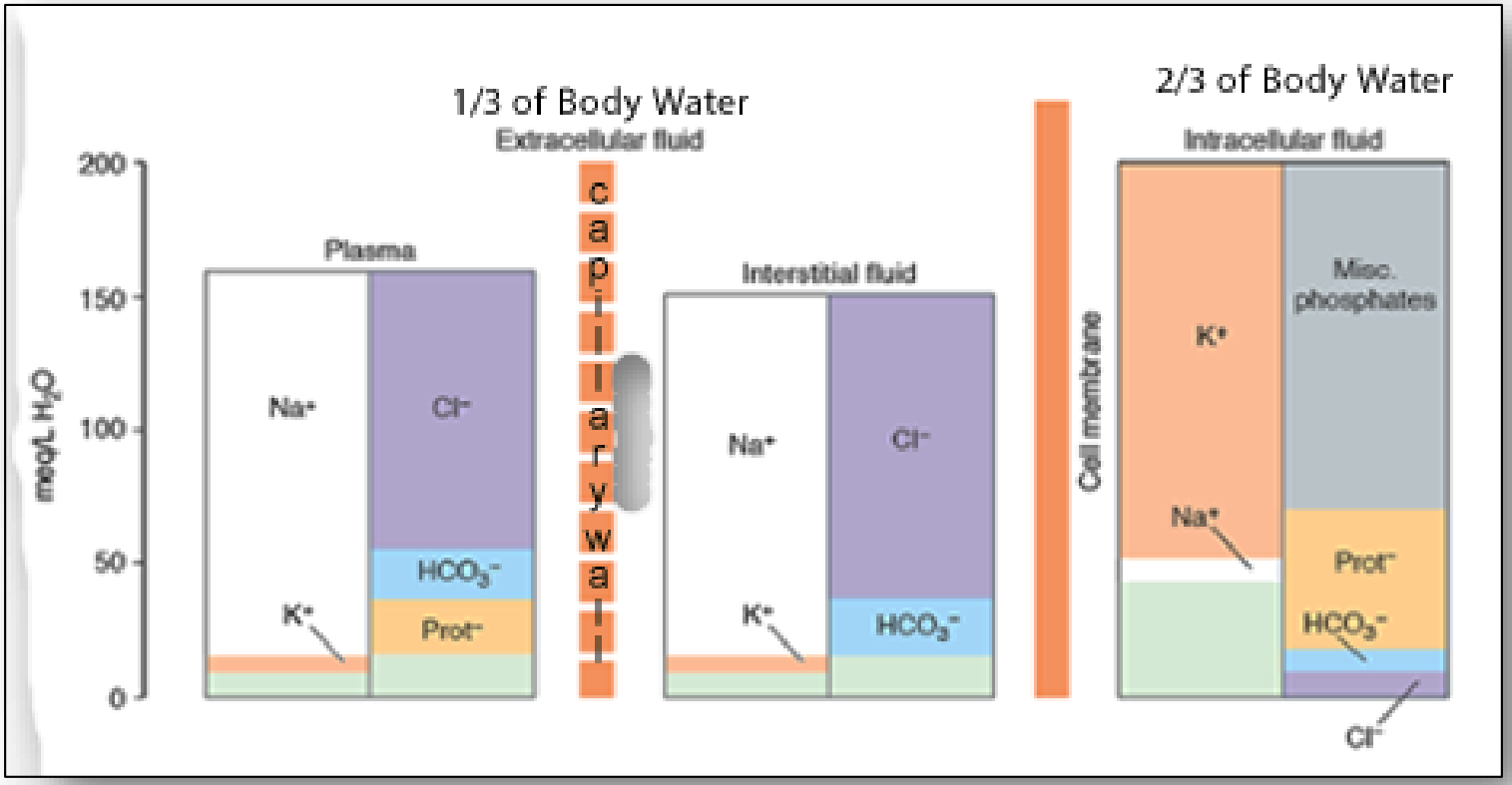
Body fluid compartments



Dr Sunita Mittal

Learning Objectives

To learn:

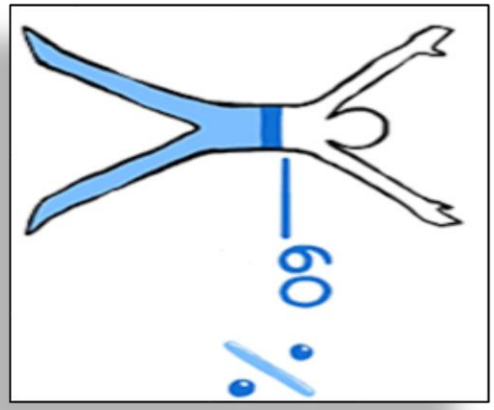
- Composition of body fluid compartments.
- Differences of various body fluid compartments.
- Molarity, Equivalence,Osmolarity-Osmolality, Osmotic pressure and Tonicity of substances
- Effect of dehydration and overhydration on body fluids

Why is this knowledge important?

- To understand various changes in body fluid compartments, we should understand normal configuration of body fluids.

Total Body Water (TBW)

Water is 60% by body weight
(**<u>42 L</u>** in an adult of **<u>70 kg</u>** - a major part of body).

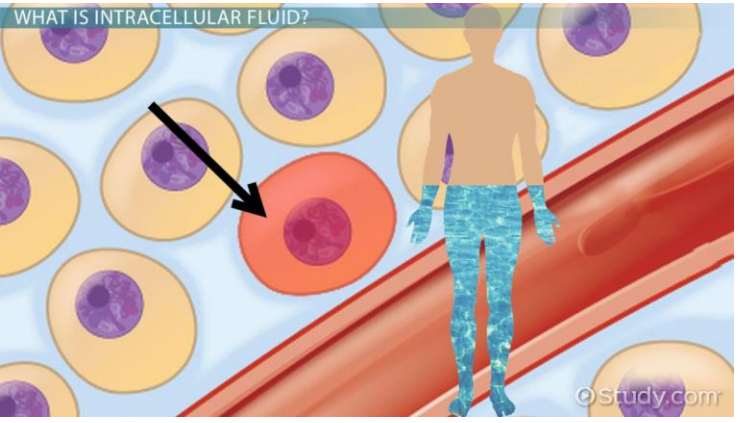


Water content varies in different body organs & tissues,

Distribution of TBW in various fluid compartments

Total Body Water (TBW) Volume
(60% bw)

- Intracellular Fluid Compartment **(40%)**
- Extracellular Fluid Compartment **(20%)**
  - Extra Vascular Comp **(15%)**
  - Intra Vascular Comp (Plasma) **(05%)**

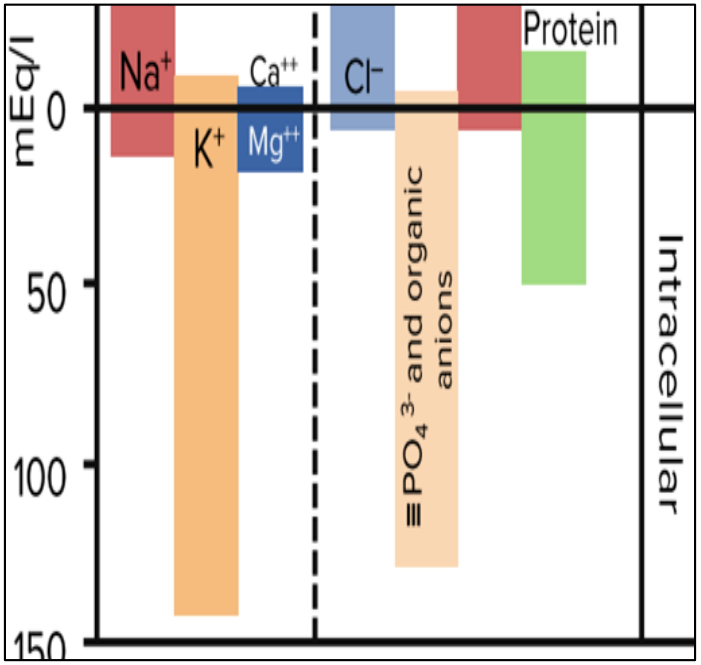


Electrolytes distribution in body fluid compartments

Intracellular fluid comp.mEq/L

Major Cation
K^+

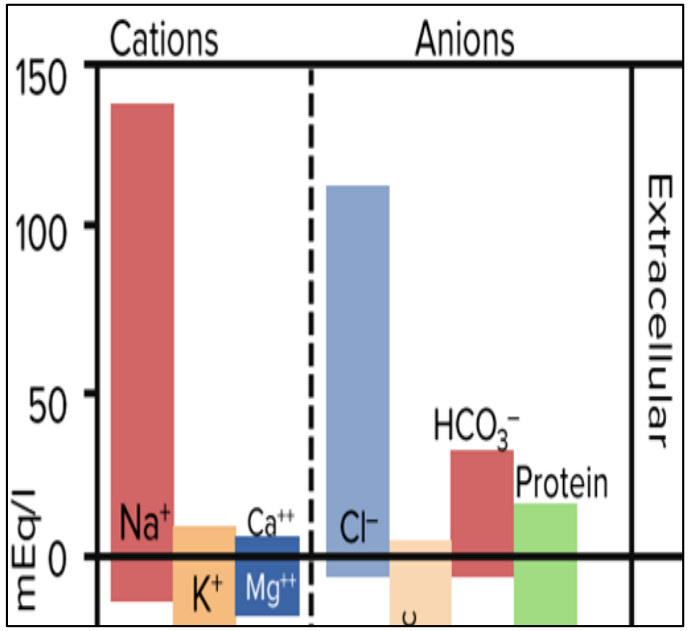
Major Anions
$HPO4^{--}$
Proteins -



Extracellular fluid comp.mEq/L

Major Cation
Na^+

Major Anions
Cl^-
$HCO3^-$



A set ‘Terminology’ is required to understand change of volume &/or ionic conc of various body fluid compartments.

Molarity

Definition

Example

Equivalence

$$\text{mEq/L} = \text{mmol/L} \times \text{valence}$$

Osmolarity

Osmolarity is total no. of osmotically active solute particles (the particles which attract water to it) per 1 L of solvent **- Osm/L.**

Example-

Osmolarity and Osmolality?

Osmolarity is total no. of osmotically active solute particles per 1 L of solvent - Osm/**L**

Osmolality is total no. of osmotically active solute particles per 1 Kg of solvent - Osm/**Kg**

Osmosis

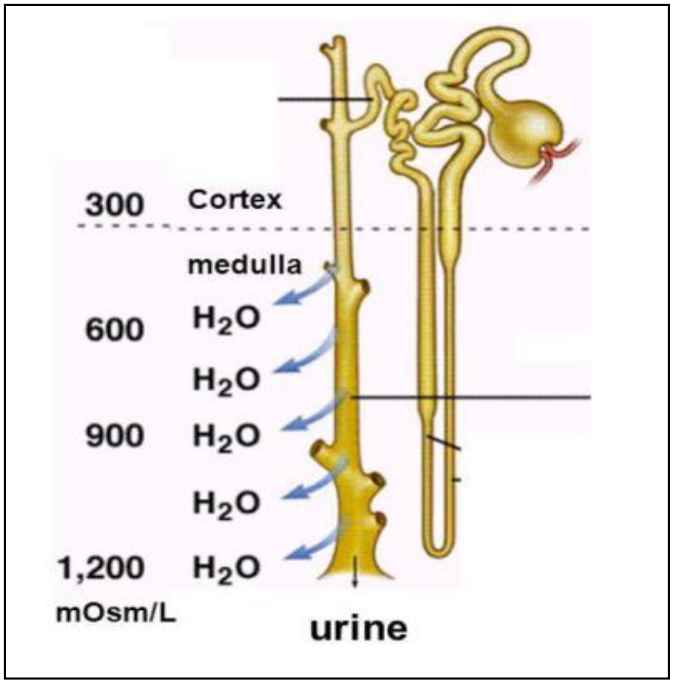
Tendency of water to move passively, across a semi-permeable membrane, separating two fluids of **different osmolarity** is referred to as ‘Osmosis’.

Osmotic Pressure

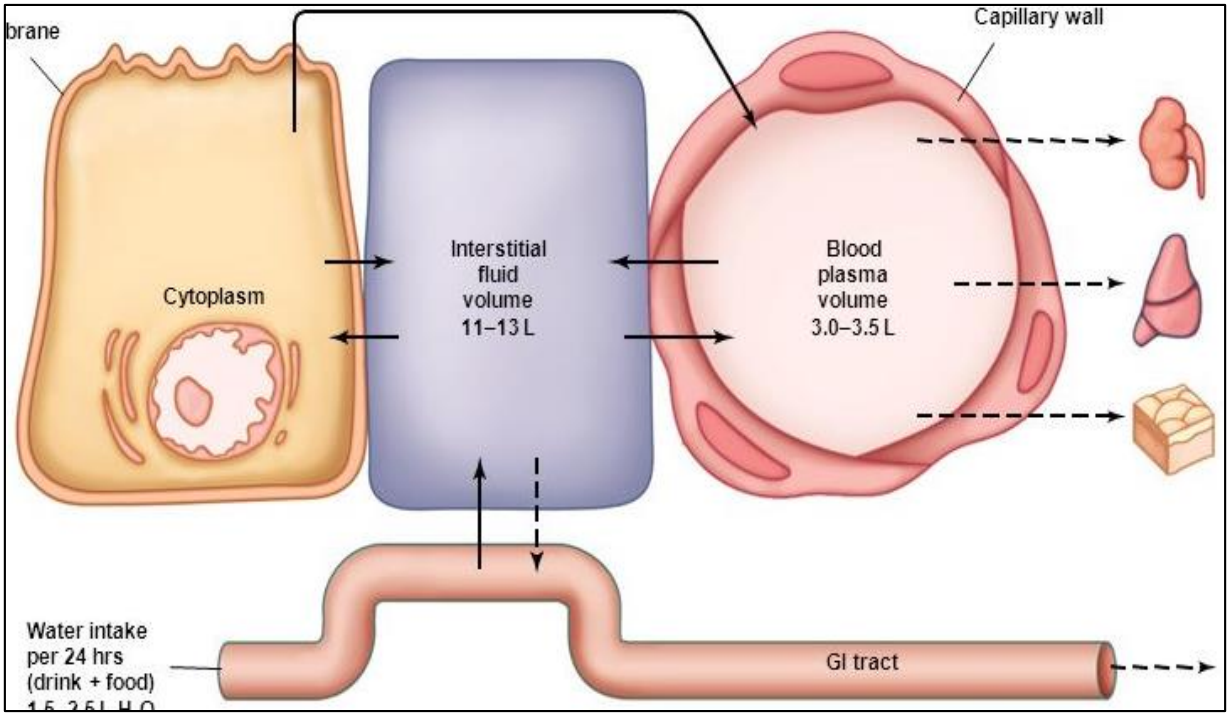
Osmotic pressure is the pressure, applied **to stop the flow of solvent molecules** from low osmolarity to a compartment of high osmolarity, separated through a semi-permeable membrane.

Normal osmolality of the ECF and ICF

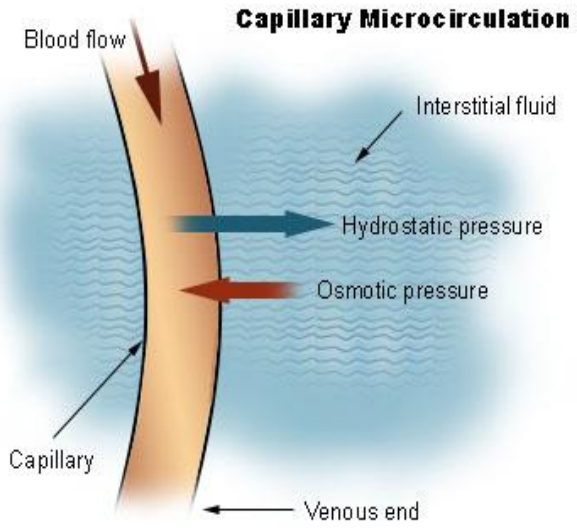
Averages 280-300 mOsm/L

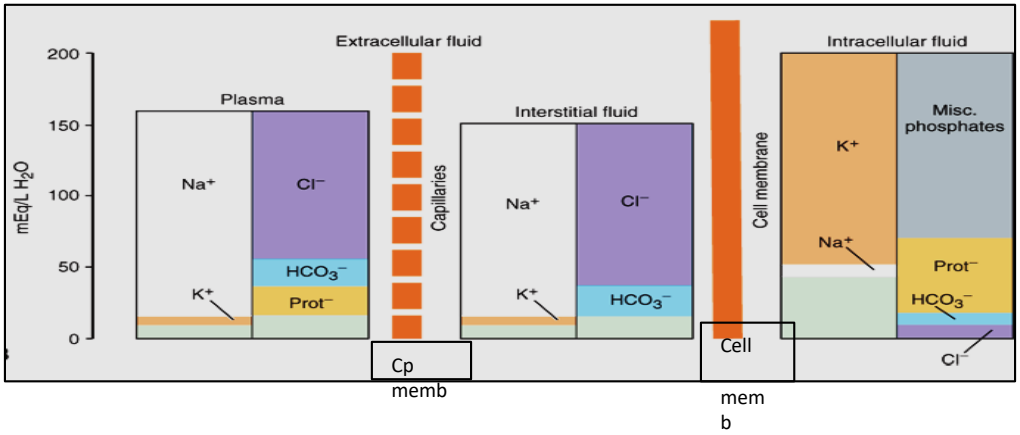


Osmolality of ICF



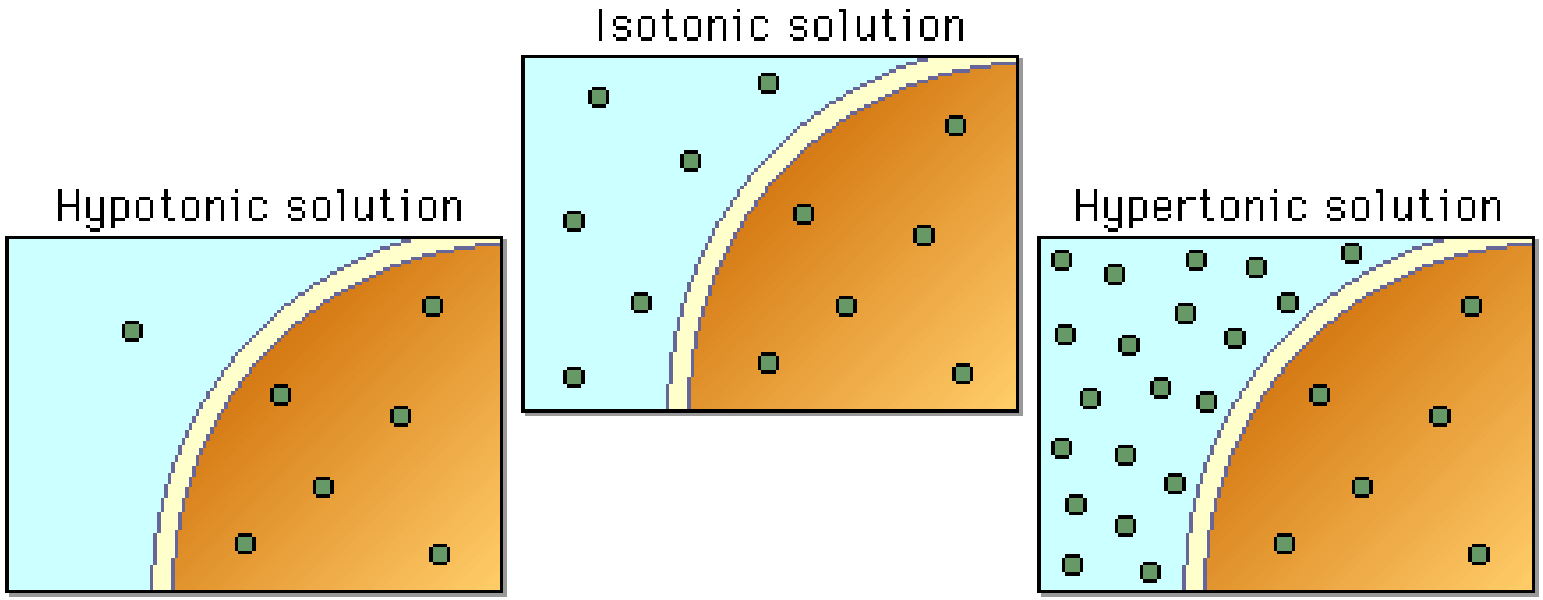
Pressures causing water moves freely between various body fluid compartments





Tonicity

Tonicity of a solution defines **cell volume change** that occurs, if the cell is placed in that solution.



Significant points of the Lecture

Importance of the knowledge about Body Fluid Compartment –

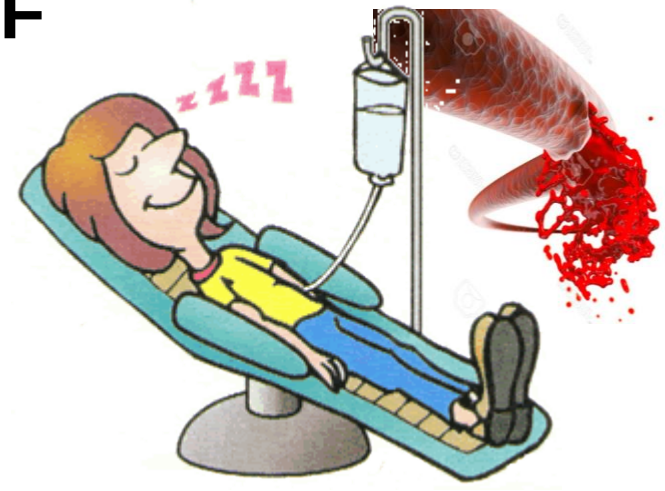
Water distribution in different compartment-

Ionic difference of different body fluid compartments-Major cation and anions-

Difference of Molarity, Equivalence, Osmolarity and Osmolality, Tonicity-

Next Lecture

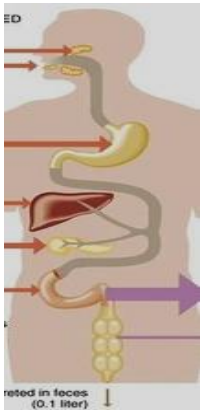
Basic principles for analysis of fluid shifts between ICF & ECF



- All exchanges of water and solutes with the external environment occur through the **extracellular fluid (ECF)**

e.g. intake or loss via the

- Gastrointestinal tract
- Intravenous route.



Basic principles for analysis of fluid shifts between ICF & ECF

- Hyposmotic dehydration/overhydration will result in cell volume ↑ and net Osmolarity↓

- Hyperosmotic dehydration/overhydration will result in cell volume ↓and net Osmolarity↑

Clinical implications

Water loss from body (ECF) -
Dehydration (volume contraction)

Excess water gain to the body (ECF) -
Overhydration (volume expansion)

Signs and symptoms of ‘dehydration’↓ and ‘overhydration’↓ ↓

Weight gain

Weight loss

Swollen ankles and puffy eyes

Dry mouth

High blood pressure

Low blood pressure

Breathlessness

Dizziness

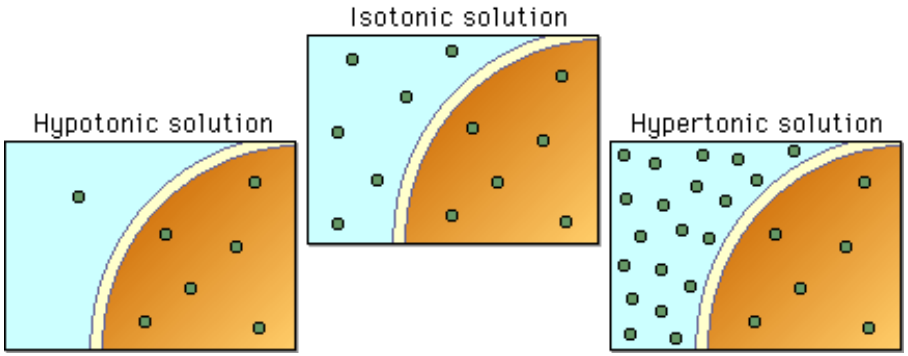
Dehydration (volume contraction)

Three types:

-Isosmotic dehydration

-Hyperosmotic dehydration,

-Hyposmotic dehydration



Overhydration (volume expansion)

Three types:

-Isosmotic overhydration

-Hyperosmotic overhydration

-Hyposmotic overhydration

Adapted from: Costanzo, L., Physiology, Table 6-2, p. 245

Summary of Disturbances in Fluid Shifts in Health and Disease

Type	Example	ECF volume	ICF volume	osmolarity
Isosmotic volume contraction	-diarrhea -burn	↓	No Change	No Change
Isosmotic volume expansion	-Isotonic NaCl infusion	↑	No Change	No Change
Hyposmotic volume contraction	-aldosterone insufficiency	↓	↑	↓
Hyposmotic volume expansion	-High water intake -SIADH	↑	↑	↓
Hyperosmotic volume contraction	-sweating -fever -diabetes insipidus	↓	↓	↑
Hyperosmotic volume expansion	-High NaCl intake	↑	↓	↑

Thank you