Body fluids and body fluid compartments

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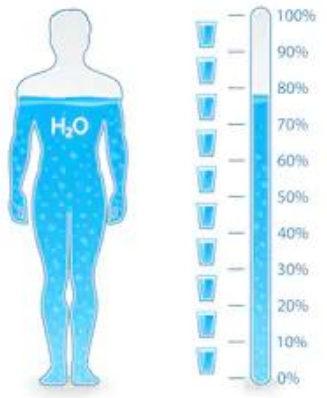
- Please refer to Vander’s Human Physiology

- *Body fluid*: watery solution of dissolved substances such as oxygen, nutrients, and wastes
  - present within and around all cells of the body, and within blood vessels - *internal environment*

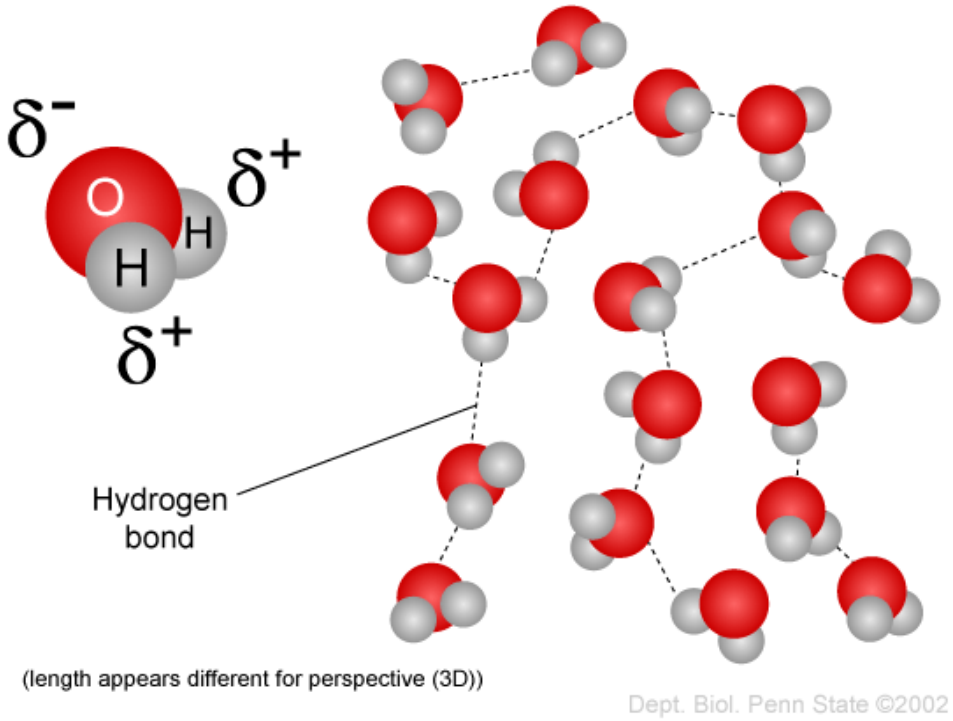


Water

- Life on Earth began in water and evolved there for 3 billion years before spreading onto land
- All organisms are made mostly of water and live in an environment dominated by water.

Properties of Water

- Cohesion and adhesion
- High surface tension
- High heat capacity
- Changes in density
- Universal solvent



Water in Human Body

- Solvent
- Transporter
- Heat regulation
- Buffer

Body Fluid

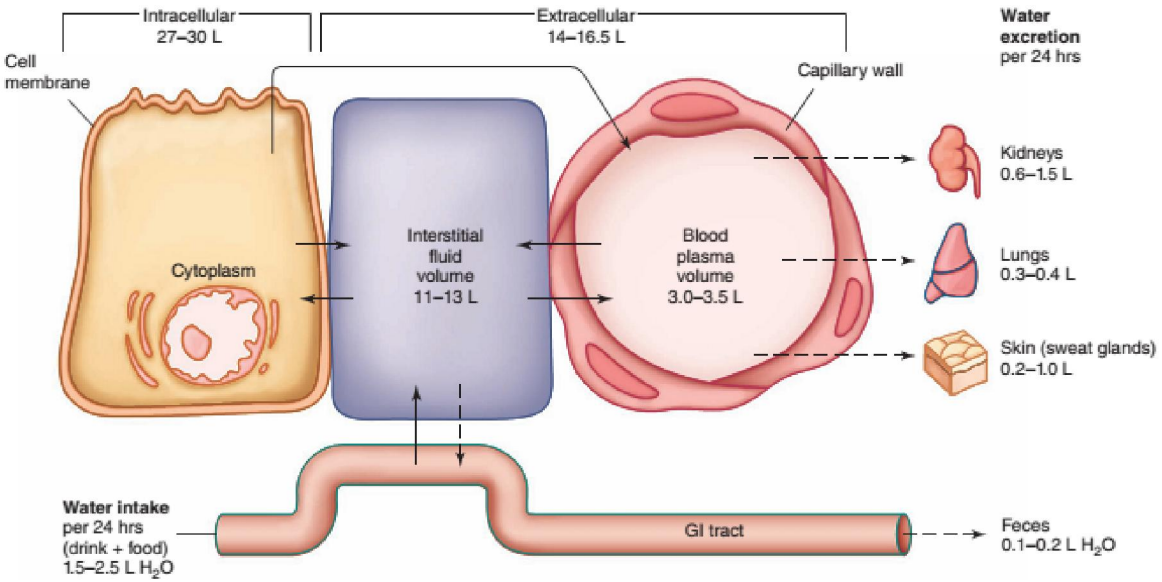
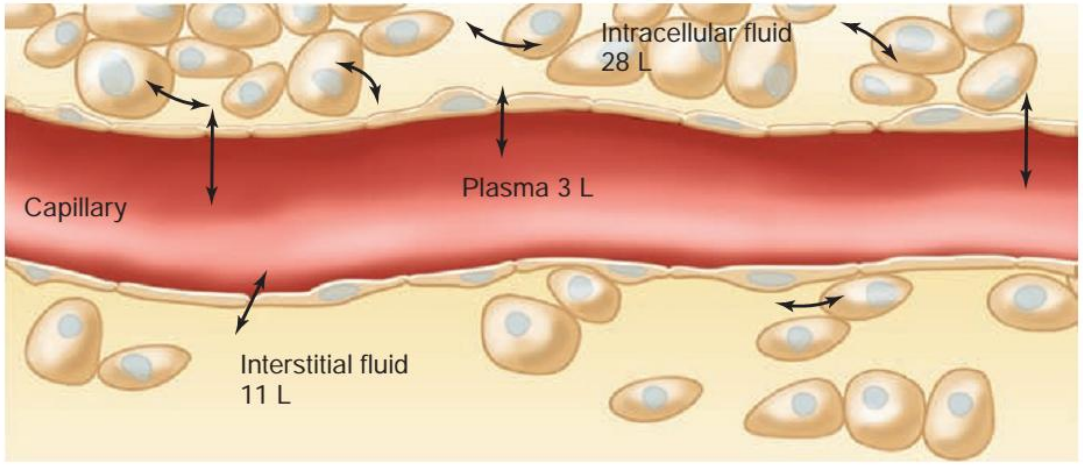


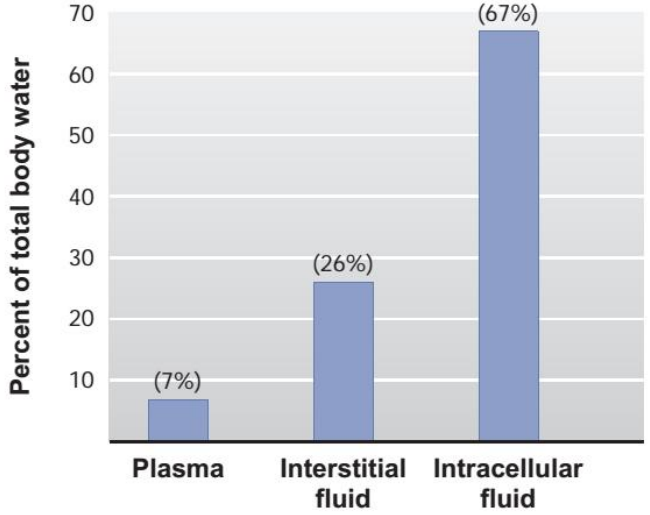
TABLE 14.3 Average Daily Water Gain and Loss in Adults

Intake	
In liquids	1400 mL
In food	1100 mL
Metabolically produced	350 mL
Total	**2850 mL**
Output	
Insensible loss (skin and lungs)	900 mL
Sweat	50 mL
In feces	100 mL
Urine	1800 mL
Total	**2850 mL**

Body Fluid Compartments

- Intracellular Fluid (ICF)
- Extracelular Fluid (ECF)
  - Interstitial Fluid: surrounds the cells but does not circulate. ¾ of the ECF
  - Plasma: circulated as the extracellular component of blood. ¼ of the ECF





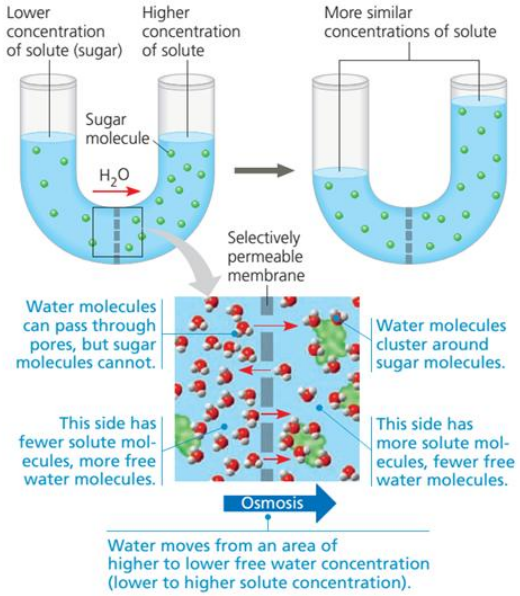
Homeostasis

- The internal environment is made up of the ECF
  - Cells that are isolated from the external environment can still exchange materials with the ECF

- **Homeostasis** is the maintenance of constant conditions in fluid surrounding cells (extracellular fluid) or internal environment by the integrated actions of various organs within the organism

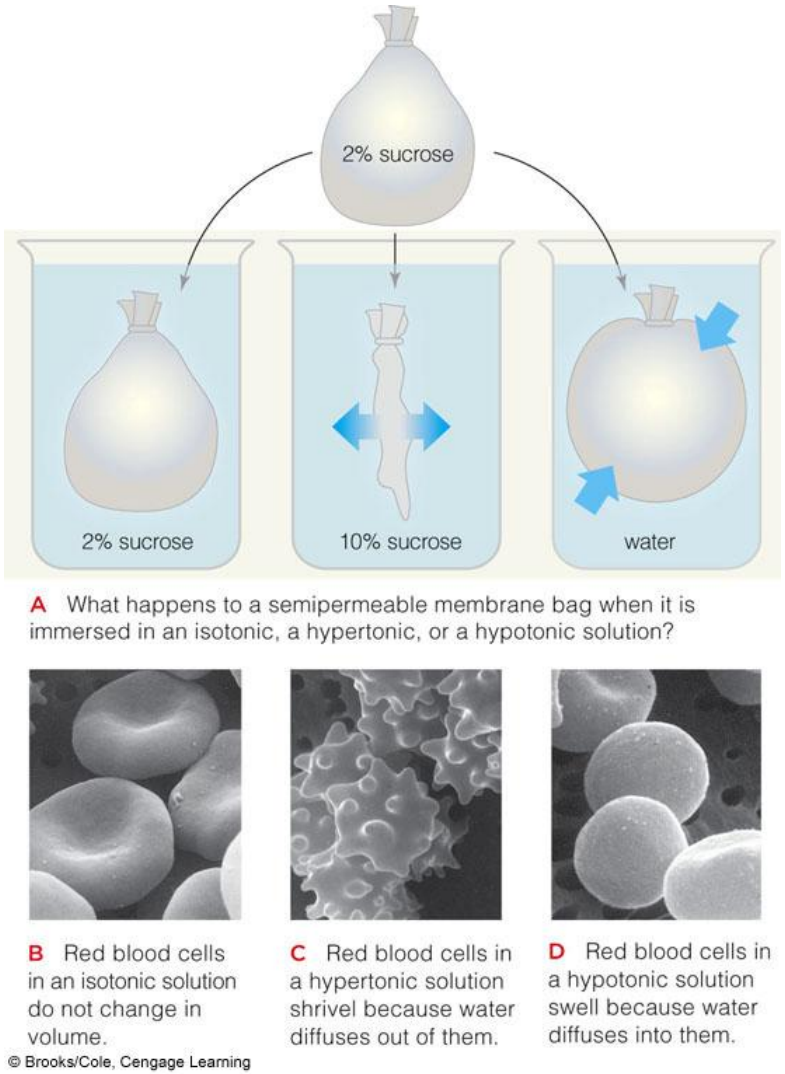
Osmosis

- Net diffusion of water across a membrane
- Osmolarity: the total solute concentration of a solution
- 1 osmol (osm) = 1 mol of solute particles
  - 1 M glucose = 1 osm
  - 1 M NaCl =2 osm
- Osmolarity ⬆ water concentration ⬇



Tonicity

- For two fluids separated by a semipermeable membrane, the one with lower solute concentration is *hypotonic*, and the one with higher solute concentration is *hypertonic*
  - Water diffuses from hypotonic to hypertonic
- *Isotonic* fluids have the same solute concentration
- Osmolarity of the intracellular fluids 300 mOsm
  - Isotonic = 300 mOsm
  - Hypertonic > 300 mOsm
  - Hypotonic < 300 mOsm



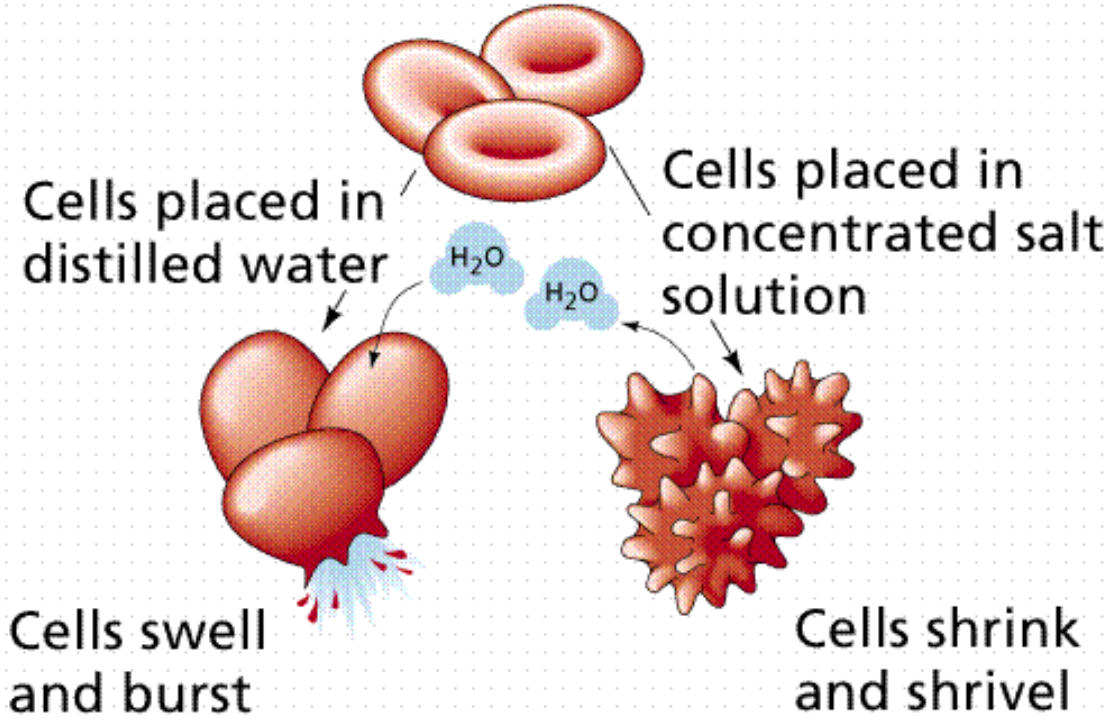
Osmotic Pressure

- When a solution containing solutes is separated from pure water by a *semipermeable membrane* (a membrane permeable to water but not to solutes), the pressure that must be applied to the solution to prevent the net flow of water into it is known as the osmotic pressure of the solution.

- Osmolarity ⬆ Osmotic pressure ⬆

- Represents the amount of pressure that would have to be applied to a solution to prevent the net flow of water into the solution by osmosis

Cytolysis & Plasmolysis



- *Cytolysis* *Plasmolysis*

Isotonic Solutions

150 mM NaCl

300 mOsm NaCl (0.9% NaCl)

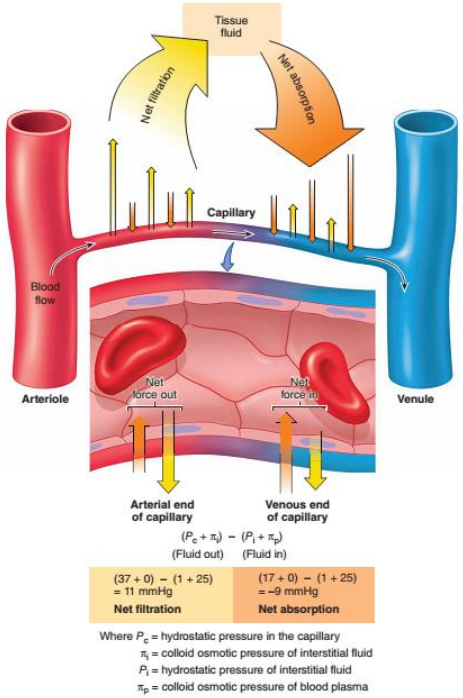
300 mM glucose

300 mOsm glucose (5% glucose)

Ringer lactate

- Treatment of fluid loss

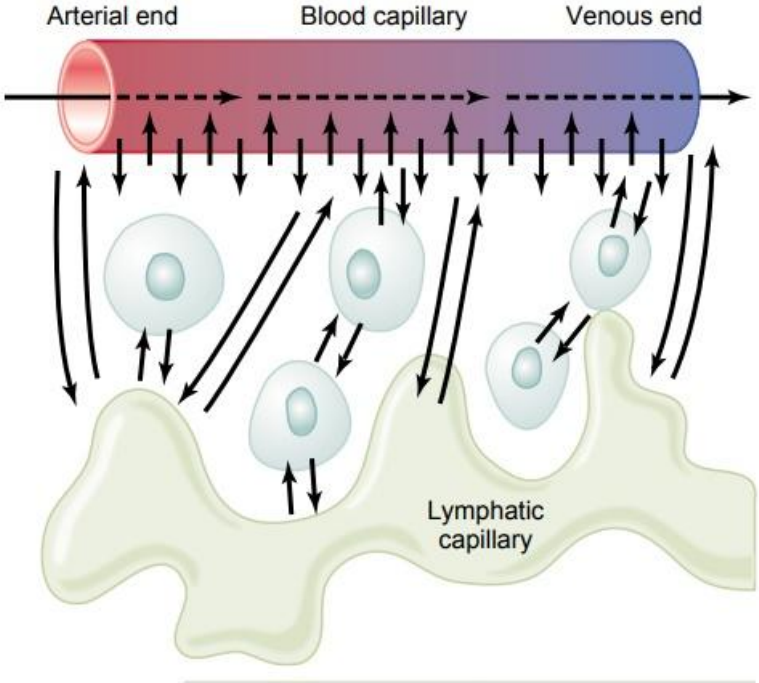
Distribution of Fluid Across the Walls of Capillary



- Interstitial fluid
  - formed by filtration as a result of blood pressures at the arteriolar ends of capillaries
  - Returned to the venılar ends of capillaries by the colloid osmotic pressure of plasma proteins

Interstitial Fluid Return by the Lymphatic System

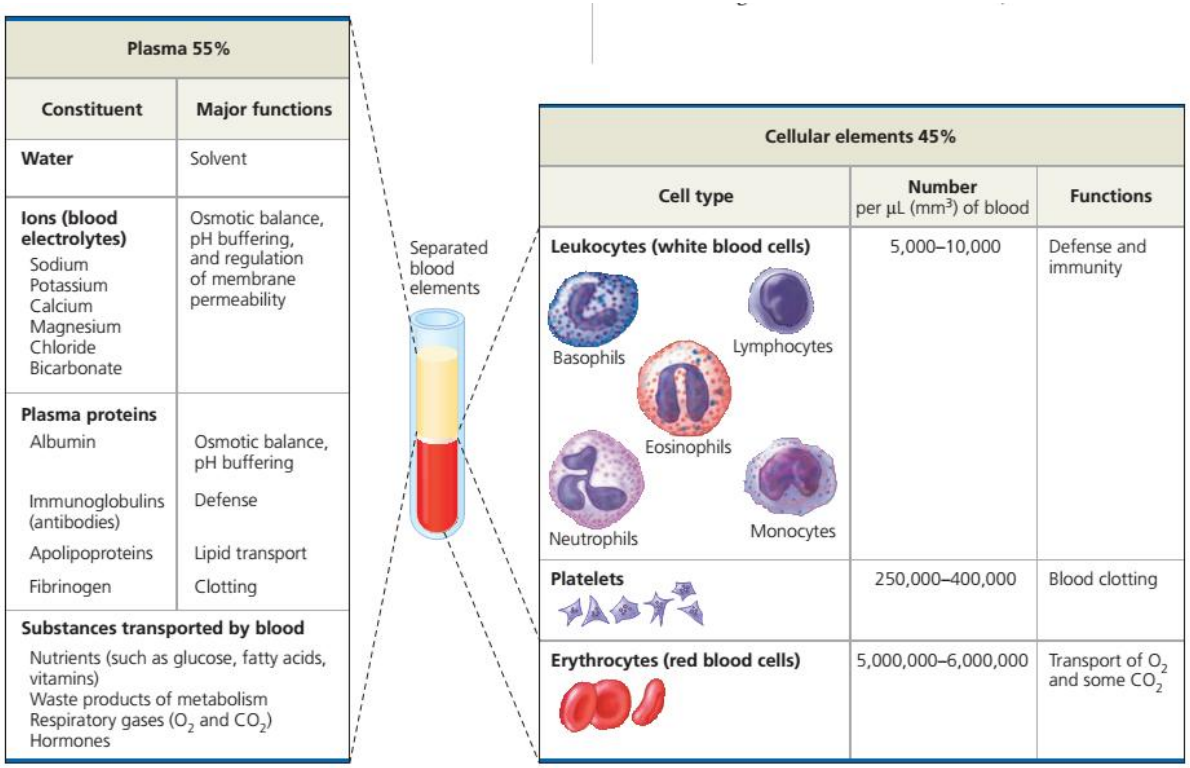
- Network of tiny vessels intermingled among capillaries
- After entering the lymphatic system by diffusion, the fluid is called lymph; its composition is about the same as that of interstitial fluid
- Disruptions in lymph flow often result in fluid accumulation, or edema



Diffusion of fluid molecules and dissolved substances between the capillary and interstitial fluid spaces.

Blood components

- Blood is a connective tissue consisting of cells suspended in a liquid matrix called *plasma*
- Similar composition to interstitial fluid (protein is absent in interstitial fluid)



Plasma 55%

Constituent	Major functions
Water	Solvent
Ions (blood electrolytes) Sodium Potassium Calcium Magnesium Chloride Bicarbonate	Osmotic balance, pH buffering, and regulation of membrane permeability
Plasma proteins	
Albumin	Osmotic balance, pH buffering
Immunoglobulins (antibodies)	Defense
Apolipoproteins	Lipid transport
Fibrinogen	Clotting
Substances transported by blood	
Nutrients (such as glucose, fatty acids, vitamins) Waste products of metabolism Respiratory gases (O_2 and CO_2) Hormones	

Cellular elements 45%

Cell type	Number per µL (mm^3) of blood	Functions
Leukocytes (white blood cells) Basophils, Lymphocytes, Eosinophils, Neutrophils, Monocytes	5,000–10,000	Defense and immunity
Platelets	250,000–400,000	Blood clotting
Erythrocytes (red blood cells)	5,000,000–6,000,000	Transport of O_2 and some CO_2