

Body fluids and its compartments

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-Water is the most abundant constituent in our bodies.

- It forms 60% of total body weight of normal adult male weighing 70 Kg.



Water Content in the Human Body

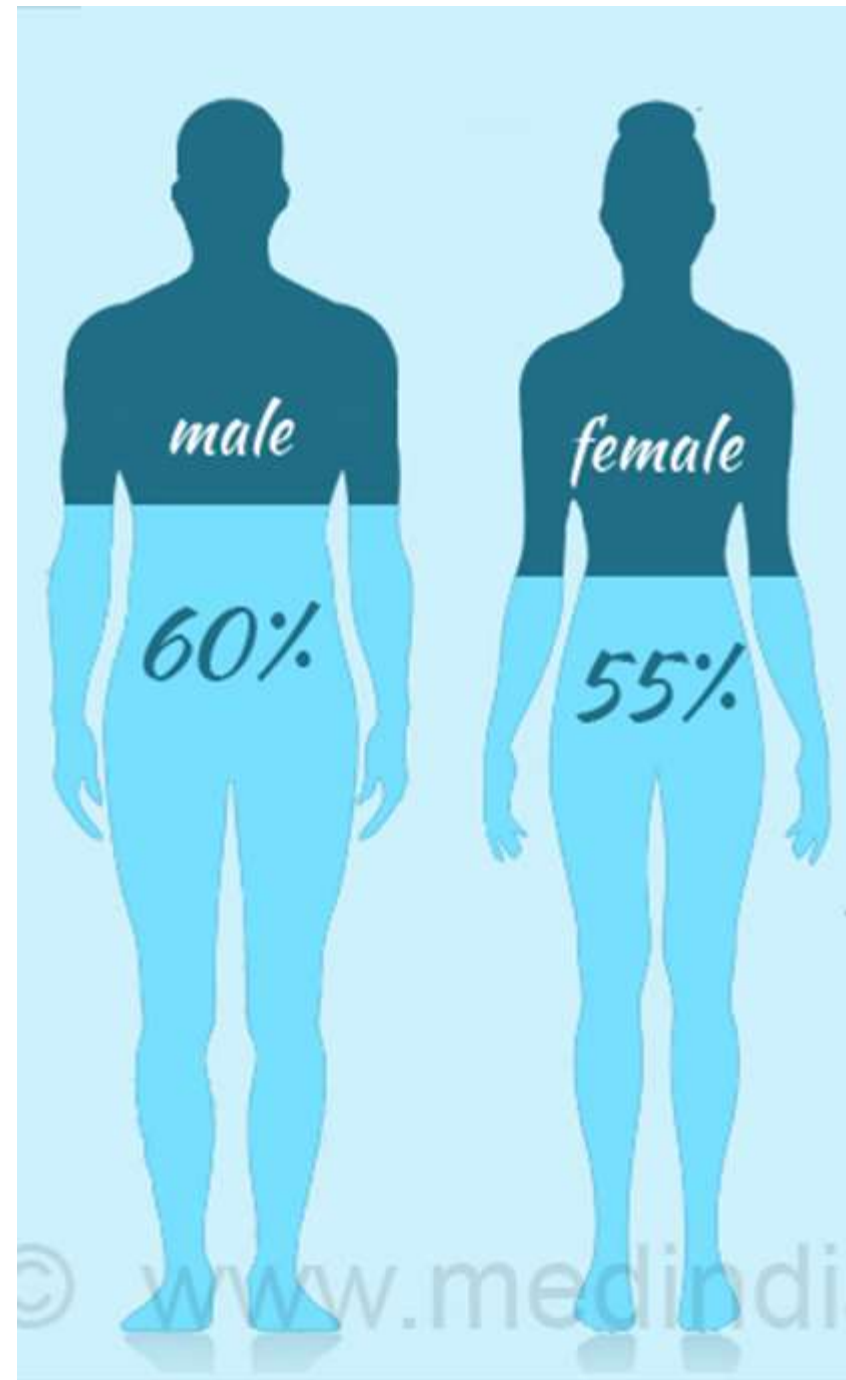
Age

Sex



Sex

Fat cells contain less water and thus females (being fatter than males) contain slightly less water.



Age



Infant 75%



Adult 60%

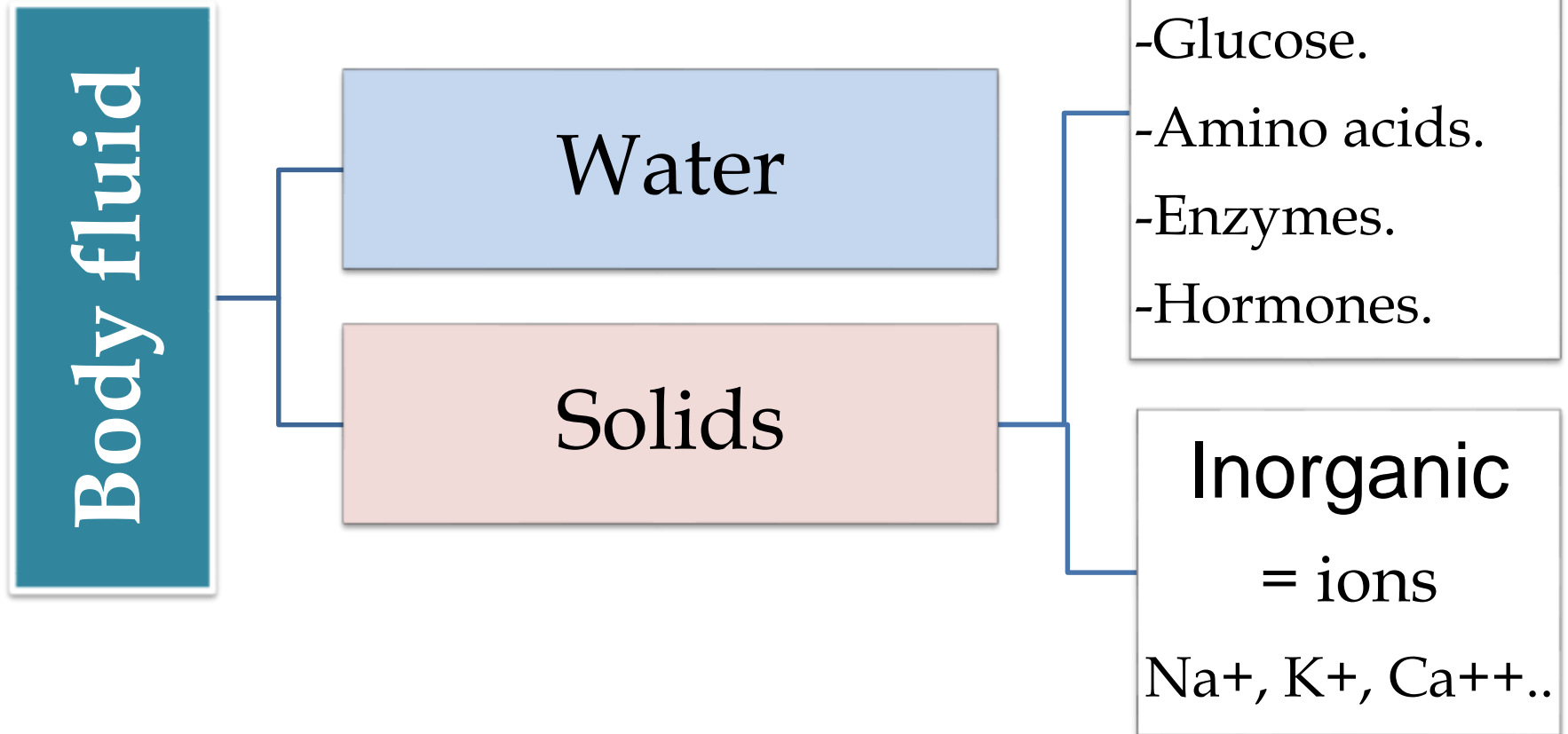


Elderly 50-55%

Although the newly born have more percentage of their body as water than adults, yet **most** of their body water is **intracellular** and the percentage of **their ECF is less than adults** thus they are **more liable to dehydration** in cases of vomiting and diarrhea than adults.

Composition
& distribution
of body fluids

1- Composition of body fluids



2- Distribution of body fluids

Total Body fluid

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graph TD; A[Total Body fluid] --> B[Intracellular Fluid (40%)]; A --> C[Extracellular Fluid (20%)]; C --> D[Intravascular Fluid (Plasma)]; C --> E[Interstitial Fluid]; C --> F[Transcellular Fluid]; F --> G[Lymph]; F --> H[CSF]; F --> I[Pleural Fluid]; F --> J[Pericardial Fluid]; F --> K[Joint Fluid];
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Intracellular Fluid (40%)

Extracellular Fluid (20%)

Intravascular Fluid (Plasma)

Interstitial Fluid

Transcellular Fluid

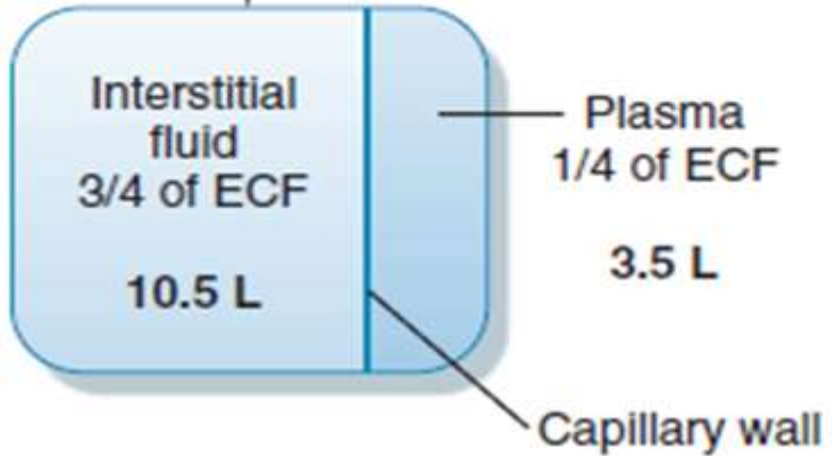
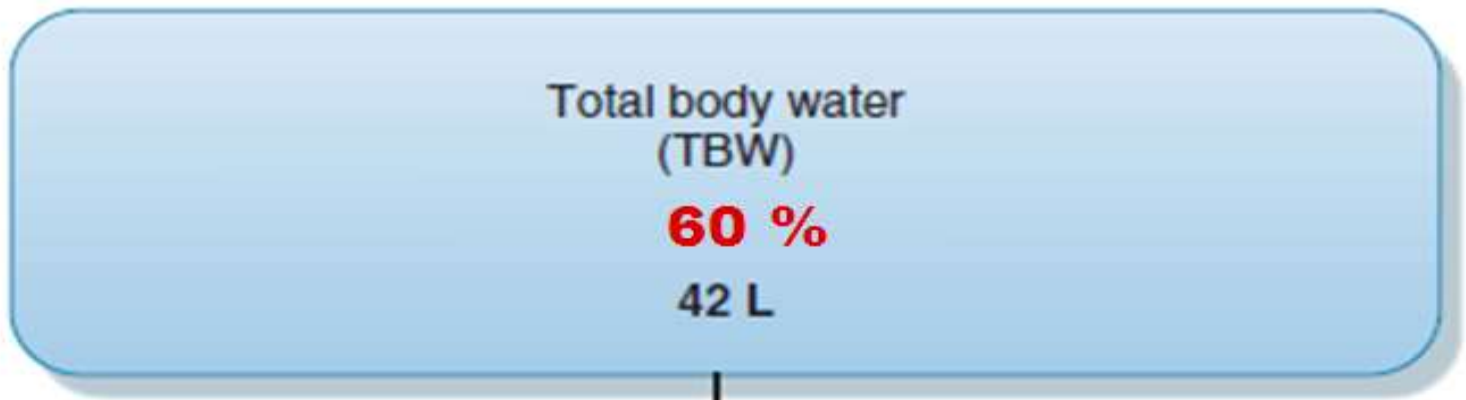
Lymph

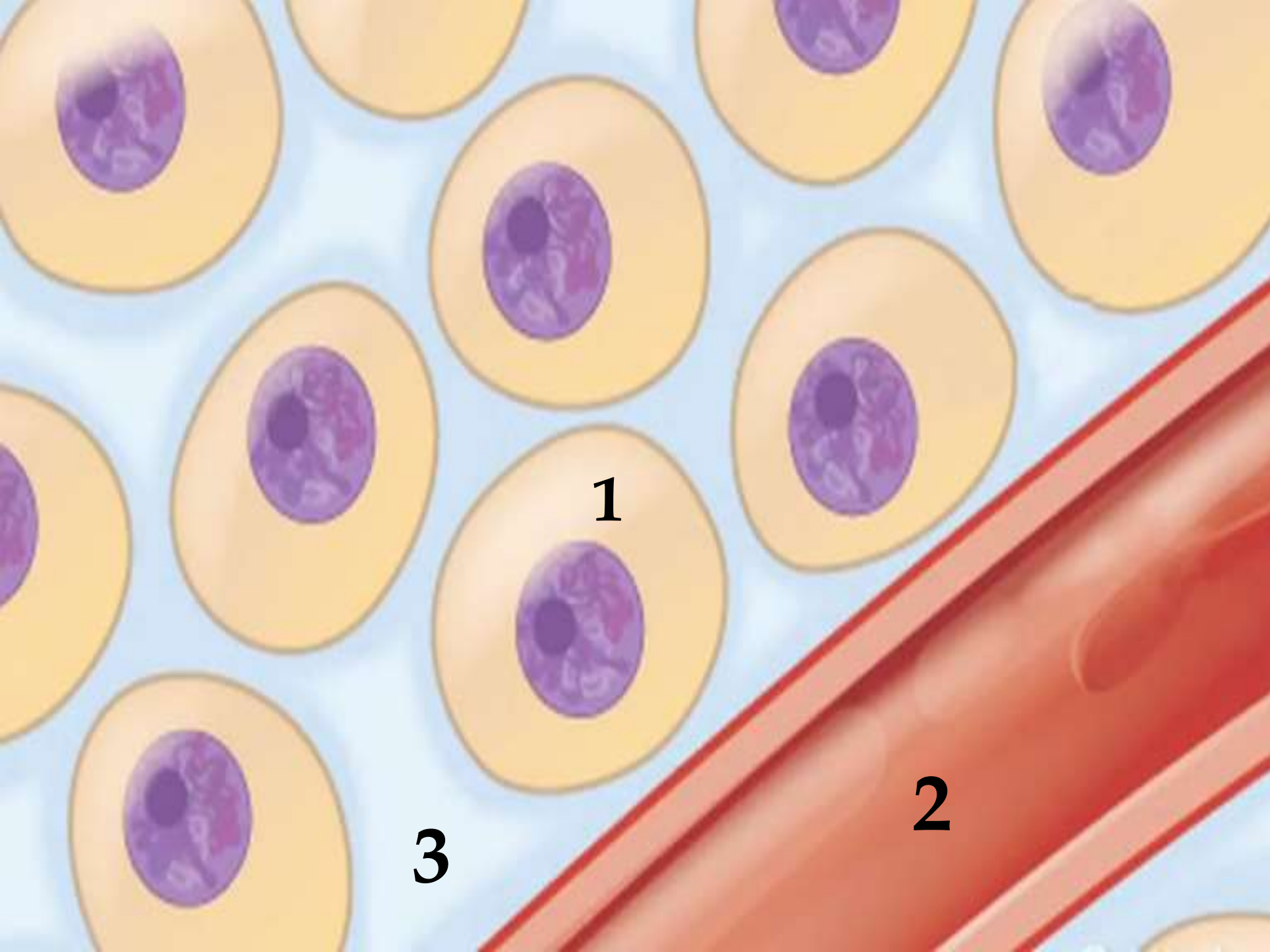
CSF

Pleural Fluid

Pericardial Fluid

Joint Fluid





1

2

3

What is the importance of body fluid ?



❖ Water is the origin of life, and there is no form of life can be maintained without water. Moreover, all the chemical & biological reactions in the body must be performed in an aqueous media.

❖ Some other vital functions of water are:

1. It favors ionization of dissolved salts.
2. It regulates body temperature via both heat loss and heat gain balance.
3. It gives the blood its fluidity to reach all cells and to maintain BP.

Regulates body temperature



Moistens tissues such as those in the mouth, eyes and nose



Protects body organs and tissues



Lubricates joints



Helps prevent constipation



Lessens the burden on the kidneys and liver by flushing out waste products



Helps dissolve minerals and other nutrients to make them accessible to the body



Carries nutrients and oxygen to cells



Body water balance

- ❖ It is the balance between water intake and water loss.
- ❖ In comfortable zone of body temperature (22°C) it was estimated that **water intake** by normal adult 70kg male= **2500 ml/day** which distributed as follow: **1500 ml** is taken as pure water and beverages (tea for example), **800 ml** from food as fruits and vegetables and **200ml** from metabolic processes.
- ❖ The **water loss** normally = **2500ml/day** which distributed as follow:
1500 ml excreted as **urine**, **900ml** evaporated **from the skin** and **lungs** and **100 ml excreted in feces**.
- ❖ The amount of water lost by sweating is highly variable, depending on physical activity and environmental temperature.
- The volume of **sweat** normally is about **100 ml/day**.

Obligatory water loss = **1 L/day**. So, minimal intake of 1 L/day is essential for life as there is **No reserve of water** in the body.

Regulation of Water Intake (Thirst Sensation)

The stimuli of thirst sensations are:

1. Increased plasma osmolarity either due to pure water loss or excessive intake of salts.
2. Loss of large amount of ECF fluid (following vomiting or diarrhea).
3. Hemorrhage and shock.
4. Dryness of mouth (from inhibition of salivary secretion).
5. Increased **angiotensin II** secretion.

Thirst center located in the hypothalamus.

Water output each day

Urines	1.5 litres
Feces	0.1 litre
Breathing and sweating	0.9 litre
TOTAL	2.5 litres

Water input each day

Water contained in food	0.8 litre
Water produced by the cells	0.2 litre
Water you drink	1.5 litres
TOTAL	2.5 litres



- ❖ A serious problem that faces us that there is **no reserve of water in our bodies** despite the large amount present.
- ❖ A reduction of 5% of water content makes the person very thirsty, a loss of 10% makes him very ill while a reduction of 20% will kill him.
- ❖ without water intake there is obligatory water loss = 1 liter/day (in urine, insensible perspiration and in expired air) thus death occurs even in cool climate if water is not totally taken *after 4-6 days*.
- ❖ A minimal intake of **liter/day** is essential for life.
- ❖ Antidiuretic hormone “**ADH**” controls water loss by the kidney.

How can we measure body fluid volume??



DILUTION PRINCIPLE

- **Based on using a marker whose concentration can be measured.**

Inject x gm of marker into compartment
measure concentration at equilibrium (y gm/L)

Since concentration = mass / volume

Volume = mass / concentration

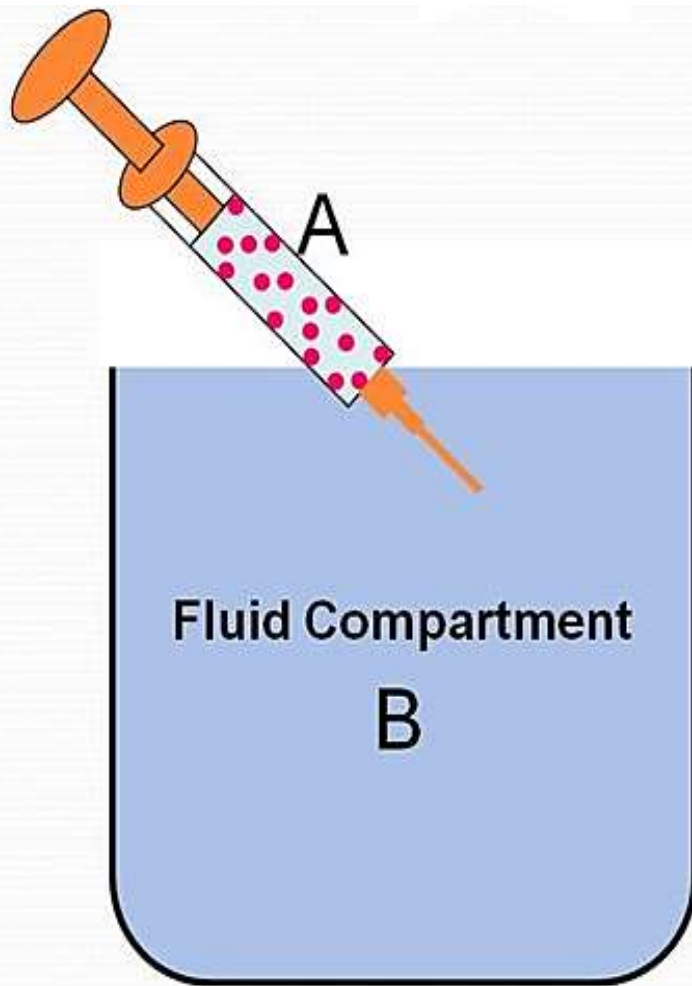
- $V = x/y \text{ L}$

Total body water volume

- It is measured by the application of the **Indicator dilution principle** or **dye dilution principle**.

$$C_A \times V_A = C_B \times V_B$$

$$\text{Volume B} = \frac{\text{Volume A} \times \text{Concentration A}}{\text{Concentration B}}$$



Determination of compartmental volume

1. Place indicator A in the compartment B.
2. Allow it to disperse evenly though out the compartment's fluid
3. Analyze the extent to which the substance is diluted

Indicators used for measuring plasma volume, ECF volume and total body H₂O

Compartment	Criterion	Indicators
1. Plasma	Substance should not cross capillaries	<ol style="list-style-type: none">1. Evans blue dye;2. radioiodinated fibrinogen;3. radioiodinated albumin
1. ECF volume	Substance should cross capillaries but not cross cell membranes	Isotonic solutions of sucrose, inulin, mannitol, NaCl
1. Total body H ₂ O (TBW)	Substance distributes evenly in ICF & ECF	Heavy H ₂ O, tritiated H ₂ O, aminopyrine, antipyrine

CRITERIA FOR A SUITABLE DYE.

BODY FLUID MARKER

1. Must mix evenly throughout the compartment
2. Non toxic, no physiological activity
3. Even mixing
4. Must have no effect of its own on the distribution of H₂O or other substances in the body
5. Either it must be unchanged during the experiment or if it changes , the amount changed must be known.
6. The material should be relatively easy to measure.

Compartments with no Compartment-Specific Substance

1. Determine by subtraction:
2. How would you measure ICF volume?
3. Cannot be measured; it is calculated (estimated)..
4. $\text{ICF volume} = \text{Total body H}_2\text{O} - \text{ECF volume}$

5. Interstitial volume
 1. Can not be measured directly
6. Interstitial Fluid Volume (ISFV).
 $\text{ISFV} = \text{ECFV} - \text{PV}$

Activity time!



- In 1mL of solution a certain mass of dye is dispersed resulted in concentration equal **(10mg/mL)** then dye in chamber B and final concentration in the chamber is **0.01mg/mL** .
- What is the volume in chamber B?



Thank you!