

Introduction to Physiology

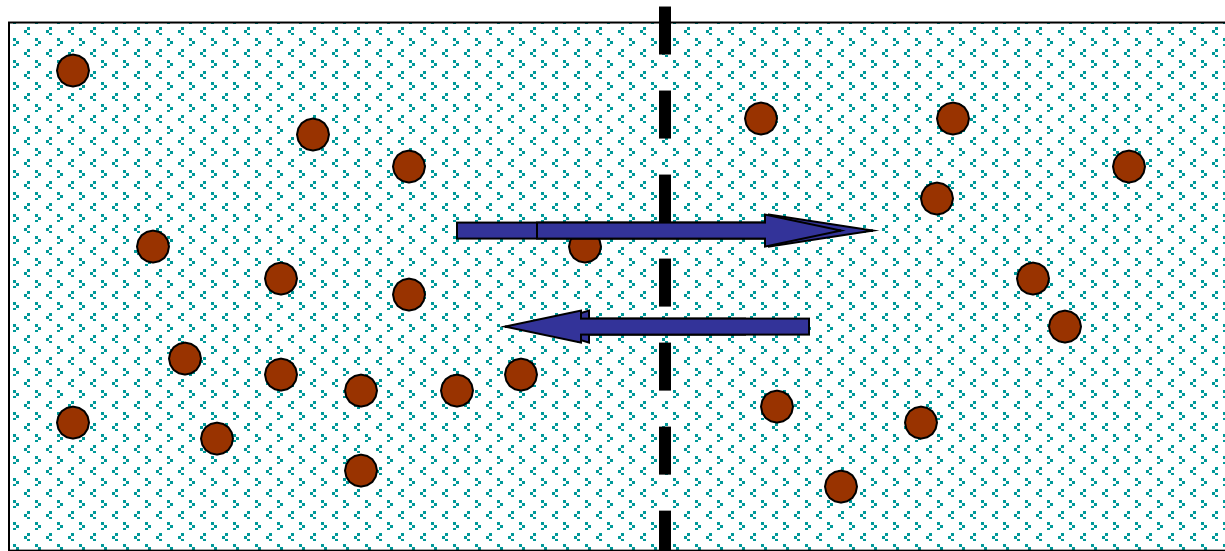
Homeostasis

Def. – maintenance of the constancy of the internal environment of the body.

Internal environment – **milieu interieur**
extracellular fluid which includes
interstitial fluid.

Simple diffusion -

Movement of molecules from higher concentration to lower concentration till equilibrium is reached



Diffusion can takes place through:

a) Lipid bilayer

i) Lipid soluble substances-

O₂, Co₂, alcohol, steroids etc

ii) Lipid insoluble – water (through spaces bet lipid mol) urea, sugar

(less or no permeability)

iii) Electrolytes – impermeable

– charge on fatty acid chain

Factors affecting rate of diffusion

- Lipid solubility
 - Molecular size & wt.
 - Temperature
- Molecular**
-
- Thickness of membrane
 - Surface area
- Membrane related**
-
- Concentration gradient
 - Pressure gradient
 - Electrical gradient
- Gradients**

Imp.

Fick's law of diffusion –

$$Q \propto \frac{\Delta C \cdot P \cdot A}{MW \cdot \Delta X}$$

Q = net rate of diffusion

ΔC = conc. gradient of a substance

P = permeability of membrane to the sub.

A = surface area of a membrane

MW = molecular wt. of sub.

ΔX = thickness or distance

Two big jump in the tree of LIFE

- Movement
- Multicellularity

Volume and composition of this fluid should be maintained constant (within narrow limits) in spite of changes in external environment for the normal function of cell.

Failure of homeostasis leads to disease

Some regulating systems and their functions –

Resp. system - CO₂ content

Liver and pancreas – glucose

Kidney – conc. of ions

CVS – blood flow and temp regulation

Nervous and endocrine systems
regulate the function of other systems

Composition of ECF is same all over
the body because of constant mixing
of interstitial fluid and blood and
circulation of blood

Foundation steps for the movement

- Mass and Newton law of motion
- Self generated movement (Intention and will)
- Role of dual nature of Charge

The role of permeability and RMP

- Cell membrane
- Lipid bilayer
- Lipid soluble substance can freely pass through the cell membrane

Thought question???

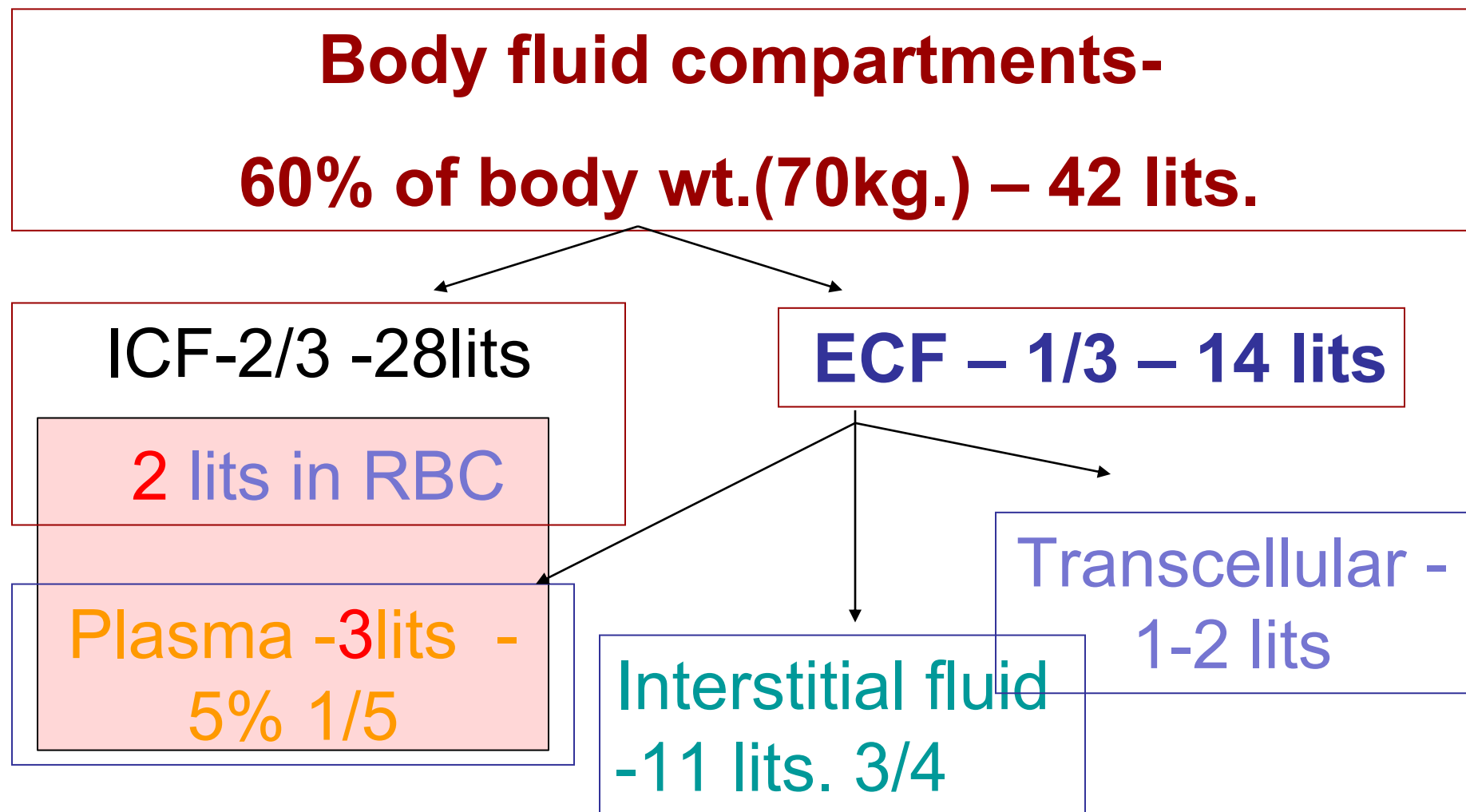
- Does lipid soluble substance pass through the gap between two lipid molecules or does it pass through the lipid itself?

Transport of charge ions across cell membrane

- Need for special carrier or channel or transporter
- Sodium channel

Thought question

- Size of sodium channel
- Approximate number of sodium channel in typical cell
- Carrying capacity of sodium channel
- Number of transported molecule in unit time
- Duty cycle duration



7% of fluid in intravascular compartment

Body fluids

- 62% of body wt in males and 52 % in females
- 72% of lean body mass (adipose free)

body wt is 70kg in man

body water is 42 lits.

28 lits (2/3) ICF – 2 lits - intravascular

14 lits. (1/3) ECF – 3 lits - intravascular

Body fluids

Measurement of body fluid compartments-

- indicator dilution technique –
- Criteria for ideal dye –
 - Dye should get uniformly diluted only in the compartment whose volume is to be measured

Body fluids

- Dye should be nontoxic,
- should not change fluid volume,
- should not be metabolized, altered
- or excreted in significant amount
- should be able to estimate easily

Body fluids

Two spaces are calculated indirectly –

- Intracellular fluid compartment

$$(TBW - ECF)$$

- Extravascular fluid compartment

$$(ECF - \text{plasma vol.})$$

Body fluids

Example

Inulin for ECF – 100 mg inulin injected

After 30 min. inulin conc in blood –
0.75 mg /dl

25 mg excreted in urine during 30
mins.

$$\begin{aligned} ECF \text{ vol} &= 100 - 25 / 0.75 = 10000 \text{ ml} \\ &= 10 \text{ lits.} \end{aligned}$$

Body fluids

Substances used –

TBW – D_2O , tritiated H_2O , aminopyrine

ECF – Na thiosulphate, sucrose, mannitol,

Intravascular fluid –

Plasma vol. - Evan's blue, T_{1824} , $^{131}I_2$

Hematocrit

Osmolarity of ECF = 290 mOsm / lit

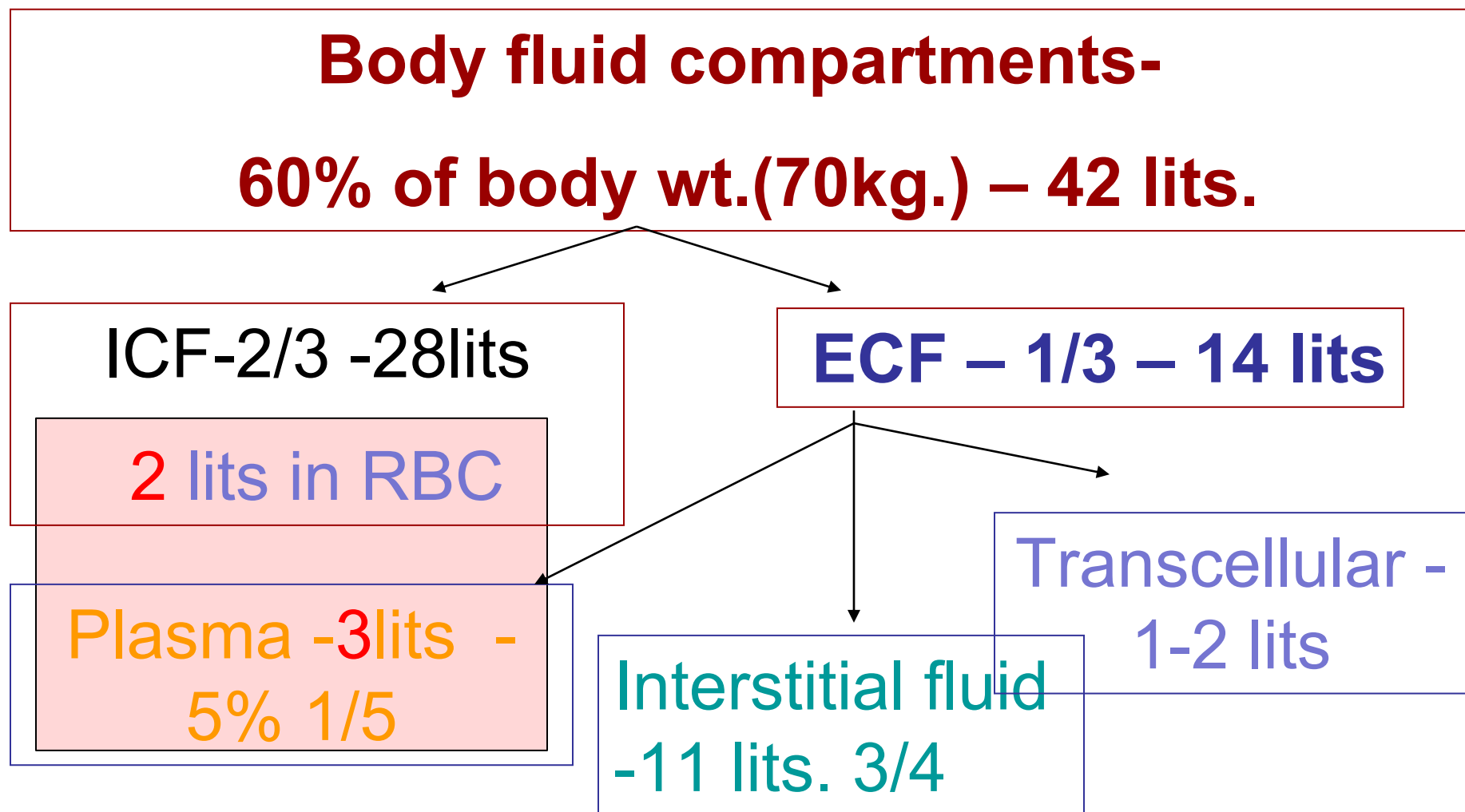
- Control system
- OR
- Regulating system

Limitations –

- age

Undamped oscillations due to long dead time and more gain of system – overcorrection

e.g. Chyene Stoke's breathing, clonus during deep reflexes



7% of fluid in intravascular compartment