

UNIT ONE

INTRODUCTION TO PHYSIOLOGY

Dr

Physiology

✓ **the study of body
function and its
mechanisms**

LEVELS OF STRUCTURAL ORGANIZATION OF HUMAN BODY

The human body has many levels of structural complexity.

I. Chemical level

- ✓ Includes all atoms and molecules essential for maintaining life.
 - o major atoms : C,H,O,N,Ca,K & Na
 - o Molecules: proteins, carbohydrates, fats, nucleic acids (DNA, RNA) & vitamins.
- ✓ Atoms unite to form molecules; molecules are building blocks of the structures at cellular level.

Organization...

II. Cellular level

- Cells are the smallest living things in the body.
- Cells are the basic structural and functional unit of an organism.
- Cells have three principal parts
 - ***Plasma (cell) membrane***
 - ***Cytoplasm***
 - ***Nucleus***

III. Tissue level

- ✓ Tissues are groups of similar cells (and the substance surrounding them) that usually arise from common ancestor cells and work together to perform a particular function.
- ✓ 4 basic types of tissues: epithelial, muscle, connective & nervous.

Organization...

IV. Organ level

- ✓ Organs are structures that are composed of two or more different tissues that have specific functions and usually have recognizable shape.

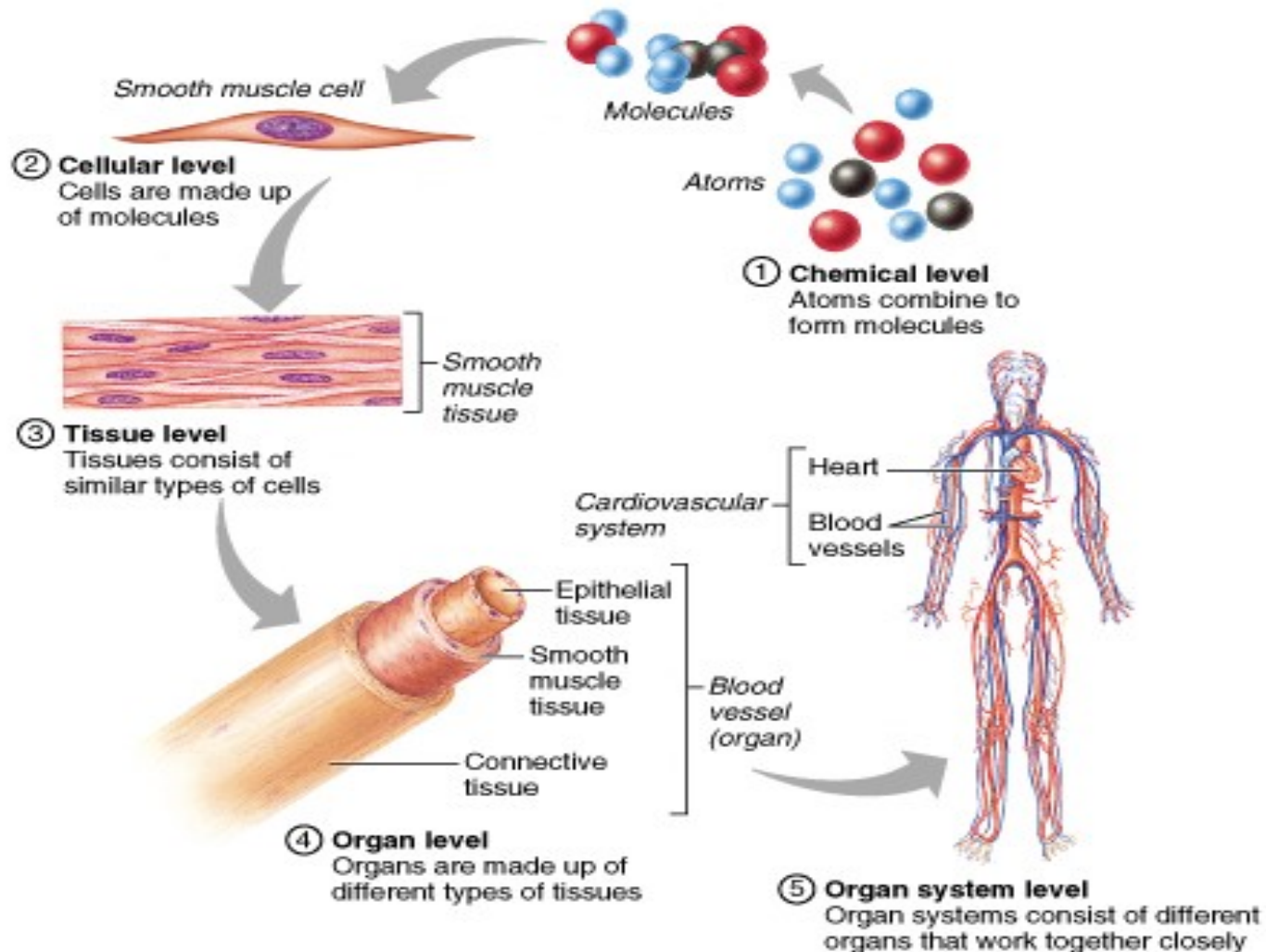
V. System level

- A system consists of several related organs that have a common function.
e.g. Digestive system - breakdown of food and absorption.

VI. Organismic level

- Is the result of all of the simpler levels working in union to sustain life.

Level of organization



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Chemical composition of the human body

Major elements:

- Hydrogen 63%
- Oxygen 26%
- Carbon 9%
- Nitrogen 1%
- Major elements 0.7 %
- Trace elements < 0.01%

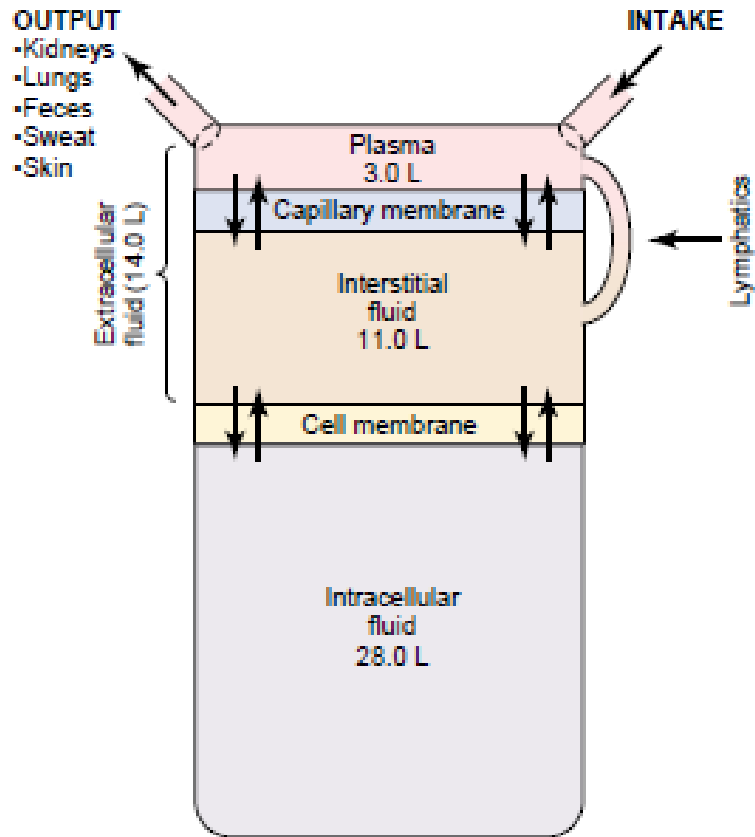
Major compounds

- Water 60%
- Proteins 18%
- Fats 15%
- Major minerals 7%

Compartments of water

- Approximately 60% of lean body weight is water
- two-thirds of which is **intracellular** and the remainder is in **extracellular** compartments, mostly as **interstitial fluid**
- only 5% of total body water is in **blood plasma**
- **Normal body water volume (70 kg man)**
 - **Intracellular 30 liters (2/3)**
 - **Extracellular 12 liters(1/3): 3 vascular & 9 Interstitial**

Compartments of water



Compartment	Fraction of BWt (%)	Volume (L)
Total body water	60	42
Intracellular fluid	40	28
Extracellular fluid	20	14
Plasma	4	3
Interstitial fluid	16	11
Paracellular fluid	1.2	~1
CSF, Occular, synovial, pleural		

Electrolytes of body fluids

Ion	Plasma			IF meq/l	ICF mOsm/l	Urine meq/l
	mg/l	mOmol/l	meq/l			
Cation	3500					
Na ⁺	3266	142	142	140	14	107-380
K ⁺	156	4.2	4.2	4	140	50-130
Ca ²⁺	50	1.3	2	2	0.0001	20-170
Mg ²⁺	27	0.8	0.8	0.8	20	2-12
NH ₄ ⁺	...	...	...	...	...	5-8
						30-50
Anions	70,451					
Cl ⁻	3650	108	108	108	4	120-265
HCO ⁻³	1464	24	26	30	10	50-130
Phosp ⁻¹	104	2	2	2	11	...
Sulph ⁻¹	16	0.3	1	1	1	20-40
Prot ⁻¹ (aa)	65,000	6	17	1	12	...
Org.acids	175	14	65	8.2	114	30-45
						20-50
Total Electrolytes	73,950	301	326	301	364	227-640
Osmolarity mOsm/l		285			285	
Total mOsm		4200	8400		4200	
Osmotic pressure		5790	5790		5790	

Dynamics of fluid compartment

- Its composition is similar to the plasma except that the fluid has almost no protein.
- Between Plasma and IF
 - Starling forces
 - Capillary hydrostatic pressure
 - Interstitial oncotic pressure
 - Capillary oncotic pressure
 - Interstitial hydrostatic pressure
- Between IF and ICF
 - Osmotic pressure is
 - The precise amount of pressure required to prevent the osmosis

Sodium and Calcium are cations of the ECF.

70% of the body sodium is exchangeable

1% of the body calcium is exchangeable

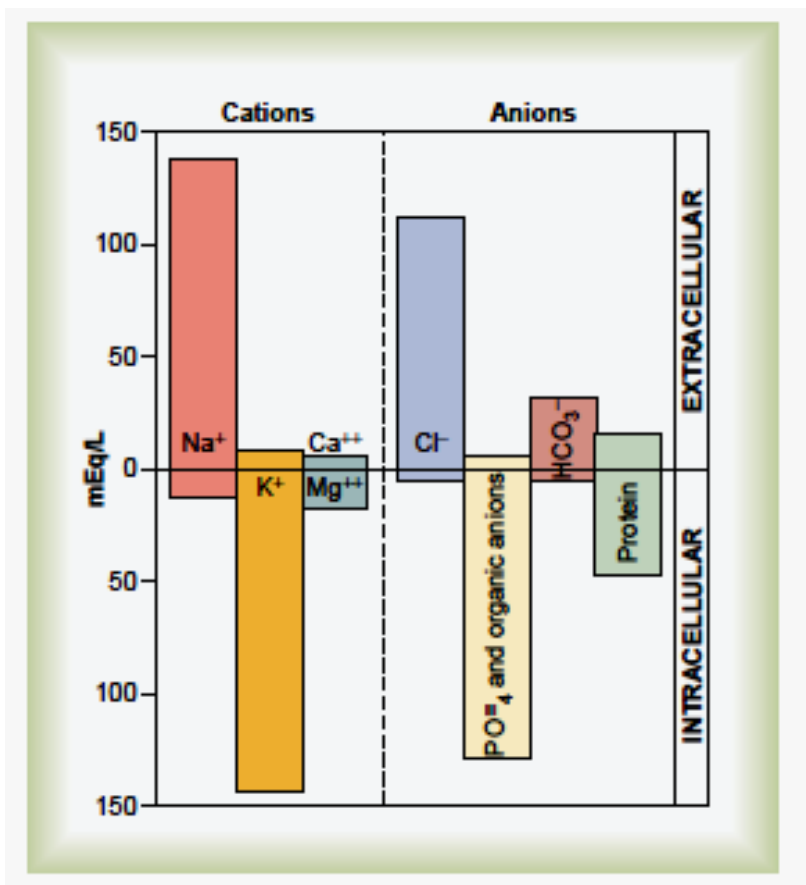
Potassium and magnesium are the major cation of the ECF

90% of potassium is exchangeable

10% of magnesium is exchangeable

Chloride and bicarbonates are anions of ECF

Phosphate, organic acids and proteins are anions of ICF



Osmolarity:

- Is number of osmoles per liter of water
- Total body osmolarity is 280 mOsm/L - 295 mOsm/L (Conventionally 300 mOsm/l)
- Isotonic, Hypotonic, and Hypertonic Fluids

Isotonic Fluid

- If a cell is placed in a solution of impermeant solutes having an osmolarity of 282 mOsm/L, the cells will not **shrink** or **swell** because **the water concentration in the intracellular and extracellular fluids is equal**
- the solutes cannot enter or leave the cell

Hypotonic Fluid

- If a cell is placed into a hypotonic solution that has a lower concentration of impermeant solutes (less than 282 mOsm/L), water will diffuse into the cell
- Causing it to swell
- water will continue to diffuse into the cell, diluting the intracellular fluid while also concentrating the extracellular fluid until both solutions have about the same osmolarity

Hypertonic Fluid

- If a cell is placed in a hypertonic solution having a higher concentration of impermeant solutes, water will flow out of the cell into the extracellular fluid
- the cell will shrink until the two concentrations become equal

Homeostasis

- ✓ Greek, homeo = same; stasis = staying
- ✓ a dynamic equilibrium where body conditions
- ✓ are maintained within narrow limits
- ✓ are maintained stable internal environment despite external various
- ✓ necessary for each cell to survive

Factors homeostatically maintained include:

- Concentration of nutrient molecules
- Concentration of oxygen and carbondioxide
- Concentration of waste products
- pH
- Temperature
- Concentration of water, salt, and other electrolytes
- Volume (fluids), osmolality, and pressure

Control Mechanisms

- body controlled mainly by nervous and endocrine systems
- control systems divided into
 1. **negative feedback**
 - ❖ **decreases or shuts off** original stimulus
 - ❖ resists change
 - ❖ **most** control systems operate using negative feedback
 2. **positive feedback**
 - ❖ **enhances** original stimulus
 - ❖ uterine contractions during childbirth