

Body fluids

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Learning Objective

- To understand body fluids and its composition

Percent of Water in the Human Body

100%



Fetus

80%



Baby
at Birth

70%



Normal
Adult

50%



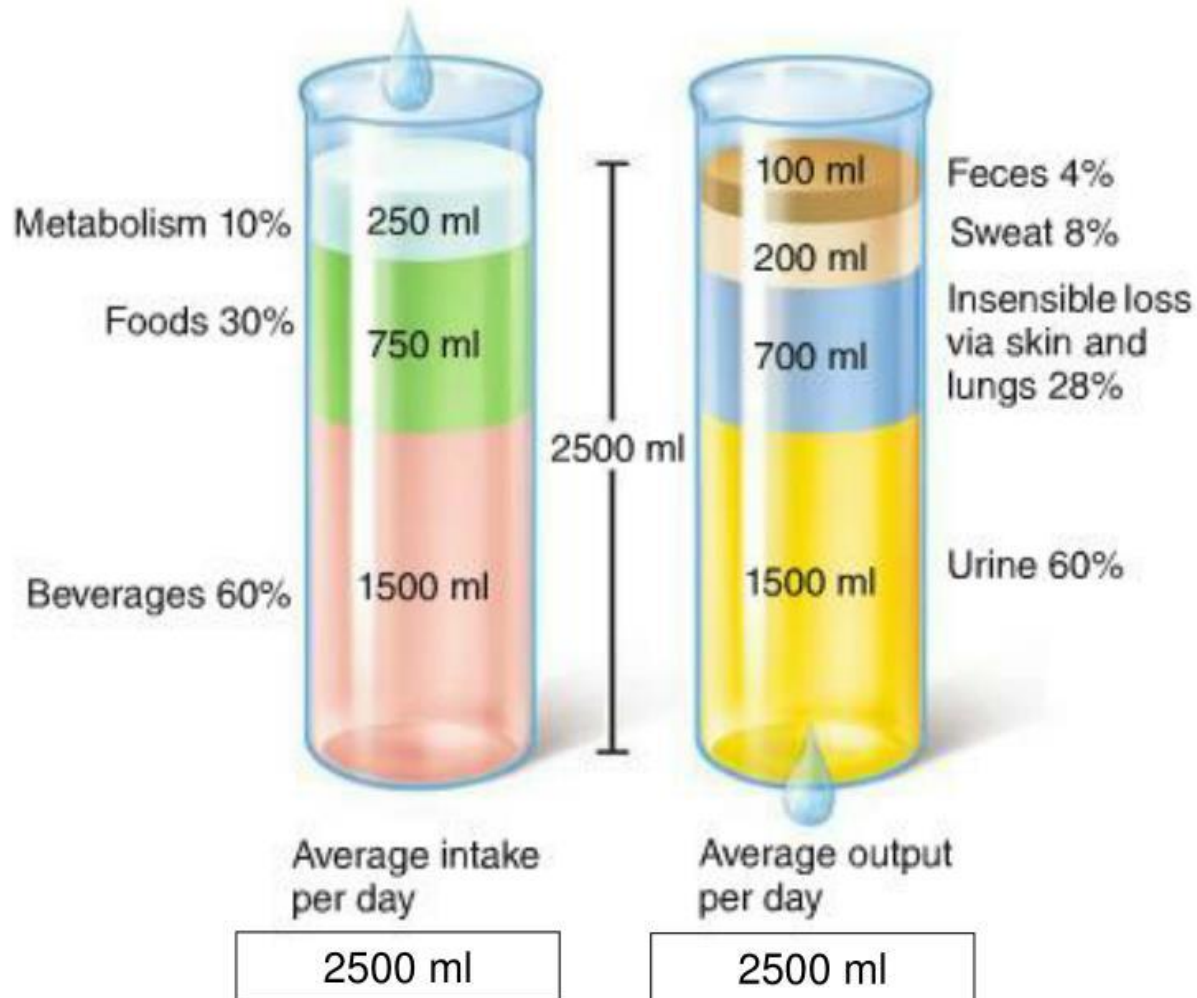
Elderly
Person

servignature

Functions of Body Fluids

1. Homeostasis
2. Transport mechanism
3. Metabolic reactions
4. Texture of tissues
5. Temperature regulation

Sources of water intake/output



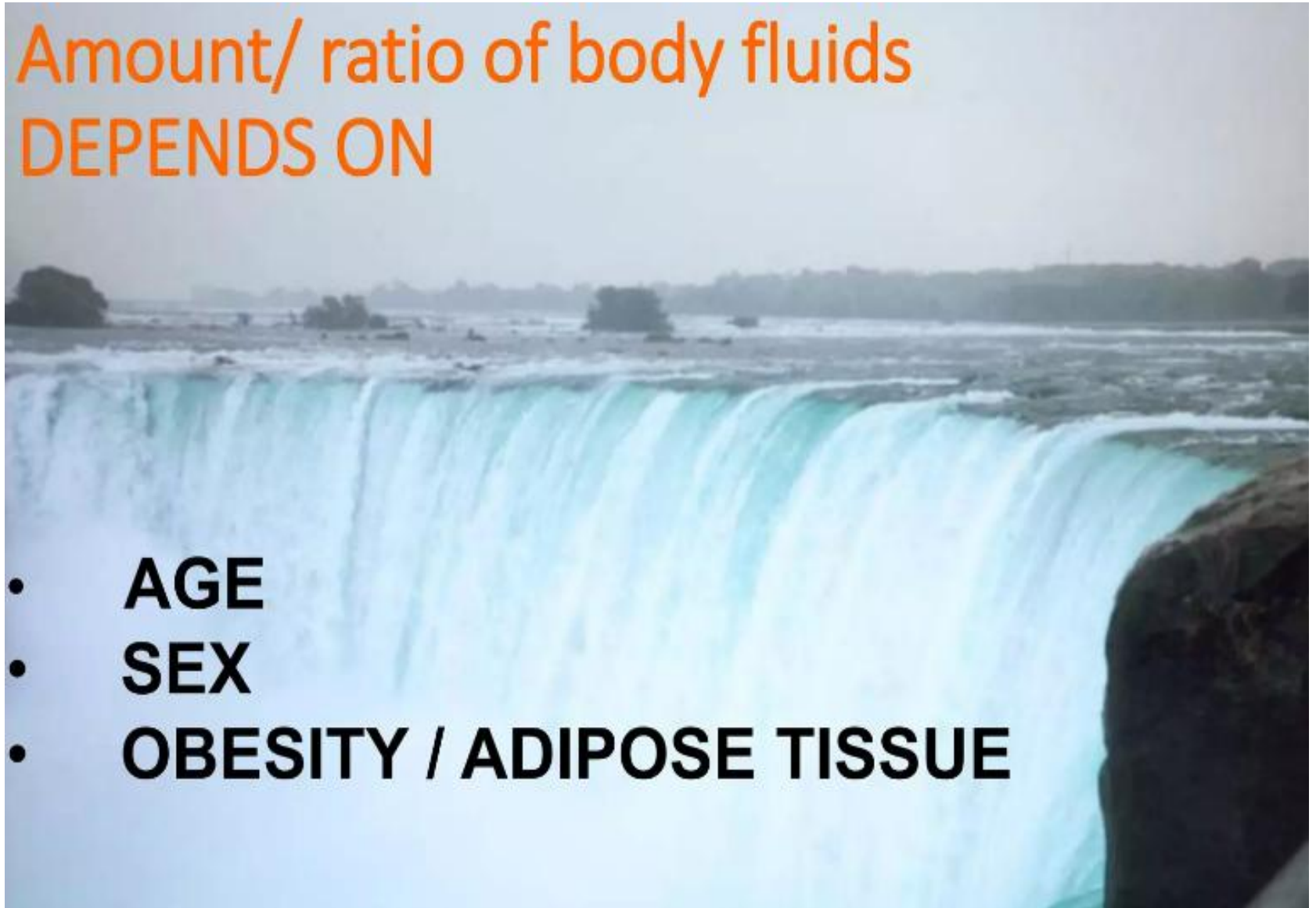
Water intake must equal water output

Water content in tissues



Amount/ ratio of body fluids DEPENDS ON

- **AGE**
- **SEX**
- **OBESITY / ADIPOSE TISSUE**



OUTPUT

- Kidneys
- Lungs
- Feces
- Sweat
- Skin

INTAKE

BODY FLUIDS



Extracellular fluid



Cell membrane

Intracellular fluid

**Average Adult
70 Kg
Male**

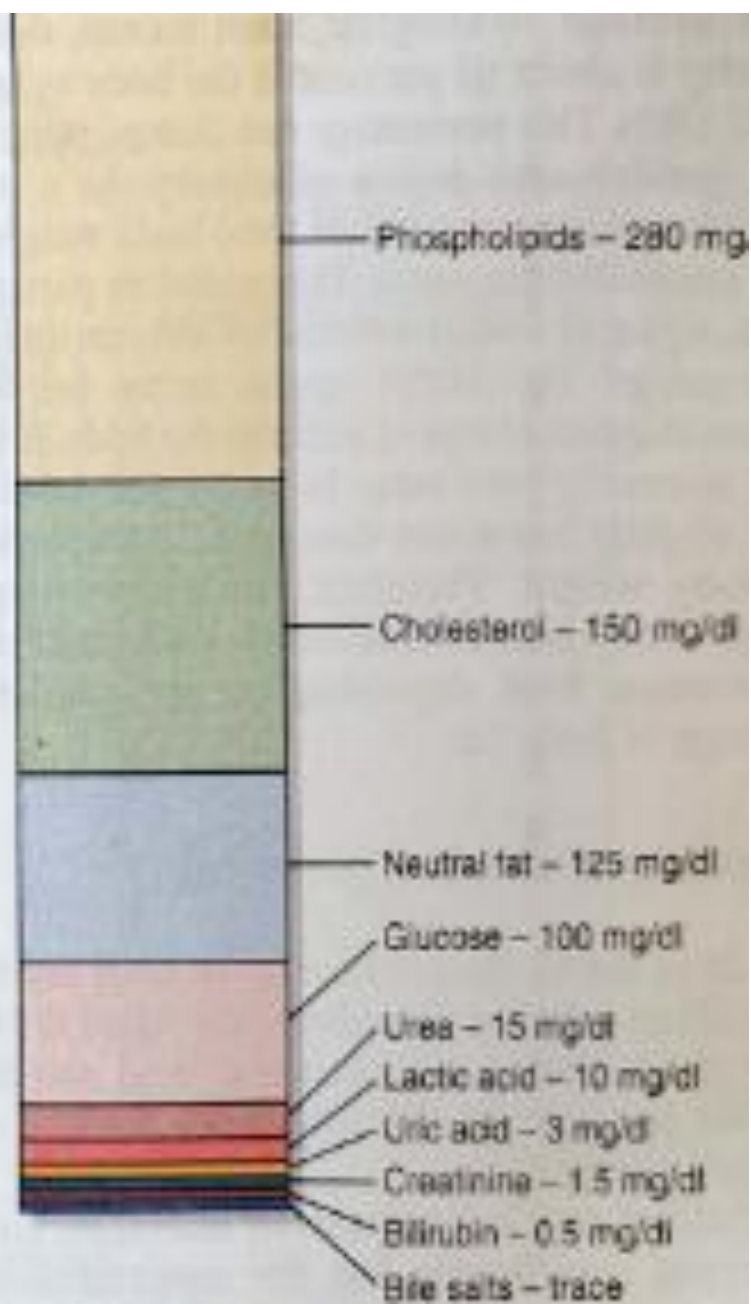
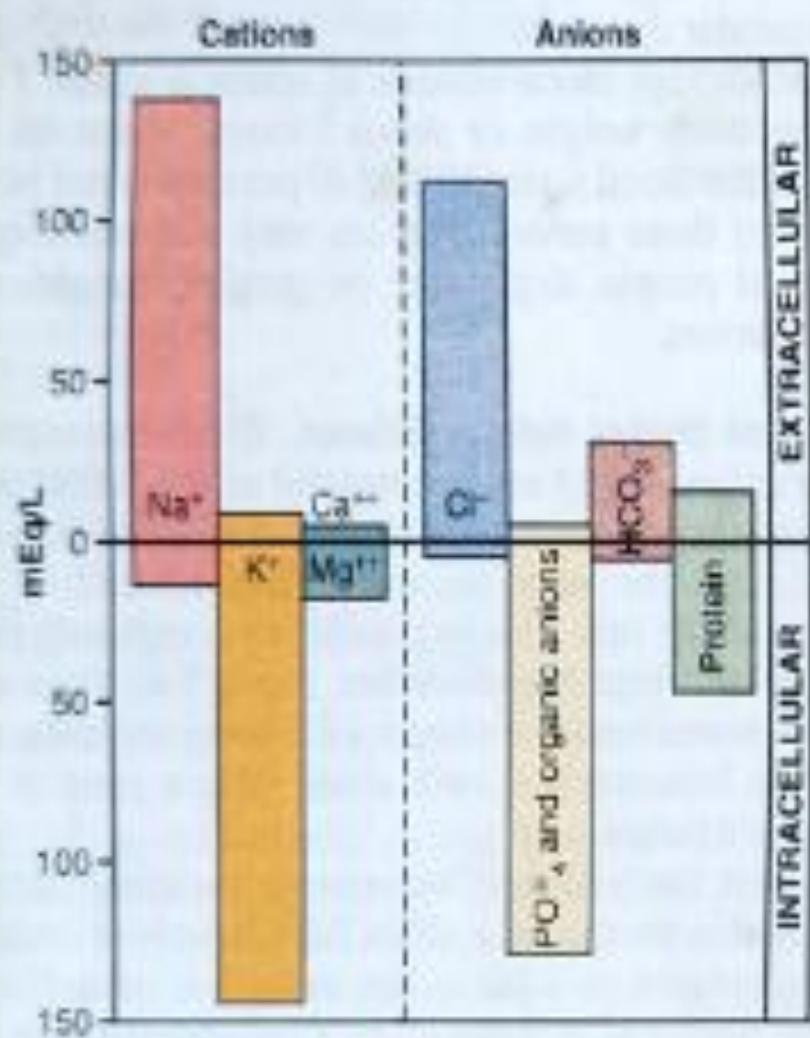


Figure 25.2

Osmolar Substances in Extracellular and Intracellular Fluids

	Plasma (mOsm/L H ₂ O)	Interstitial (mOsm/L H ₂ O)	Intracellular (mOsm/L H ₂ O)
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 ₂ PO 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	281.0	281.0
Total osmotic pressure at 37°C (mm Hg)	5443	5423	5423

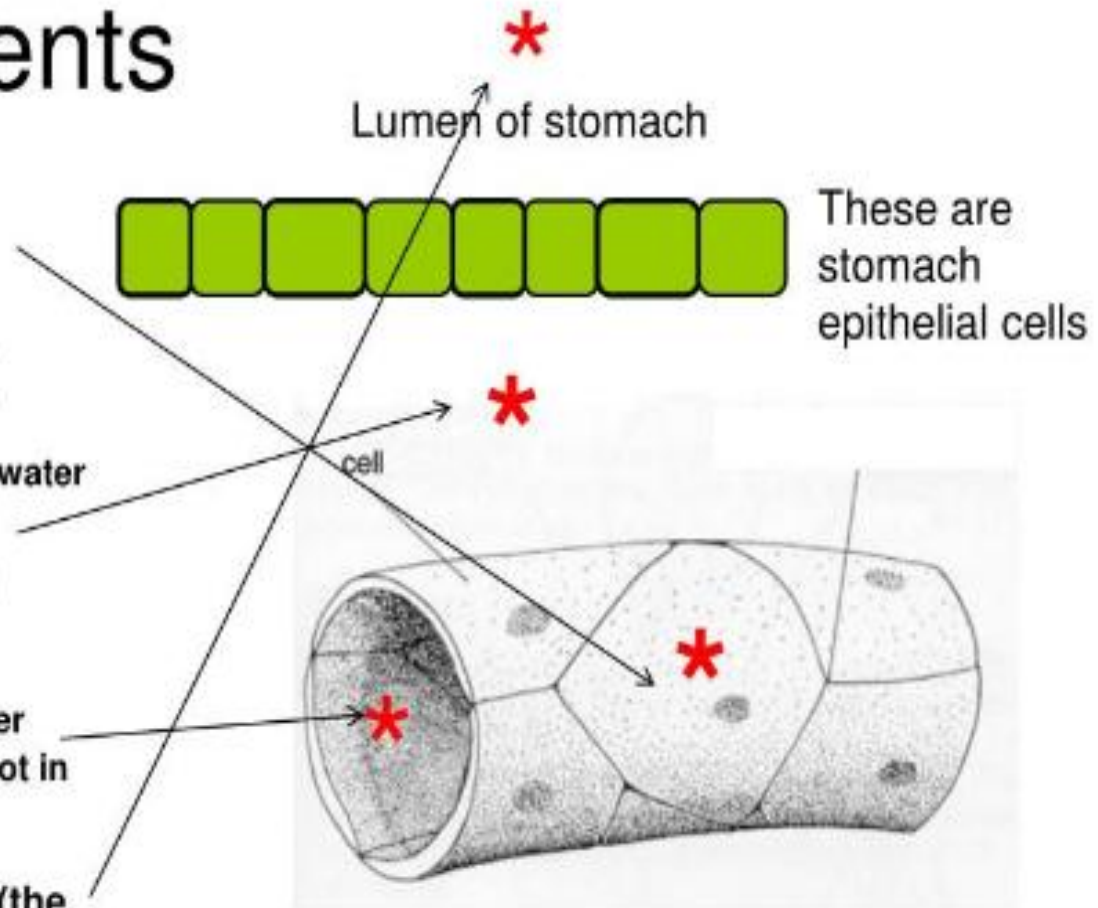
- Ionic composition of plasma and interstitial fluid same
- High concentration of Protein in plasma
- Positive charged ions high in plasma due to negatively charged proteins
- Negatively charged ions less in plasma

Compartments

- **Intracellular Fluid**
(60% Body Wt)

- **Extracellular Fluid**

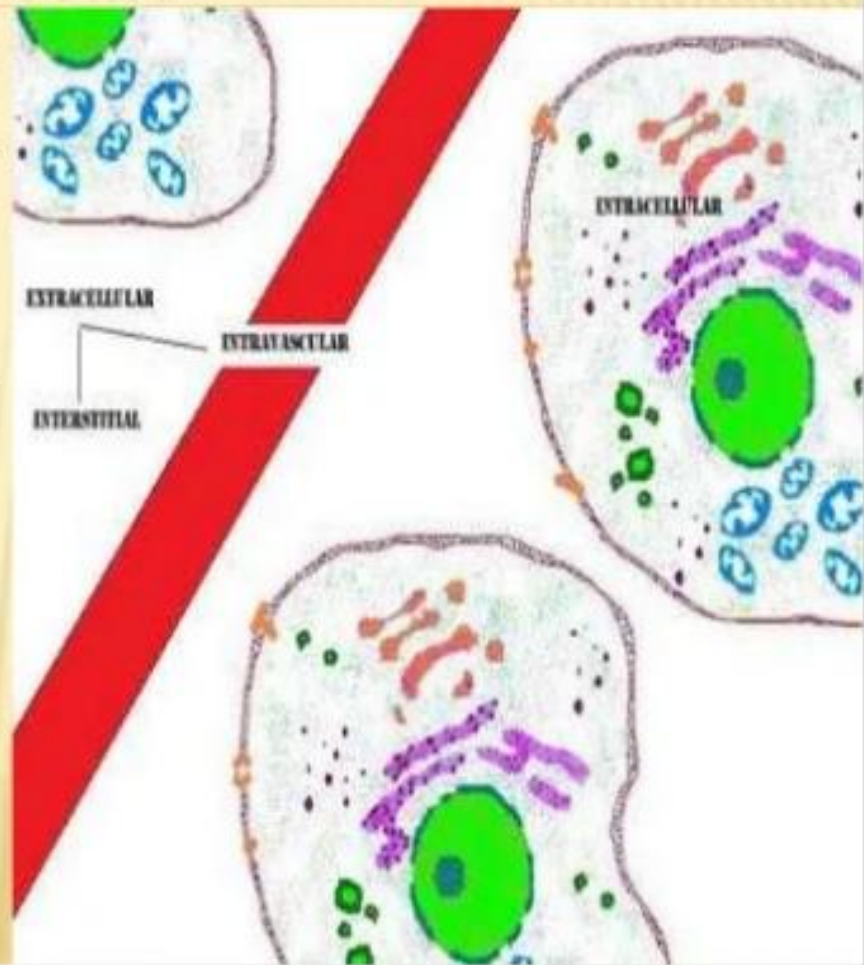
- **Interstitial fluid** (the water immediately outside cells, between and around cells) (30%)
- **Plasma fluid** (the water inside blood vessels, but not in blood cells) (9%)
- **Transcellular fluid** (the water enclosed in chambers lined by epithelial membranes) (1%)



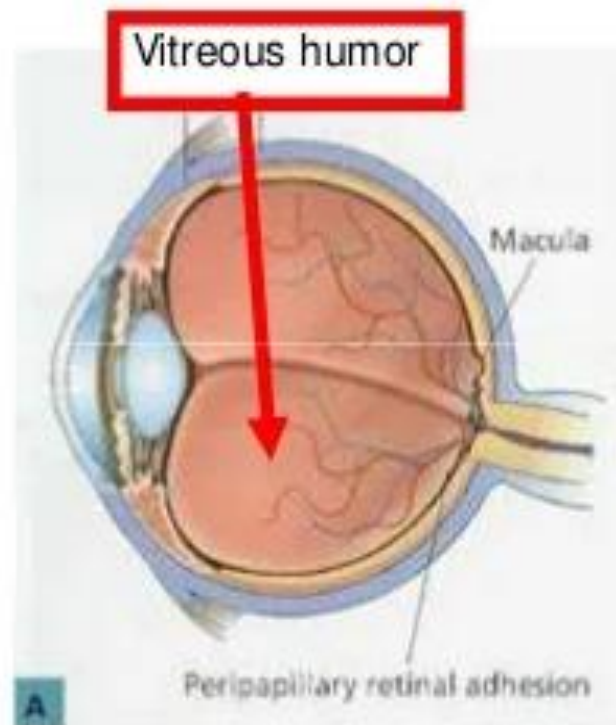
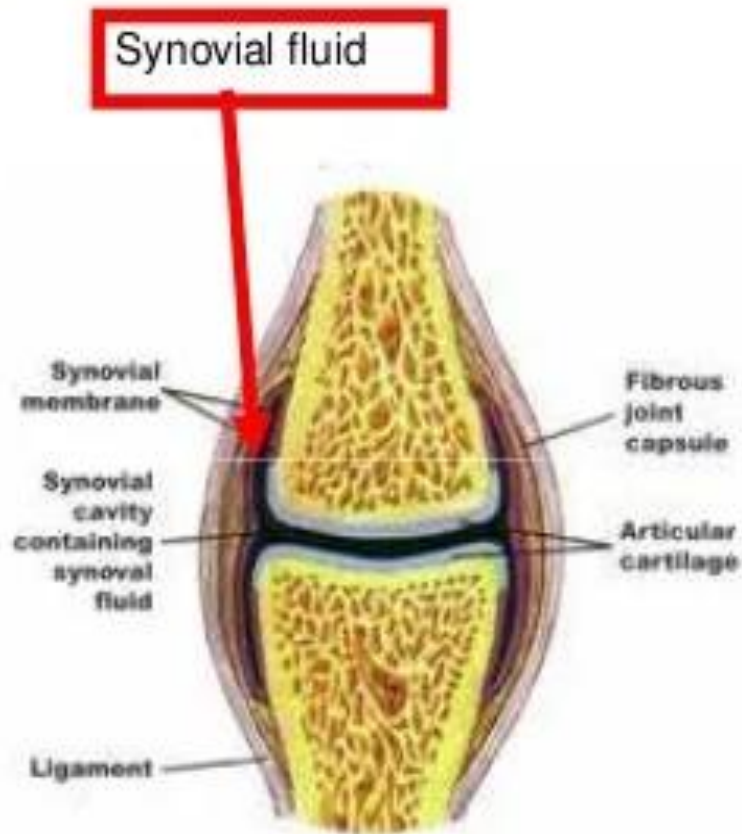
TRANSCELLULAR FLUID

Specialized ECF or another small compartment of fluid. It is the fluid separated from plasma by epithelium. This compartment includes:

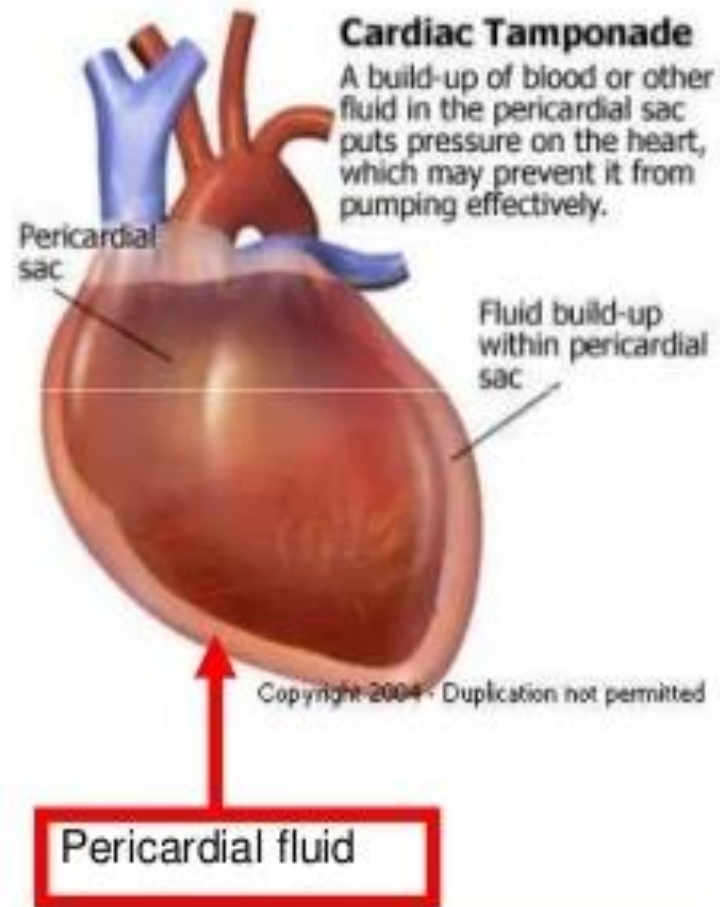
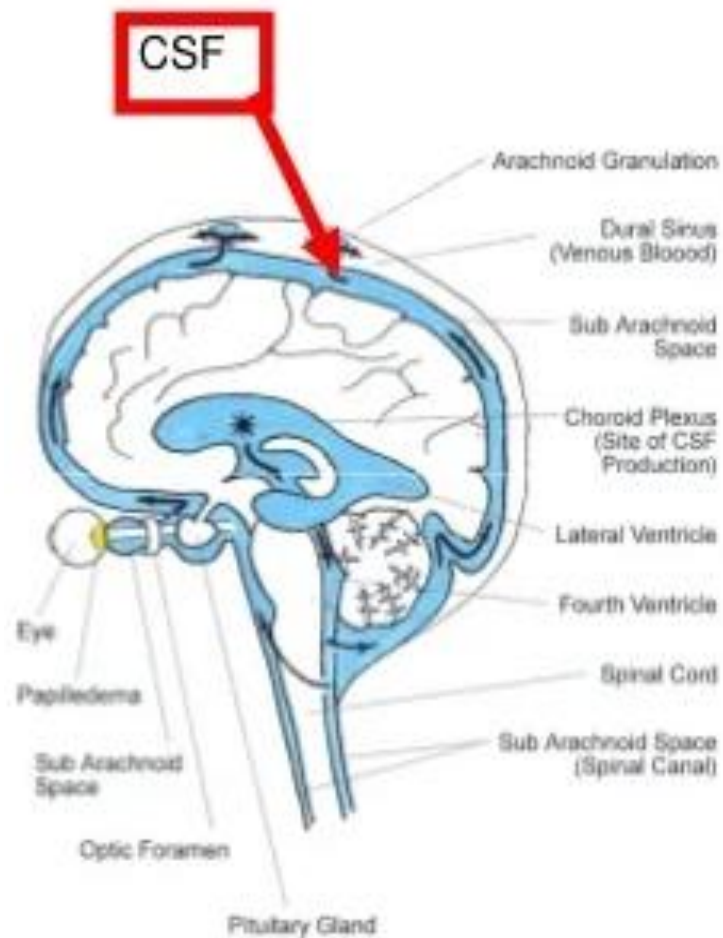
- ✘ Synovial fluid
- ✘ Peritoneal fluid
- ✘ Pericardial fluid
- ✘ Intraocular fluid
- ✘ Cerebrospinal fluid



Transcellular fluid



Transcellular fluid



Tissue fluid

- Fluid in intercellular space
- 20% of body fluid
- Fluid exchange between intravascular and interstitial compartments occurs only at the level of capillaries.

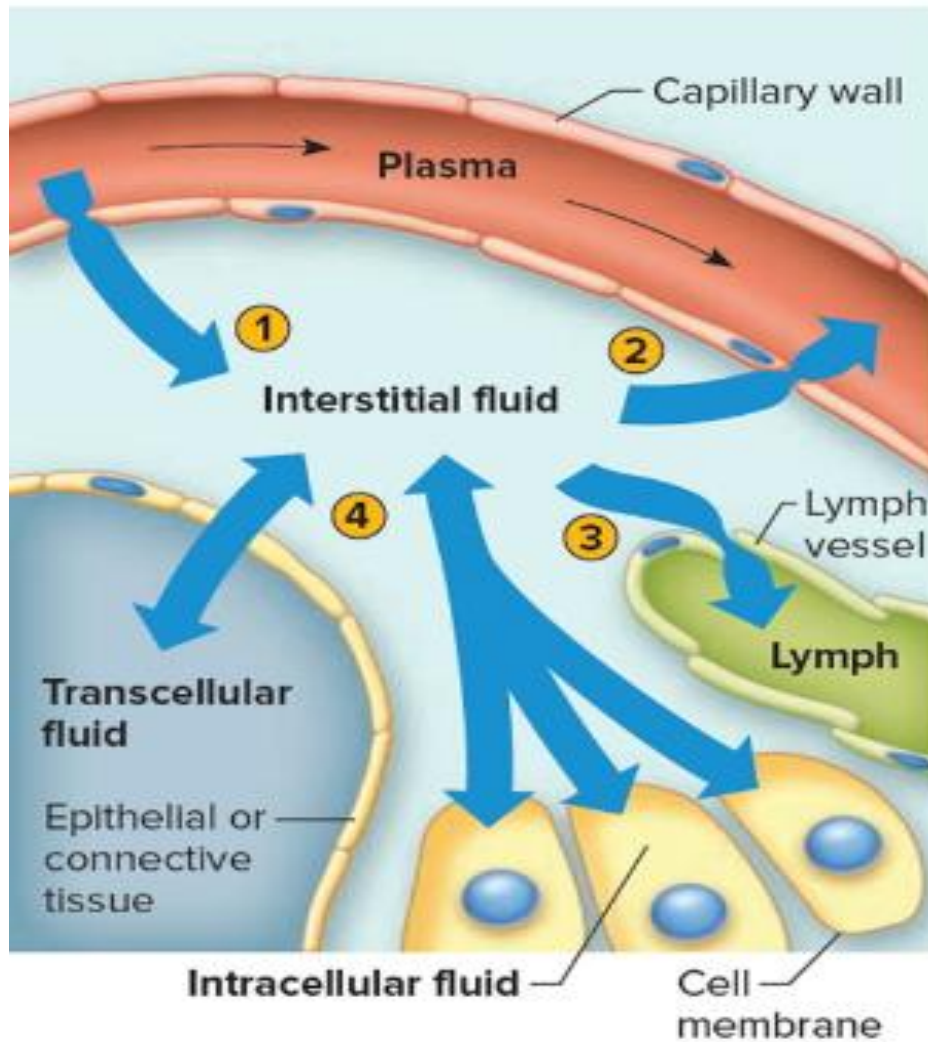
Function:

- Medium for exchange of substances like nutrients, CO_2 , O_2 , Metabolic wastes between cells and blood

Formation of tissue fluid

Factors affecting

- Permeability of capillaries
- Diffusion
- Filtration and absorption
- Metabolic activity of tissues



- 1 Fluid leaves plasma at arteriolar ends of capillaries because the outward force of hydrostatic pressure predominates
- 2 Fluid returns to plasma at venular ends of the capillaries because the inward force of colloid osmotic pressure predominates
- 3 Hydrostatic pressure within interstitial spaces forces fluid into lymph capillaries
- 4 Interstitial fluid is in equilibrium with transcellular and intracellular fluids

Starling's forces

- Hydrostatic pressure gradient
- Osmotic Pressure gradient

Hypothesis

- Net filtration through capillary membrane is proportional to hydrostatic pressure gradient across the membrane minus the oncotic pressure difference

- Effective hydrostatic pressure = Capillary HP (37 mmHg) - Interstitial fluid HP (0 mmHg)
- Effective osmotic pressure = Colloidal OP of plasma (25 mmHg) - Colloidal OP of interstitial fluid (0 mmHg)
- Effective filtration pressure = EHP - EOP

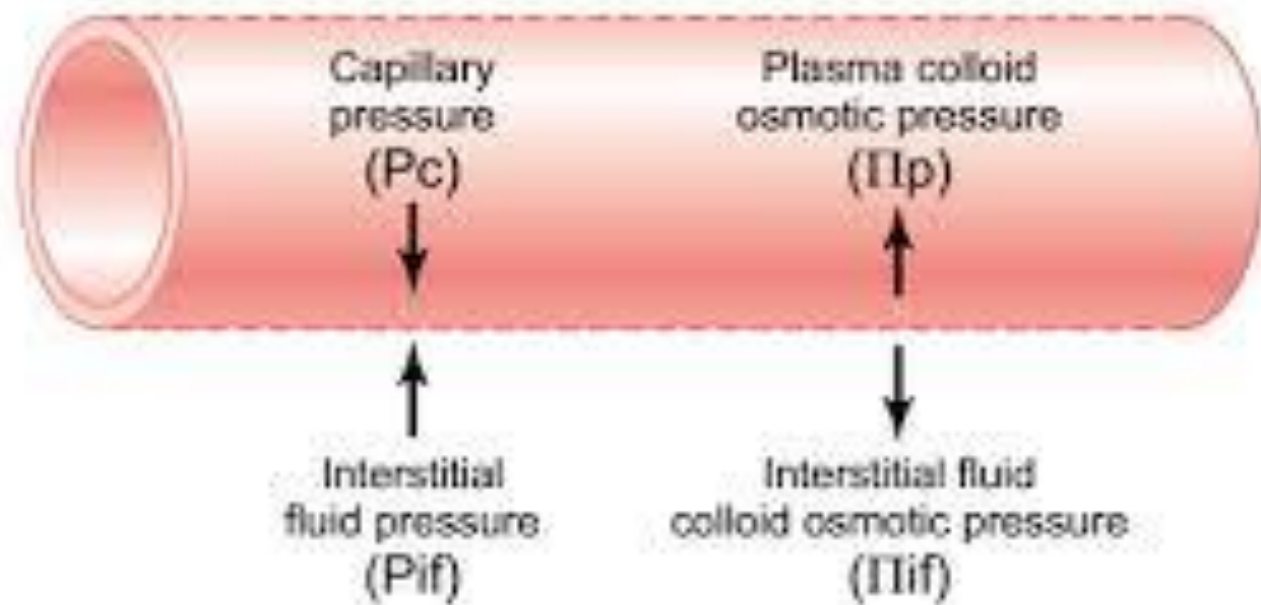


Figure 16-5

Fluid pressure and colloid osmotic pressure forces operate at the capillary membrane, tending to move fluid either outward or inward through the membrane pores.

- Fluid moves out of entire length in renal glomerulus
- In intestine fluid moves into the entire capillary
- Pulmonary capillaries filtration does not occur

Concentration of body fluids

Concentration of body fluids is expressed in three ways:

1. Osmolality
2. Osmolarity
3. Tonicity.

- **Osmolality** is expressed as the number of particles (osmoles) per kilogram of solution (osmoles/kg H₂O).
- In simple words, it is the concentration of osmotically active substance in the solution.

- Osmolarity is another term to express the osmotic concentration. It is the number of particles (osmoles) per liter of solution (osmoles/L).

Tonicity

- The ability of an extracellular solution to make water move into or out of a cell by osmosis is known as its **tonicity**.
- Tonicity is a bit different from osmolarity because it takes into account both relative solute concentrations *and* the cell membrane's permeability to those solutes.

In terms of tonicity, the solutions are classified into three categories:

- i. Isotonic fluid
- ii. Hypertonic fluid
- iii. Hypotonic fluid.

i. Isotonic Fluid

Fluid which has the same effective osmolality (tonicity) as body fluids is called isotonic fluid.

Examples are 0.9% sodium chloride solution (normal saline) and 5% glucose solution.

Disorders of Fluid and Electrolyte Balance

- Dehydration = water depletion
 - Due to:
 - Inadequate water intake
 - Fluid loss, e.g., vomiting, diarrhea
 - Inadequate ADH (hypothalamic/pituitary malfunction)
 - Leads to:
 - Too high Na^+ = hypernatremia
 - Thirst, wrinkled skin
 - Decreased blood volume and BP
 - Fatal circulatory shock

Signs and symptoms

Mild and moderate dehydration

1. Dryness of the mouth
2. Excess thirst
3. Decrease in sweating
4. Decrease in urine formation
5. Headache
6. Dizziness
7. Weakness
8. Cramps in legs and arms.

Severe dehydration

1. Decrease in blood volume
2. Decrease in cardiac output
3. Low blood pressure
4. Hypovolemic cardiac shock
5. Fainting.

Very severe dehydration

- 1. Damage of organs like brain, liver and kidneys
- 2. Mental depression and confusion
- 3. Renal failure
- 4. Convulsions
- 5. Coma.

Oral rehydration therapy

- ORS was formulated by World Health Organization (WHO).
- This solution contains anhydrous glucose, sodium chloride, potassium chloride and trisodium citrate.
- In case of very severe dehydration, proper treatment is the intravenous administration of necessary water and electrolytes.

WATER INTOXICATION OR OVERHYDRATION

- Water intoxication is the condition characterized by great increase in the water content of the body.
- It is also called overhydration, hyperhydration, water excess or water poisoning.

- Fluid status assessment-plasma Na concentration
- Normal-142meq/L

Decreased-Hyponatremia

- Diarrhoea, Vomiting
- Diuretics

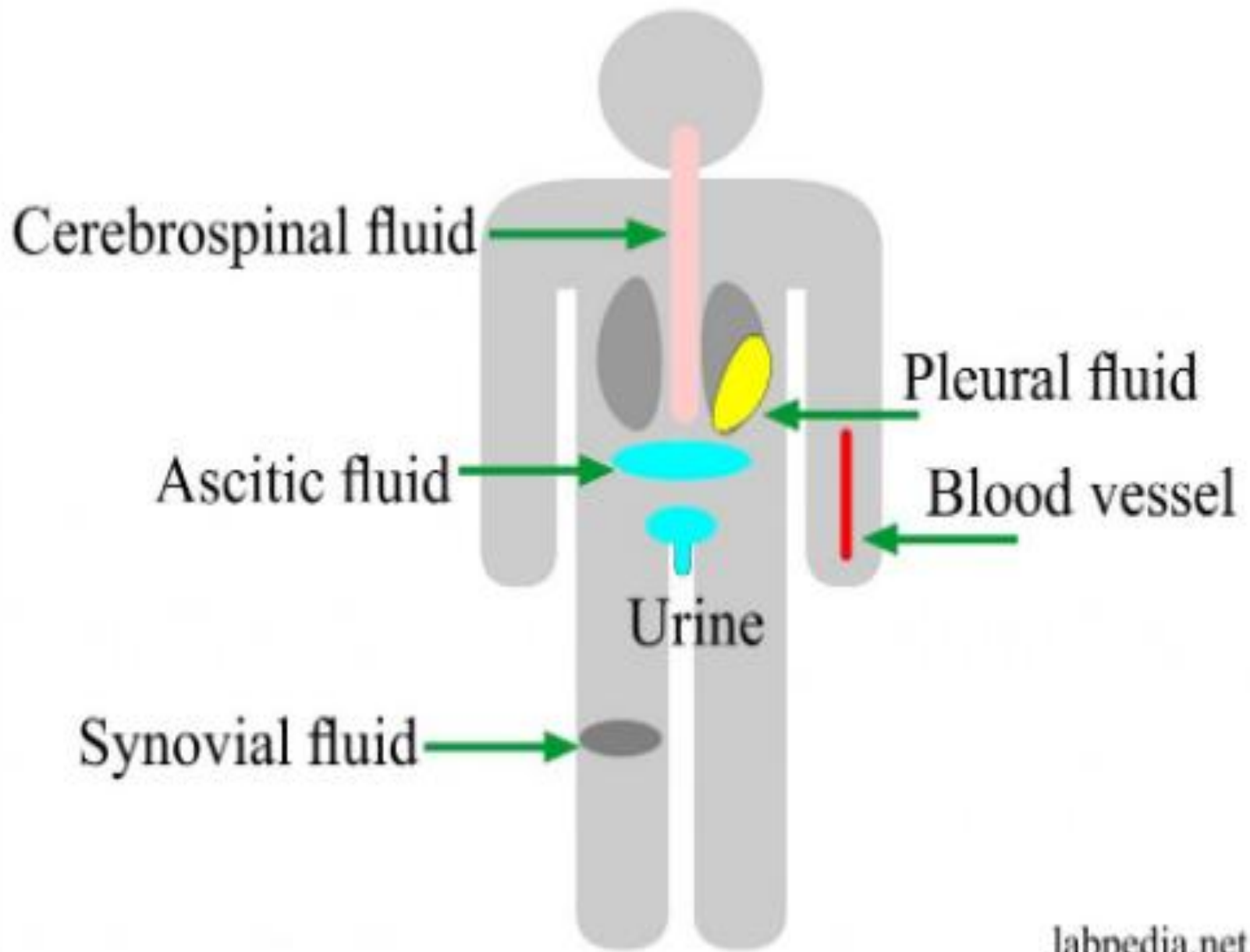
Increased-Hyponatremia-Diabetes insipidus

Disorders of Water Balance: Edema

- Atypical accumulation of fluid in the interstitial space, leading to tissue swelling
- Caused by anything that increases flow of fluids out of the bloodstream or hinders their return
- Factors that accelerate fluid loss include:
 - Increased capillary hydrostatic pressure
 - Increased blood pressure, capillary permeability, incompetent venous valves, localized blood vessel blockage, congestive heart failure, hypertension, high blood volume

Body Fluids

Specimen Collections



THANK YOU