# physiology

faculty of medicine - JU2017

◉ Sheet ○ Slides

Number

13

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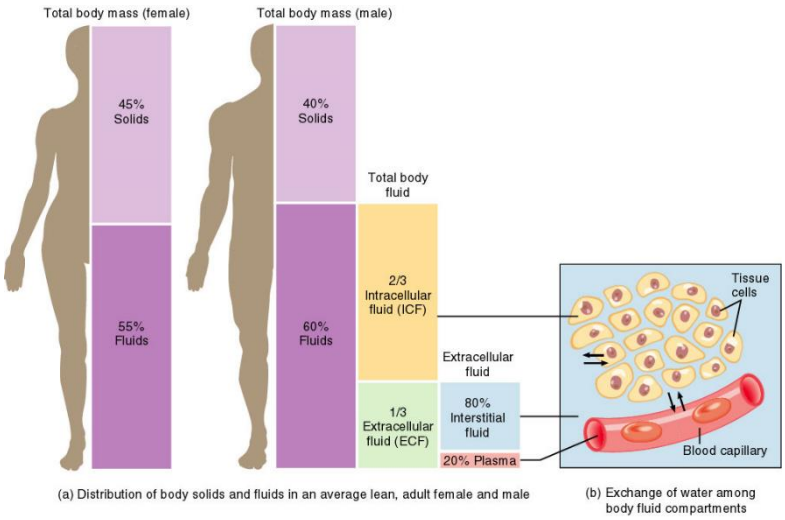
# Body Fluids

## Fluid Compartments

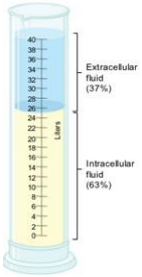
we have a lot of fluids at IC compartment and in EC.




**Q: are we have some composition between EC and IC?**

**A**: NO we have a lot of differences which they are:

1- We have high amount of Fluid in IC rather than EC compartments.
2- The amount of fluid in Female regard to IC fluid around 55% and in male around 60% **because** female have more fat.
3- Also we have differences in tissues, the amount of water in each type of tissue. For example, blood tissue have higher amount of fluids while bone have less amount of fluid.

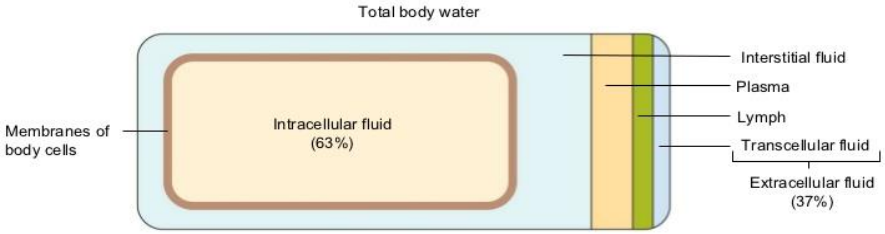



In our cells we can have more compartment of fluids. Some part of these fluids found inside the cell which called intravascular fluid (plasma= around RBC and WBC). And the other part of fluid we can be founded between cells and outside the cells which called interstitial fluid.

- Of the 40 L of the water in the adult average body, about two-thirds is intracellular fluid and one-third is extracellular fluid.

- An average adult female is about 52% water by weight, and an average male about 63% water by weight.

## Water Distribution




**Transcellular Fluids** (inside cavities which it has small amount of Fluids)

- Synovial (found in synovial joint of knee)

- Pericardial (around heart)

- Pleural

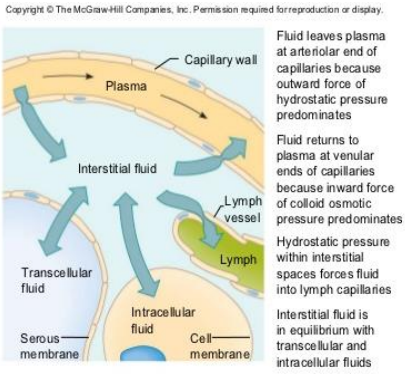
- Peritoneal (Is lining of the abdominal cavity and covers the abdominal organs.)

- Ocular (Inside our eyes)

- Cerebrospinal (around neurons tissue)

**Q: Are Fluids Static?**

A: No, there's always exchange in composition and exchange of water between the compartments (by osmosis).




**Movement of Fluids between Compartments**

Major factors that regulate movements:

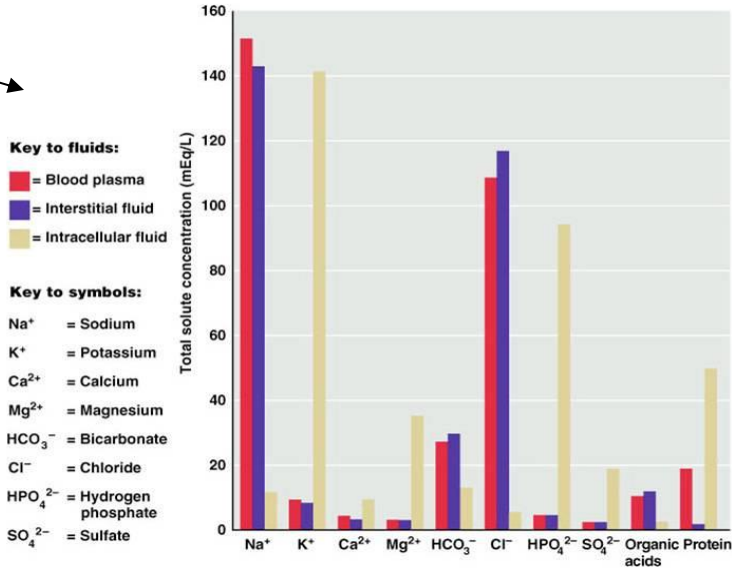
- Osmotic pressure

- Hydrostatic pressure (from high pressure to low pressure = filtration)

**Q: What will happen if low protein inside?**

A: 1- No filter of protein 2- low protein inside cause pressure (= Osmatic pressure)

**composition of Body Fluids**




- With regard to Sodium we have similar concentration of Sodium in interstitial fluid and in blood plasma. While we have much lower concentration ICF.
- With regard to potassium we have similar concentration of potassium in interstitial fluid and in blood plasma. While we have much higher concentration in ICF.
- The protein concentration in ICF is much higher than in blood plasma and interstitial fluid. Also concentration of protein is about 10 time higher in blood plasma rather interstitial fluid.

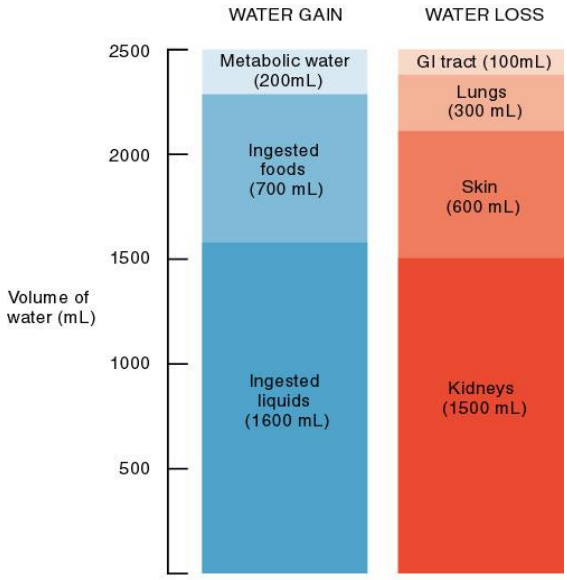
**Note**: The Unit that we used to measure concentration of solute is = milliequivalent per liter (mEq/l)

## Water Balance

There is balance all the time.

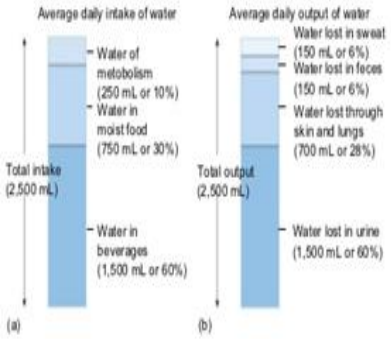
| Water output each day | |
|---|---|
| Urines | 1.5 litres |
| Feces | 0.1 litre |
| Breathing and sweating | 0.9 litre |
| TOTAL | 2.5 litres |

| 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 |


**Note:** there`s no need for the specific numbers, they are just for further understanding.

## Water input




- The volume of water gained each day varies among individuals about 2500 mL daily for an adult:
- 60% from drinking
- 30% from moist food
- 10% as a bi-product of oxidative metabolism of nutrients called water of metabolism. ( like when the glucose bearing in mitochondria the outcome is some amount of water)

## Water output

- Water normally enters the body only through the mouth, but it can be lost by a variety of routes including:

- Urine (60% loss)
- Feces (6% loss)
- Sweat (sensible perspiration) (6% loss)
- Evaporation from the skin (insensible perspiration)
- The lungs during breathing

(Evaporation from the skin and the lungs in a 28% loss)

**Note:** sensible perspiration: we sense that we loose water

insensible perspiration: we don't sense that we loose water **like** breathing

## Water and Electrolytes Homeostasis

**Systems involved in the regulation of fluids and electrolytes ( highly regulated by many physiological process)**

- Kidneys,

- Cardiovascular system,

- Endocrine (Pituitary, Parathyroids, Adrenal glands)

- Lungs

**Notes:**

1- Loosing water in intracellular = high osmolality and the diffuse from EC to IC
2- Isotonic = No change
3- Loosing NA+ ONLY =low osmolality.

## Regulation of Na+ and Water

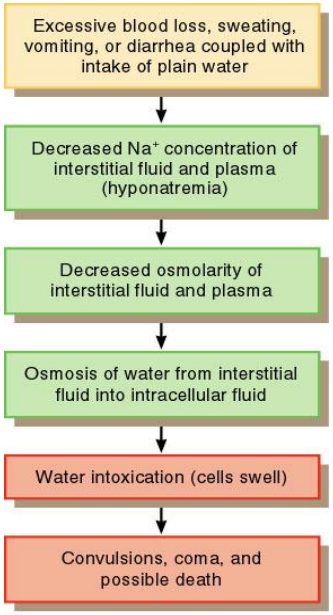
**Involves regulation of:**

- Osmolality

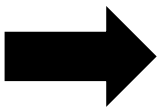
- Volume of ECF

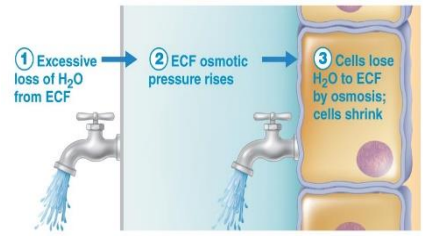
different regulations with many overlapping mechanisms.

## Importance of Na+ and Water regulation



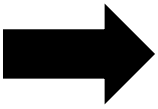

**Cell shrinks due to excessive lose of water from ECF**

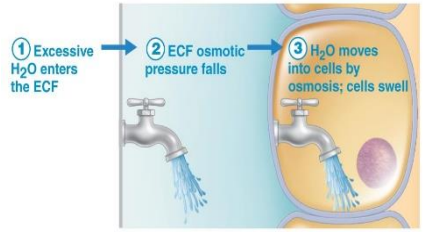





**(a) Consequences of dehydration.** If more water than solutes is lost, cells shrink.

**Cell swells due to excessive water enters the ECF**






**(b) Consequences of hypotonic hydration (water gain).** If more water than solutes is gained, cells swell.

## Measurements of Body Fluids

**Dilution Principle**

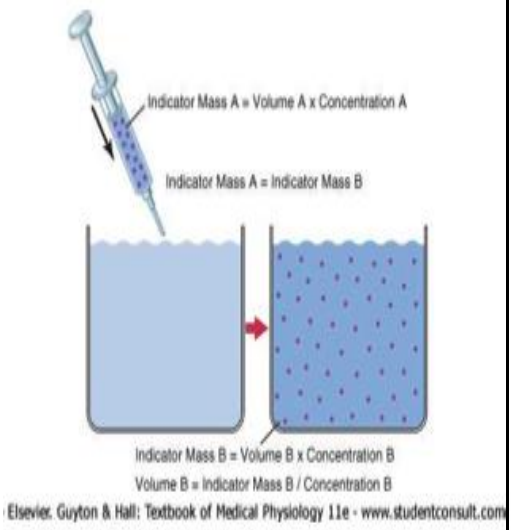
Dilution method for calculating fluid volume

$C_1V_1=C_2V_2$

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

If 1ml of a 10mg/ml solution is injected into a fluid compartment, and the final concentration is 0.01mg/ml, the volume of the fluid compartment is,

$$\text{Volume B} = \frac{1\ \text{ml} \times 10\ \text{mg/ml}}{0.01\ \text{mg/ml}} = 1000\ \text{ml}$$




## Properties of tracers used for calculation of volumes

- Properties of an Ideal Tracer The tracer should:
- be nontoxic
- be rapidly and evenly distribute throughout the nominated compartment not enter any other compartment.
- not be metabolized.
- not be excreted (or excretion is able to be corrected for) during the equilibration period
- be easy to measure
- not interfere with body fluid distribution

## Measurement of Total Body Water

* Radioactive water ($^3H_2O$, Tritium) or heavy water ($^2H_2O$, Deuterium).

This will mix with the total body water in just a few hours and the dilution method for calculation can be used.

* Antipyrine

## Measurement of ECF volumes

- $^{22}Na^+$, (Sodium Space)
- $^{125}I$-iothalamate,
- Thiosulfate,

**No need to Know how to be calculated**

- Inulin (Inulin Space)

**(Measured in 30-60 minutes)**

**<u>Calculation of ICF</u>**
**(Intra- Cellular Volume)**

**ICF= Total Body water – ECF**

# Good Luck ☺