IA	2 IIA	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8	9 VIIIB	10	11 IB	12 IIB	13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	18 VIIIA
1	1 **H** 1.00797																	2 **He** 4.0026
2	3 **Li** 6.939	4 **Be** 9.0122											5 **B** 10.811	6 **C** 12.01115	7 **N** 14.0067	8 **O** 15.9994	9 **F** 18.9984	10 **Ne** 20.179
3	11 **Na** 22.9898	12 **Mg** 24.305											13 **Al** 26.9815	14 **Si** 28.086	15 **P** 30.9738	16 **S** 32.064	17 **Cl** 35.453	18 **Ar** 39.948
4	19 **K** 39.102	20 **Ca** 40.08	21 **Sc** 44.956	22 **Ti** 47.90	23 **V** 50.942	24 **Cr** 51.996	25 **Mn** 54.9380	26 **Fe** 55.847	27 **Co** 58.9332	28 **Ni** 58.71	29 **Cu** 63.54	30 **Zn** 65.37	31 **Ga** 65.37	32 **Ge** 72.59	33 **As** 74.9216	34 **Se** 78.96	35 **Br** 79.909	36 **Kr** 83.80
5	37 **Rb** 85.47	38 **Sr** 87.62	39 **Y** 88.905	40 **Zr** 91.22	41 **Nb** 92.906	42 **Mo** 95.94	43 **Tc** [99]	44 **Ru** 101.07	45 **Rh** 102.905	46 **Pd** 106.4	47 **Ag** 107.870	48 **Cd** 112.40	49 **In** 114.82	50 **Sn** 118.69	51 **Sb** 121.75	52 **Te** 127.60	53 **I** 126.904	54 **Xe** 131.30
6	55 **Cs** 132.905	56 **Ba** 137.34	57 **La** 138.91	72 **Hf** 178.49	73 **Ta** 180.948	74 **W** 183.85	75 **Re** 186.2	76 **Os** 190.2	77 **Ir** 192.2	78 **Pt** 195.09	79 **Au** 196.967	80 **Hg** 200.59	81 **Tl** 204.37	82 **Pb** 207.19	83 **Bi** 208.980	84 **Po** [210]	85 **At** [210]	86 **Rn** [222]
7	87 **Fr** [223]	88 **Ra** [226]	89 **Ac** [227]	104 **Ku** [260]	105	106	107	108	109									

How much 1 mole of salt molecules weigh?

First, you need to find the molar mass of NaCl. To do that, just add up the masses of Na and Cl:

22.989 g/mol + 35.453 g/mol = 58.442 g/mol.
So 1 mole of table salt weights 58.442 grams

- The Mole (Avogadro’s Number) = 6.022 x 1023
- 1 dozen cookies = 12 cookies
- 1 mole of cookies = 6.02 X 1023 cookies

- The total solutes in the fluid is called tonicity
- The unit we used to quantify the tonicity is osmoles. osmole is a combination of two words osmosis and moles
- For each milli osmo of solute particle difference between inside and outside will create an osmotic pressure of 19.3 millimeters of mercury.
- 282-300mosmol/L times 19.3/mosmol/L
- it will create 5443mmHg osmotic pressure which is very high

	Plasma (mOsm/L H_2O)		Interstitial (mOsm/L H_2O)	Intracellular (mOsm/L H_2O)
Na^+	142		139	14
K^+	4.2		4.0	140
Ca^{++}	1.3		1.2	0
Mg^+	0.8		0.7	20
Cl^-	108		108	4
HCO_3^-	24		28.3	10
HPO_4^-, $H_2PO_4^-$	2		2	11
SO_4^-	0.5		0.5	1
Phosphocreatine				45
Carnosine				14
Amino acids	2		2	8
Creatine	0.2		0.2	9
Lactate	1.2		1.2	1.5
Adenosine triphosphate				5
Hexose monophosphate				3.7
Glucose	5.6		5.6	
Protein	1.2		0.2	4
Urea	4		4	4
Others	4.8		3.9	10
Total mOsm/L	301.8		300.8	301.2
Corrected osmolar activity (mOsm/L)	282.0	300	281.0	281.0
Total osmotic pressure at 37°C (mm Hg)	5443		5423	5423

Osmatic pressure : the affect of each solute particle which create the movement from one compartment to another (pressure difference)

The values of solutes on each fluid tonicity are almost the same

The affects of these solute concentration results in osmotic pressure (different from one fluid to another)

Total osmatic pressure = tonicity volume x concentration difference(19.3)

TOP for plasma = 282 x 19.3 = 5443

TOP for Interstitial fluid = 281 x 19.3 = 5423

TOP for ICF = 281 x 19. 3 = 5423

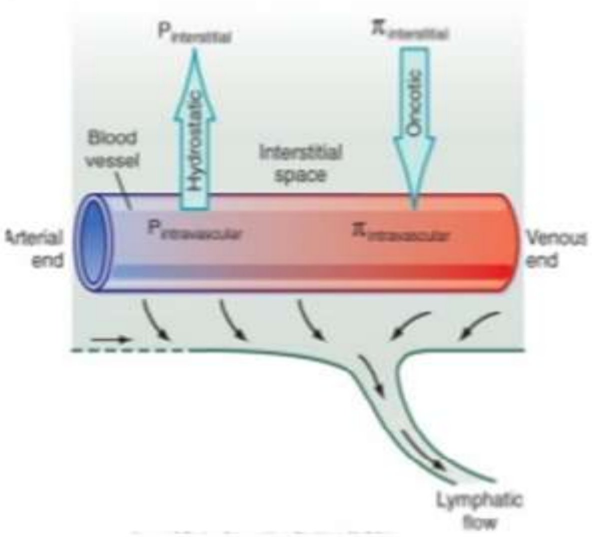
Oncotic or colloid osmotic pressure

- blood plasma likes to any other extracellular fluid except protein. The total amount of solute particles is small higher than intra and extra which make it hypertonic.(high solute concentration)

- The difference will be around 20 millimeter of mercury (albumin)

5443 – 5423 = 20 mmHg

- Which means that the blood plasma is about 20 mmHg higher than anywhere else and this is called osmotic pressure or colloid pressure



Hydrostatic pressure :
1) More water molecules inside and less solutes
2) Causing movement of water to out side

Oncotic pressure :
1) More solute inside the capillary than out side
2) Causing movement of water t the inside

Classified according the normal Mosm/L values

Osmolarity of the solutions

If the extracellular fluid becomes hypertonic the water will be drawn out and it will cause crenation (burst) (unhappy cell)

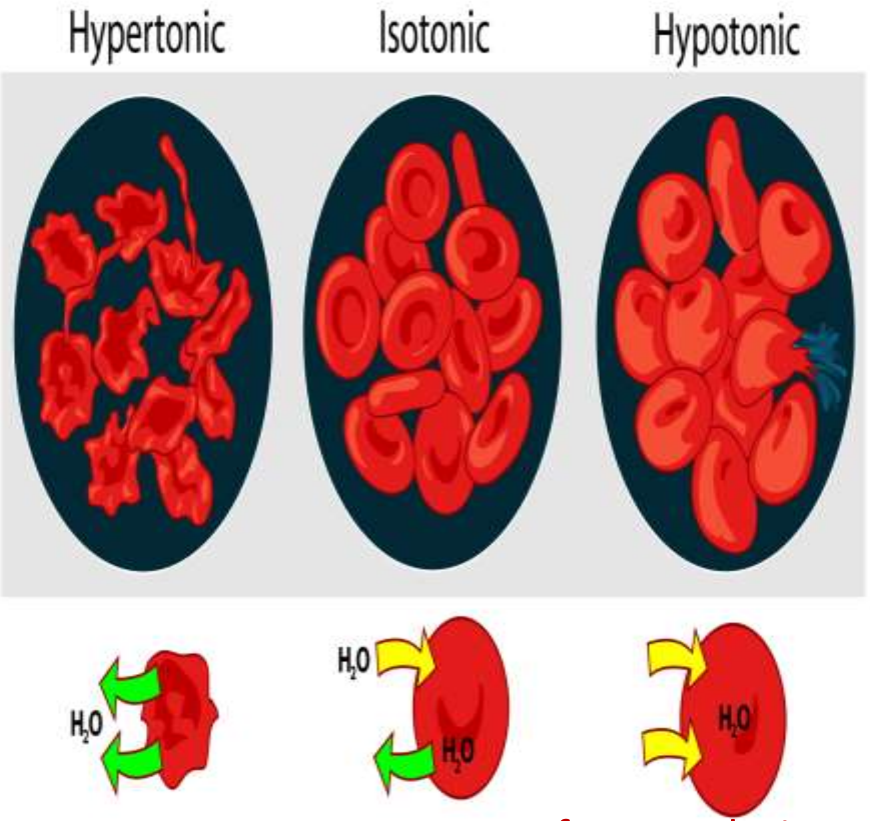
if the extracellular fluid is hypotonic the water will be drawn in and it will cause lysis (unhappy cell)

Here in the picture as shown a red blood cell surrounded by isotonic solution which means the same proportion of water inside and outside cells; (this is called a happy cell)

The question now. Is how to express quantitatively how hypo or hyper ?

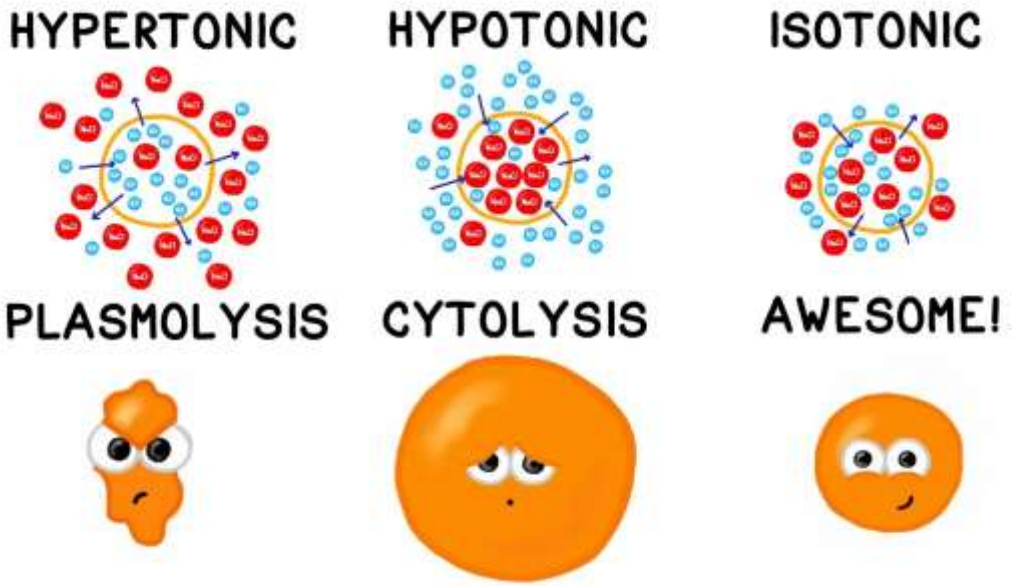
If it is hyper ; it will be adjusted by hypo solutions and if it is hypo it will be adjusted by salt.

Hypotonic : solution has high water concentration according to the solutes
Hypertonic : solution has high solutes concentration according to th water



Transfuse a solution into the body its tonicity > 300 Osmosis of water from red blood cell to out .... This solution is (hypertonic)

Transfuse a solution into the body its tonicity < 300 Osmosis of water from out to red blood cells .... This solution is (hypotonic)

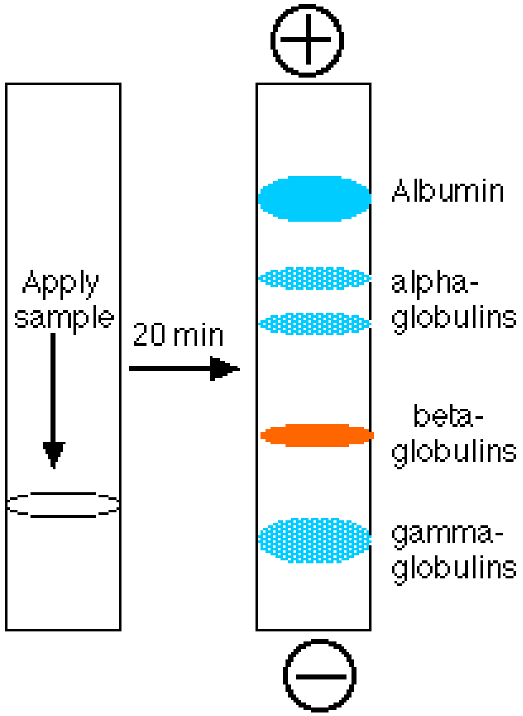


ISOTONIC VS HYPOTONIC VS HYPERTONIC

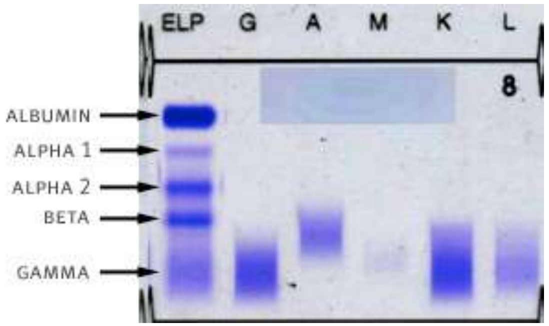
Isotonic solutions are solutions having equal osmotic pressures	Hypotonic solutions are solutions having lower osmotic pressures	Hypertonic solutions are solutions having comparatively higher osmotic pressures
Have equal solute concentrations	Have a low concentration	Have a high concentration
Isotonic environments show no effect on cells	Hypotonic environments cause cells to swell	Hypertonic environments cause cells to shrink
Isotonic solutions are not helpful in food preservation	Hypotonic solutions are not helpful in food preservation	Hypertonic solutions are helpful in food preservation

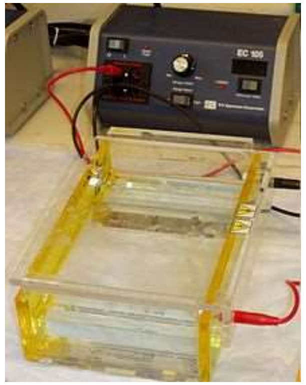
Electrophoresis

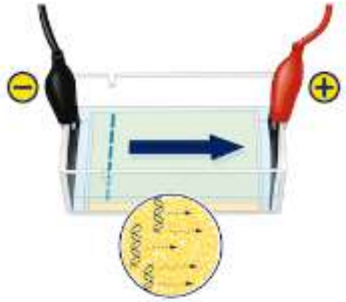
Composition of blood plasma

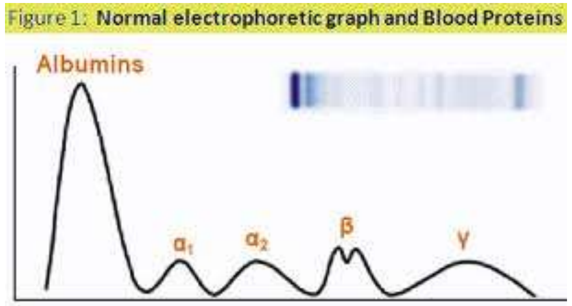


Separating serum proteins by electrophoresis









- The tonicity of the isotonic solution 282-300
- Our bodies are isotonic

plasma has more proteins than other fluids in the body which create a slightly difference in osmatic pressure

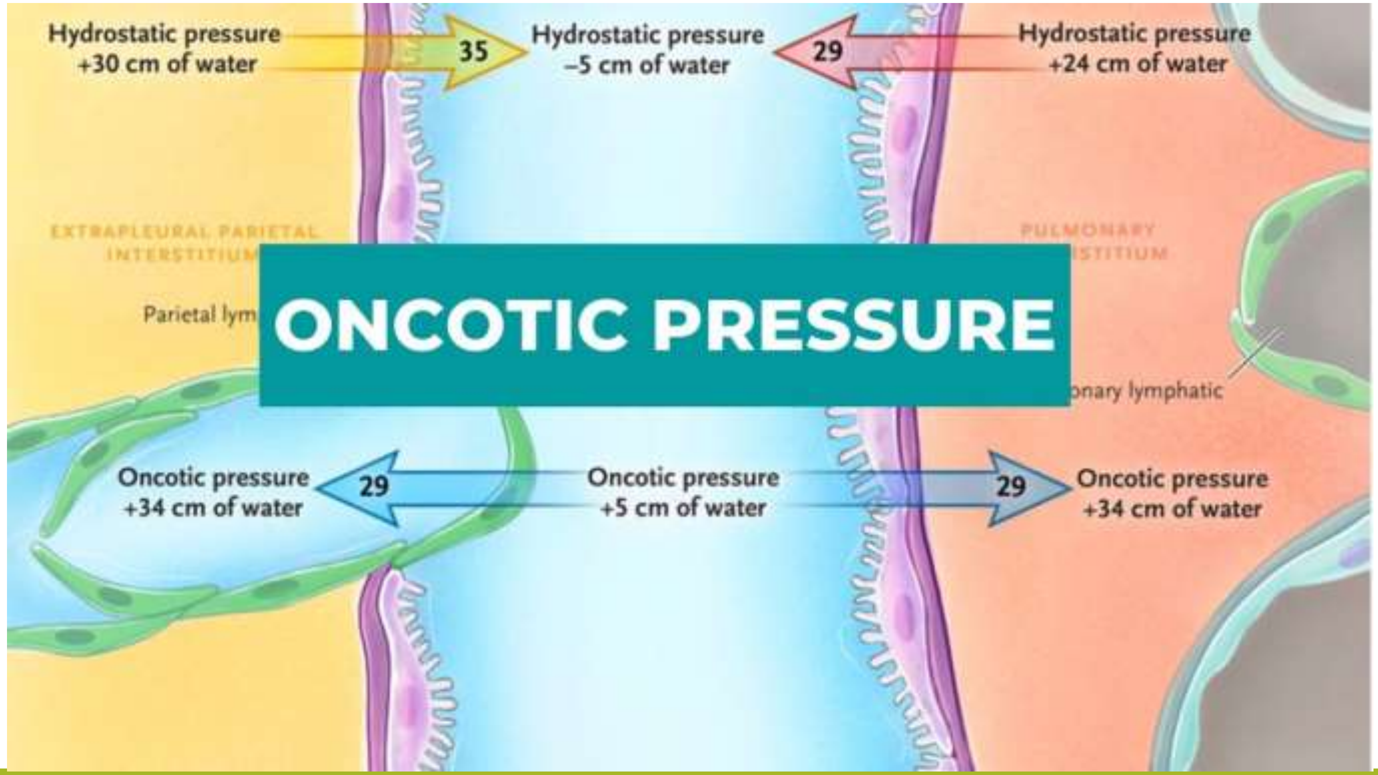
Each difference in mmole of solutes from out side to the inside create an osmatic pressure =19.3 mmHg

Total osmatic pressure in plasma = 19.3 x 282 = 5443
Which differs from other fluids about 20 and this difference because of plasma proteins

The difference between 2 osmatic pressure such as plasma and other fluids = 20 which equal to oncotic pressure

- The ECF is a little hypertonic more than ICF because of plasma proteins so always there is a tendency to move from inside ICF to outside

- The total osmatic pressure of plasma is higher than other fluids because the amount of proteins



Plasma proteins

Albumins

Globulins

- Alpha 1,2
- peta
- gam ma

Fibrinogen

The albumin protein is the mainly cause of oncotic pressure 70%-90% because of its law weight Also, globulins but not as albumin

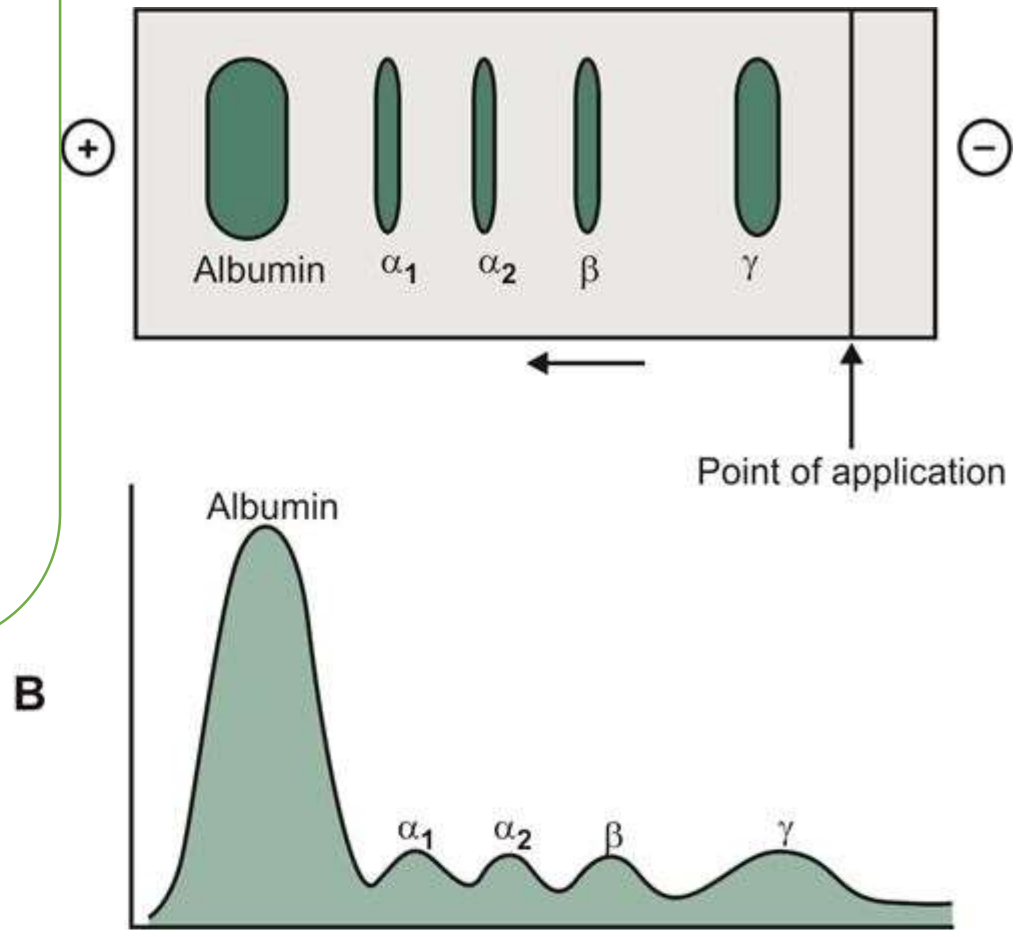
Electrophoresis : is device has a gel layer which attached to 2 poles (+,-)

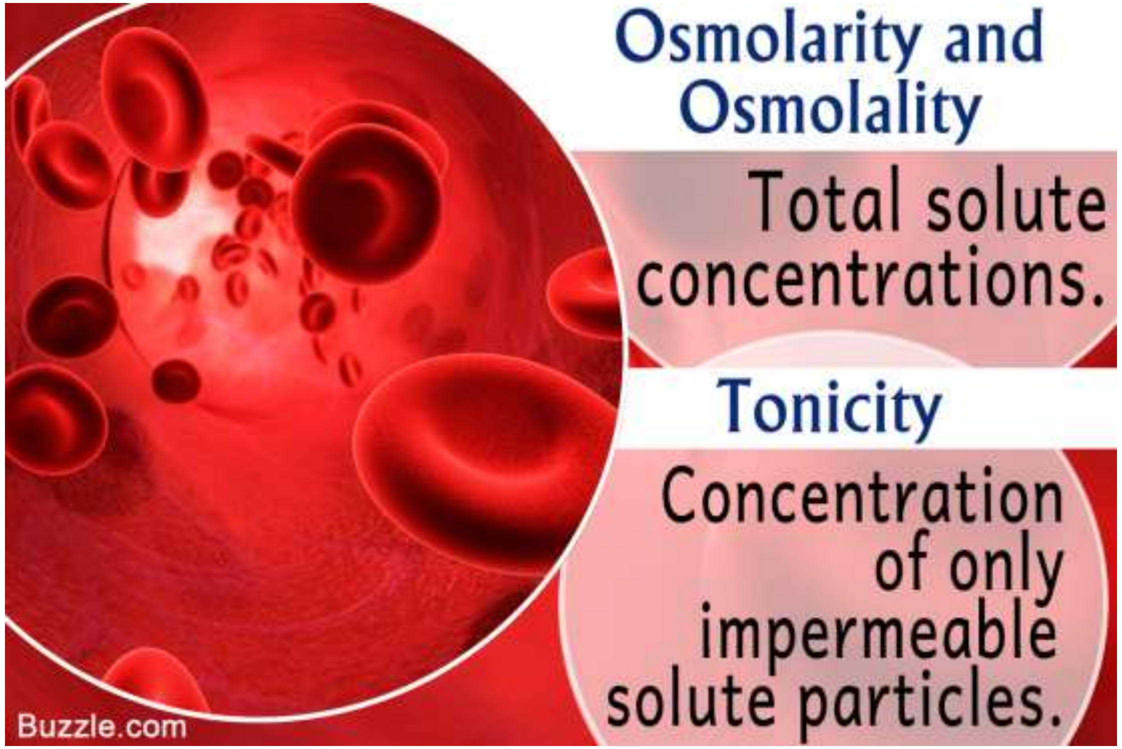
- When running this device, the components of plasma with + charge will move toward the – poles and the one with – charges like plasma proteins will move toward the + poles
- This device also separates articles according to their weight the one with the least weight will be separated first and in plasma proteins albumin is the smallest weight of them

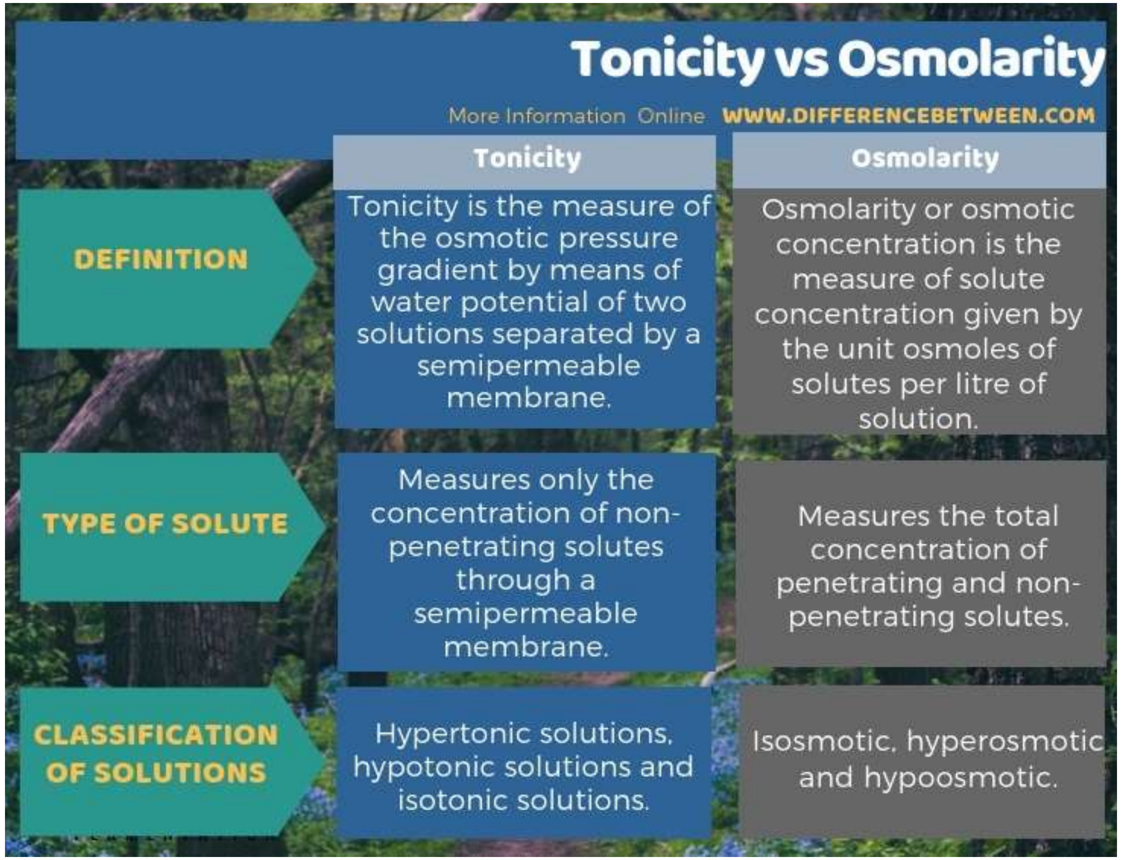
This diagram showing the speed of protein separation from plasma through electrophoresis

electrophoresis

According to the charge and weight




Osmolarity and Osmolality
Total solute concentrations.
Tonicity
Concentration of only impermeable solute particles.
Buzzle.com


Tonicity vs Osmolarity
More Information Online WWW.DIFFERENCEBETWEEN.COM
Tonicity
Osmolarity
DEFINITION
Tonicity is the measure of the osmotic pressure gradient by means of water potential of two solutions separated by a semipermeable membrane.
Osmolarity or osmotic concentration is the measure of solute concentration given by the unit osmoles of solutes per litre of solution.
TYPE OF SOLUTE
Measures only the concentration of non-penetrating solutes through a semipermeable membrane.
Measures the total concentration of penetrating and non-penetrating solutes.
CLASSIFICATION OF SOLUTIONS
Hypertonic solutions, hypotonic solutions and isotonic solutions.
Isosmotic, hyperosmotic and hypoosmotic.

If you add 4millimole of KCL to 1 L of water you will end up with 8 mosm/L

KCl is an ionic compound
Ionic compound dissociate in water so
Tonicity :
1) Calculate the moles of each ion :
- Moles of the compound x atoms number
- K^+ = 1 atom x 4 mmole =4
- Cl^-= 1 atom x 4 mmole =4

2) Gather the number of mole for each ions :
- 4 + 4 = 8 mosm/L = tonicity

If we add 2 millimole cacl2 into 1 L of water, you will end up with 6mosm/L

$CaCl_2$ is an ionic compound
Ionic compound dissociate in water so
Tonicity :
1) Calculate the moles of each ion :
- Moles of the compound x atoms number
- Ca^{2+} = 1 atom x 2 mmole=2
- Cl^-= 2 atom x 2 mmole = 4

2) Gather the number of mole for each ions :
- 2 + 4 = 6 mosm/L = tonicity

If you add 5 millimole of glucose into water, it will stay as one particle so it will end up with 5 mosm/L

The covalent compound wont dissociated in water so the tonicity = 5 mosm/L in glucose

How to quantify numerically the tonicity of solution?

How to compute the total osmolarity of 150 mM Nacl solution?

150 mM solution is equal to 0.15 M solution .

First of all, what we mean by this question is the total of solute particle in a Liter of solution.

If you take 150 mmole of Nacl molecule in each salt particle you will multiply times two since it will break up into 150moml Na and 150mmol cl for the total of 300 mosmol/L

mole/L of solution or M: Molarity - it is the # molecules of EACH solute found in a solution per unit of volume of solution. It is expressed in mole/ liter of solution

mole/kg of solvent or m: Molality - it is the # molecules of EACH solute found in a solution per unit of weight of solvent. It is expressed in mole / 1000g of solvent

Physiological saline is 0.9% NaCl. This means that 100 ml's of physiological saline contains 0.9 g of NaCl. One liter of physiological saline must contain 9 g of NaCl. We can determine the molarity of a physiological saline solution by dividing 9 g by 58 g... since we have 9 g of NaCl in a liter of physiological saline, but we have 58 grams of NaCl in a mole of NaCl. When we divide 9 g by 58 g, we find that physiological saline contains 0.154 moles of NaCl per liter. That means that physiological saline (0.9% NaCl) has a molarity of 0.154 molar. We might express this as 0.154 M... or 154 millimolar (154 mM).

A 0.9% NaCl and a 0.154 M NaCl solution are the same thing. They are physiologic isotonic solution

How to quantify numerically the tonicity of solution?

- A 3% sodium chloride (NaCl) solution is hypertonic and when infused intravenously would increase extracellular fluid volume and osmolarity, thereby causing water to flow out of the cell. This would decrease intracellular fluid volume and further increase extracellular fluid volume.

- The 0.9% NaCl solution and 5% dextrose solution are isotonic, and therefore would not reduce intracellular fluid volume.

- Pure water and the 0.45% NaCl solution are hypotonic, and when infused would increase both intracellular and extracellular fluid volumes

Questions :

1. What would happen to a cell placed in a hypertonic solution

A) The cell would shrink
B) The cell would expand and possibly burst
C) The cell would remain the same
D) The cell would dance and do the HEY HEY!
(A)

2. What is an isotonic solution?

A) When solutions are in equilibrium
B) When the solution has more solute
C) When the solution has less solute
D) Has a greater pressure
(A)

3. Which plasma protein is responsible for oncotic pressure ?

A)alpha globulins
B) collagen
C) fibrinogen
D) albumin
(D)

4. A person should never drink salty water because their cells would

A) shrink
B) expand
C) DYE
B) EQUILIBRIUM
(B)

5. Calculate the osmolarity (i.e. numerical value) of the following Molar solutions :

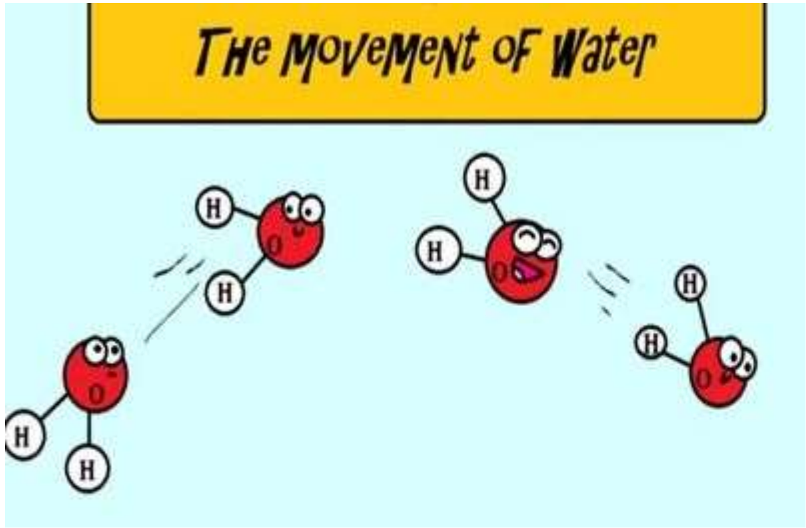
1) 0.30 M NaCl solution = __________ Osm/L
ANW = 0.60 osm/L (hypertonic) (hyposmatic)

2) 0.15 M glucose solution = __________ Osm/L
ANW = 0.15 osm/L (hypotonic) (hyperosmotic)

3) 0.20 M urea solution = __________ Osm/L
ANW= .20 osm /L (hypotonic) (hyperosmotic)

6) A 0.30 M penetrating propanol solution which does not dissociates is ?
ANW : iso-osmotic and hypo-tonic

7) .What is the Movement of WATER IN and OUT of the cell membrane?



A) Diffusion
B) Osmosis
C) Hypertonic
D) My 4g is slowww
(B)

8) Why do your fingers Prune when in the water for a long time?

A) Carbon goes out
B) Diffusion
C) Osmosis
D)Magic

(C)